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[A National Study of Baccalaureate Degree Completions in the Sciences: An Overview of Institutional Success by Public, Private, and Proprietary](#)

For the United States to successfully compete in a global economy, universities must produce qualified graduates in the sciences. According to studies from the National Science Foundation (Bachman et al., 2008), science achievement of American students severely lags behind achievement rates posted within many other nations. Chang (2002) indicated that within the next decade the United States will need 1.9 million more entrants to the sciences workforce. In light of lagging student performance, meeting the nation's science workforce needs will require inclusion of all constituencies. Recognition of changing national demographics may lead to expanded efforts to recruit and retain minorities in this field of study. Unfortunately a current trend in the sciences indicates serious issues in student attrition, dramatically so among underrepresented minorities.

White, Altschuld, and Lee (2007) and Chang (2002) identified many factors that impact minority student retention in the sciences. These factors included issues such as pre-collegiate preparation, maintained interest, cultural identity, engagement, faculty training and interaction, and financial considerations. Financial considerations often overshadowed other issues and were a huge factor in determining whether students continue in science technology engineering and mathematics (STEM) studies. Tyson et al. (2007) suggested that a racial disparity exists because fewer African-American and Hispanic students are prepared for STEM studies in high school based on specific course-taking patterns. These researchers strongly advocated the need for more rigorous science and mathematics coursework to prepare all students for STEM careers.

Tinto (2006) indicated that one of the key factors to student success is faculty ability to engage students in the learning process. Though faculty pedagogical abilities and student retention are strongly linked, most colleges and universities often assign the lowest paid and less experienced faculty members to the mandatory first year courses due to financial priorities. Francis, Kelly, and Bell (1993) related student success to assimilation into the academic culture, including connections with faculty and staff. The researchers believed such connections are superficial at best, if "adjuncts and junior professors" are routinely assigned to freshman students. Junior faculty members were often promoted based on interests other than teaching ability. Thus, accountability and funding did little to support minority retention. Tinto (2006) called for a greater emphasis on promoting entry-level student learning in order to improve minority student retention. The researcher further stressed that continuation of current practices would do little to improve already declining retention rates among minority students.

Specific course preparation is a key proponent for supporting degree completion in the sciences. Tyson et al. (2007) indicated that students taking vigorous mathematics courses attained a higher level of achievement in the sciences. Additionally, rigidity of science courses taken was more important than the number of courses completed. Hazari, Tai, and Sadler (2007) discussed the role of a student's

home environment in promoting success and a higher level of student achievement. Students whose families supported the importance of scientific study had a higher level of success. Positive family support also influenced the completion of a degree.

According to Schmidt (2008), a notable increase exists in the overall enrollment of minorities in university studies; however a severe under-enrollment exists among Hispanic students. Hispanic students born outside of the United States compose approximately 7% of the nation's population aged between 16 to 25 years of age. Of this 7%, 28% are not enrolled in high school and will not earn a high-school diploma.

Ryan (2004) examined the impact of institutional financial expenditures on graduation rates at 363 Carnegie-classified 4-year universities. Expenditures for instructional support produced a positive and significant effect on graduation rates. Expenditures for student services support did not have a positive or significant effect on retention or graduation rates. Ryan (2005) found that increased administrative spending at an institution resulted in lower levels of student engagement. Subsequently, Titus (2006a) also studied the effects of institutional expenditures upon retention. The researcher concluded that an increase in the percent of expenditures spent on administration was associated with lower retention rates of students.

Titus (2006b) suggested that African American and Hispanic students are more likely to attend public universities and have a lower probability of completing college. The author found that social status of students was linked directly to parental income instead of race or ethnicity. The author also found that retention was positively related to the tuition revenue of the institution. Titus concluded that affordability and financial resources contributed to a student's overall college success.

St. John, Paulsen, and Carter (2005) examined the costs of college and student financial aid in promoting a successful college experience for various ethnic groups. In comparison to white students, African-Americans normally attended less expensive colleges and had greater financial need. African-Americans were also highly sensitive to finances in their college choices and in their persistence decisions. The authors also found that grants and tuition costs had a direct influence on persistence and retention.

As well as being a major issue from an institutional standpoint, economics is also a major factor for the minority student. Hayes (2006) indicated that student income is a significant factor in creating an equity gap for students in higher education. This economic gap causes many low-income minorities to select areas of study that could be completed at the community college levels, which discourages them from the sciences. Students, who are underrepresented minorities with low incomes, usually must work while attending school; and they typically will attend 2-year colleges due to lower tuitions. Science-related fields requiring more in-depth studies, full-time status, and additional years of studies may be financially impractical.

Review of the literature unequivocally supported examination of degree completion numbers and rates for minority students by educational sector in order to guide both policy and practice. Identified success in any one sector may potentially reach into other sectors to improve the number of degrees awarded to minority students, thus improving the nation's ability to fill projected workforce needs and improve global competitiveness. The sciences may be divided into five major categories: engineering, engineering technologies, biological sciences, physical sciences, and science technology. The

purpose of this study was to examine baccalaureate degree completions in the sciences within public, private, and proprietary higher education institutions by ethnicity to determine which educational sectors (and science categories) were producing more graduates, specifically minority graduates.

Research Questions

Specifically, this study addressed the following research questions:

1. How many baccalaureate degrees in academic year 2005-06 were awarded in the sciences by ethnicity within public, private, and proprietary higher education?
2. What percentages of baccalaureate degrees in academic year 2005-06 were awarded in the sciences by ethnicity within public, private, and proprietary higher education?
3. Do differences exist in percentages of baccalaureate degrees in academic year 2005-06 awarded in the sciences to African-American and Hispanic students between and among public, private, and proprietary institutions of higher education?

Methodology

National data was extracted from the Integrated Post-Secondary Education Data System (IPEDS). The data included the limitations traditionally associated with institutional self-reporting and estimation of enrollment patterns. The most current information available at the time of the study was for the 2005 academic year (AY 2005). Extracted data corresponded to public, private, and proprietary 4-year institutions with baccalaureate degree granting status. The study was delimited to institutions providing science degrees through the IPEDS data cutting tool. Data was also broken down further by gender and ethnicity.

Statistical Packages for the Social Sciences (SPSS) was utilized to obtain descriptive statistics and to conduct multiple-factor analysis of variance (MANOVA) to examine differences between and among the several variables. The statistical testing utilized a significance level of 0.05.

Two repeated measure MANOVAS were conducted on (a) Classification of Instructional Programs (CIP) codes across the various percentages of ethnic students completing their bachelor's degree and (b) school type (public, private, and proprietary) across the various percentages of ethnics students completing their bachelor's degree. Both the examination of CIP codes and school type yielded statistically significant interactions across percentages of ethnic students completing their bachelor's degree. Thus, graphical representations of the data were provided to identify the interaction effects.

Findings

The number of baccalaureate degrees awarded in the sciences during the 2005-06 academic year was 1690 private, 85 proprietary, and 1449 public. Of these institutions, the percentages of baccalaureate degrees awarded in the sciences by ethnicity during the academic year 2005-2006 were as follows. At public and private institutions, less than 10% of science degrees awarded go to African Americans and Hispanics. Proprietary schools had a higher percentage rate (less than 20%) of science degrees awarded to African American and Hispanics. Hispanic students had a slightly higher degree completion rate at proprietary than African Americans students. The percentages of white students completing bachelor degrees in sciences were over 60% at private and public colleges.

However, a smaller percentage of white students complete these degrees at proprietary institutions. Asian students consisted of 10% of completed degrees at all three types of institutions.

For CIP codes (14: Engineering; 15: Engineering/Technology; 26: Biological/Biomedical Science, 40; Physical Science; and 41: Science Technology) [$F(8, 6434) = 54.60, p < .001, \eta^2 = .877$] (See Figure 1), no differences were present between African-Americans (2) and Latinos (3); but white (1) students demonstrated higher graduation rates in all categories, with perhaps the exception of the physical science and science technology areas, which were low for all ethnic groups.

Figure 1. Graduation Rates by CIP code and Ethnicity

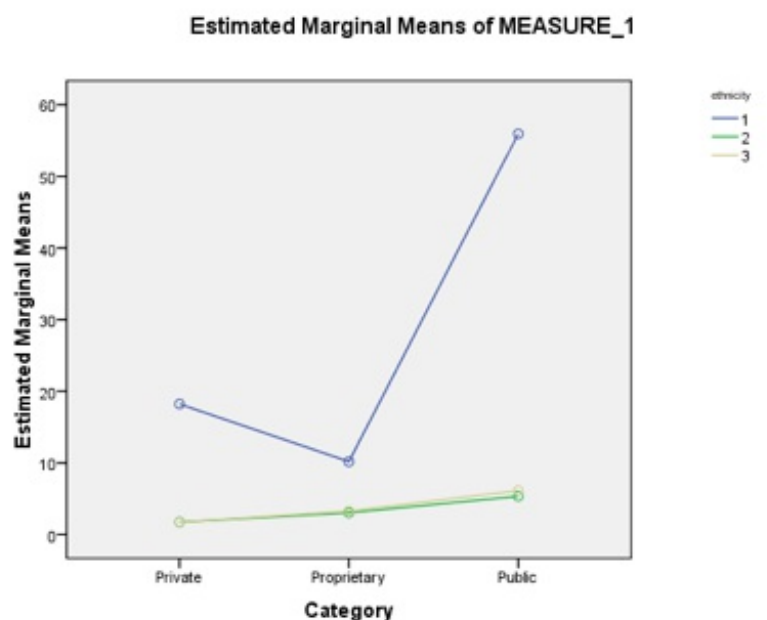
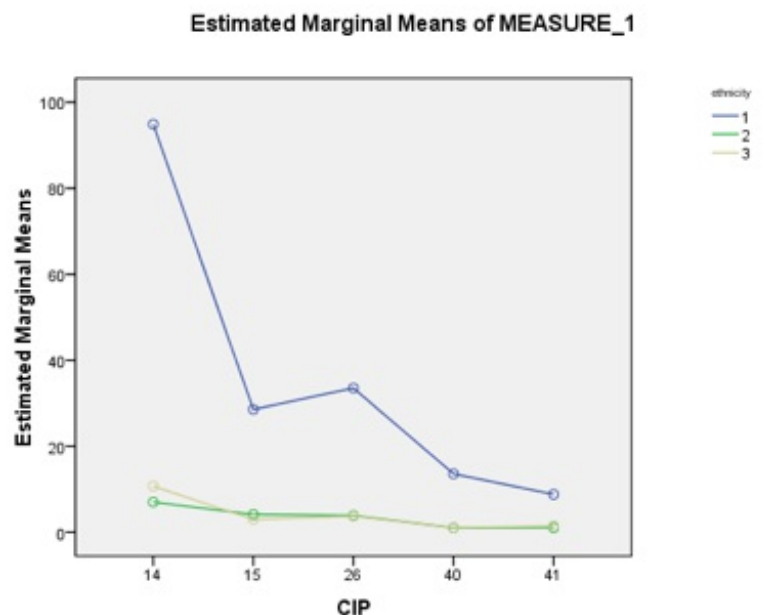
For school type [$F(4, 6440) = 52.17, p < .001, \eta^2 = .938$] (See Figure 2), no differences were present between African-Americans (2) and Latinos (3), but white (1) students demonstrated higher graduation rates in all institutions, but especially public institutions.

Figure 2. Graduation Rates by School Type and Ethnicity

A significant difference did not exist in the percentages of baccalaureate degrees in academic year 2005-06 awarded in the sciences to African-American and Hispanic students between and among public, private, and proprietary institutions of higher education.

Conclusions and Recommendations for Further Research

African American and Hispanic students are still lagging behind White students in regards to completing baccalaureate degrees in the sciences. Proprietary institutions generally have more African Americans and Hispanics graduating with baccalaureate degrees in the sciences in comparison with public and private institutions. According to Zamani-Gallaher (2004) proprietary schools do not have the common barriers that prohibit minorities from college admission such as costs, proximity, and standardized test scores. They are more cost effective and located in urban



areas that are close to students' residence or work. Therefore, this type of institution attracts more minority students.

More research is needed to develop policy and practices for private and public institutions of higher education to recruit and retain more minority graduates in the science field. Tyson et al. (2007) expressed the importance of school districts and officials being actively involved in planning and enrolling ethnic students in the highest level math and science courses to prepare them for college. Students that successfully complete these courses are more likely to pursue degrees in the science field regardless of ethnicity. In order to recruit and retain more minorities in the science fields, public and private institutions will need to become more creative and flexible for African American and Hispanic students.

Price et al. (2008) recommended a symposium format for recruiting minorities into the science fields. The symposium includes various activities such as panels, evening socials, workshops, roundtable with science graduates, and keynote addresses. The authors recommended that colleges and universities utilize this type of symposium with high school and community college students to begin forming mentorships and networking relationships with current scientists.

Recommendations for future research questions are as follows:

1. What program and policies can public and private institutions do to increase degree completions of African American and Hispanic students in the sciences?
2. What specifically can high school counselors do to prepare high school graduates for successful degree completions in the sciences?
3. With increasing opportunities in society, why has there not been an increase of minorities completing degrees in the science field?

Although the lack of minorities completing degrees in the sciences has been researched in the past, colleges and universities have been unsuccessful in increasing the number of African American and Hispanic students in comparison with White students. Further research is needed to investigate increasing baccalaureate degree completion in sciences of minority college students. Private, proprietary, and public institutions of higher education may need to conduct more extensive research to recruit and retain minority students in the sciences.

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