Report on UNM STEM Transfer Students: Student Success Outcomes

CONTENT

Background

The University of New Mexico (UNM) is the flagship university of New Mexico state. UNM is one of only four Carnegie Research University with Very High Research Activity in the nation also designated as a Hispanic-Serving Institution. UNM is the only U.S. state flagship university that is also a majority-minority undergraduate institution. With its diverse student population coupled with its research capabilities, UNM has been a leader in providing evidence and research-based, practices by widening the gateway for Hispanic and other low-income students. The STEM Gateway program funded by a U.S. Department of Education TITLE V grant, 2011-2016 *(total anticipated funding $3.82 million)* has provided education and activities focused on improving courses that commonly impede pursuit of STEM degrees. The mission of STEM Gateway is improve STEM instruction and student support at the University of New Mexico and improve STEM graduation rates among Hispanic and/or low-income students.

The UNM STEM Project has four components to achieve this mission:

Gateway Science and Math Course Reform

Faculty-driven projects designed to change instruction and curriculum to better serve low-income and minority students. Each project team includes faculty from UNM and CNM working collaboratively on such areas as: course outcome plans, curriculum revision, in-class assignments, inquiry-based lab exercises, assessment instruments, and teaching resources.

Peer Learning Facilitators (PLF)

Peer-assisted collaborative learning activities in large gateway sections. The assistance of facilitators allows instructors to incorporate a wider variety of effective instructional strategies.

STEM Gateway Program Courses

Courses that help students develop strong STEM learning skills, connect to their STEM departments earlier and understand the connections between STEM disciplines. Courses include STEM Academies and STEM Student Interest Groups.

Data-driven Prioritization

Data collection and analysis to assist UNM in better understanding the course-taking patterns and success rates of UNM students and CNM transfers in relation to STEM degree attainment. Specific research questions are posed and addressed through qualitative and quantitative methods. Data collection and analysis tools are built in collaboration with the Office of Institutional Research.

Significance

STEM Gateway focuses on socioeconomic status (SES), ethnicity and gender with respect to student achievement in STEM fields in college. SES refers to one's access to social, cultural, financial and human capital resources (National Center for Educational Statistics, 2012). In his meta-analysis of SES and student achievement, Sirin (2005) reported that there was a general agreement on definition of three different aspects of SES—(1) parental income, (2) parental education, and (3) parental occupation. Student academic performance and persistence have been relevant in regards to student demographics for quite some time. Researchers have been investigating and explaining this phenomenon from different perspectives. The National Center for Educational Statistics issued several reports on first generation students in college (e.g, Chen & Carroll, 2005; Choy, 2001; Nuñez, Cuccaro-Alamin & Carroll, 1998). All these reports revealed that first generation students tended to have lower retention, graduation, persistence rates as well as poor academic performance. Research confirmed the positive relationship between family background and student achievement (Davis-Kean & Sexton, 2009; Domina, 2005; Dubow, Boxer & Huesmann, 2009; Fan and Chen, 2001; Miranda, Kim, Reiter, Galeano, & Maxson, 2009). Prior academic performance and background characteristics predicted student college success (DaDeppo, 2009). Different definitions for first-generation exist. Some define it as both parents having

no college education (Nuñez, Cuccaro-Alamin & Carroll, 1998). In this report, we define first-generation as one or more parents that do not have a bachelor's degree.

Based on the evidence of previous research and the importance of student background characteristics playing a role in student success, this study attempts to understand if family background can explain its relation to student success in regards to STEM students. If any statistical associations between student success outcomes and student demographics or/and background are significant, the implication for UNM is that the evidence needs to be documented, discussed, and saved for future comparison and studied as STEM interventions continue. The same implication holds if the likelihood or odds for student success outcomes varies for different ethnic groups, gender, SES status and any other related grouping variables. The predictive analysis will help inform which factor(s) predict student success, which might be useful and addressed in terms of STEM intervention, course design, process control and administrative decisions at UNM.

Research Methodology

Within the STEM fields, UNM is particularly concerned with the paradox of high levels of interest among Hispanic and other low-income incoming freshmen, but low persistence to degree completion in STEM fields. The focus of this report is on STEM transfer students, including their academic achievement, their student success outcomes and their readiness to complete their degrees. This study focused on how STEM transfer students perform overtime and not necessarily the efficacy of the STEM Gateway model. There are four different success outcomes relevant to this research—(1) graduate with STEM degrees, (2) continuously enrolled in STEM majors, (3) identify those that change out of STEM majors and (4) identify those that stopped attending UNM. Descriptive analyses and predictive models were implemented to investigate the differences in these student success outcomes of STEM transfer students and how this varied within specific populations *(i.e., ethnicity/race, gender, etc.).* All analyses were conducted using SAS 9.4.

Research Questions

1. Are there associations in STEM transfer students between ethnicity, gender, family background and their student success outcomes?
2. What are the odds (or chances) of having different student success outcomes with different ethnic groups, gender, students with different SES?
3. What are the predictors of transfer student academic performance as indicated by cumulative GPA as well as by if enrolled or graduated in a STEM degree?

Sample

The sample consisted of transfer students who are bachelor-degree seeking and transferred into UNM STEM majors from fall 2006 to spring 2009, either from in-state institutions or from out-of-state institutions. STEM majors were classified using the CIP codes by the Department of Homeland Security (2012). It is common for students to shift out of STEM majors, thus the cut off time for their change of major was spring 2014. Similarly, if the students stopped attending UNM in spring 2014, they were considered a stop out.

Out of the 912 transfer students, 434 *(47.59%)* stopped attending UNM and 309 *(33.88%)* graduated. Of the students, about *14.91%* shifted their majors out of STEM and only *3.62%* were still enrolled and pursuing a STEM degree. More students from different ethnic groups stopped attending UNM. The stop rate was 54.39% for American Indian, 43.33% for Asian, 70% for Black, 46.74% for Hispanic, 52.94% for race unknown and 46.72% for White.

Figure 1. STEM Transfer Student Outcomes

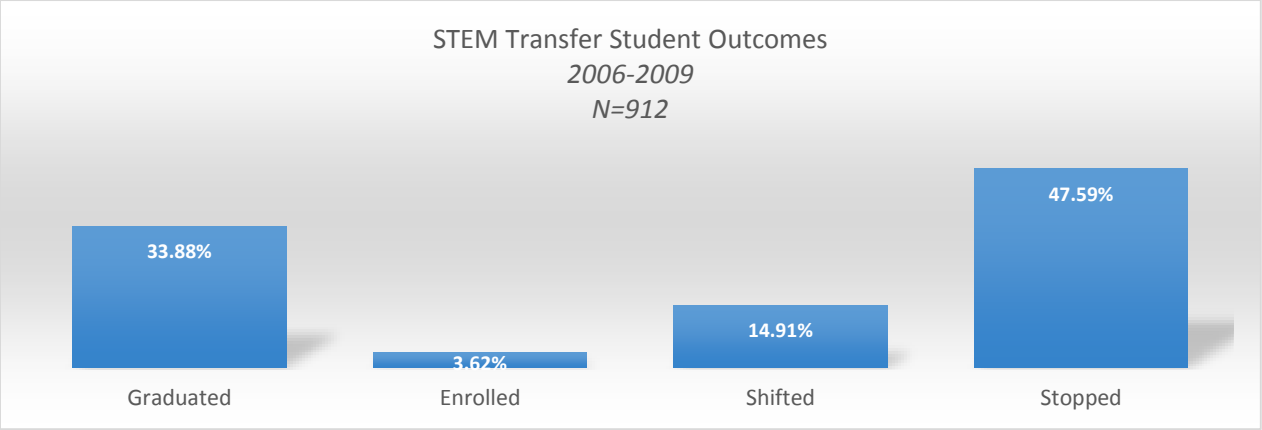
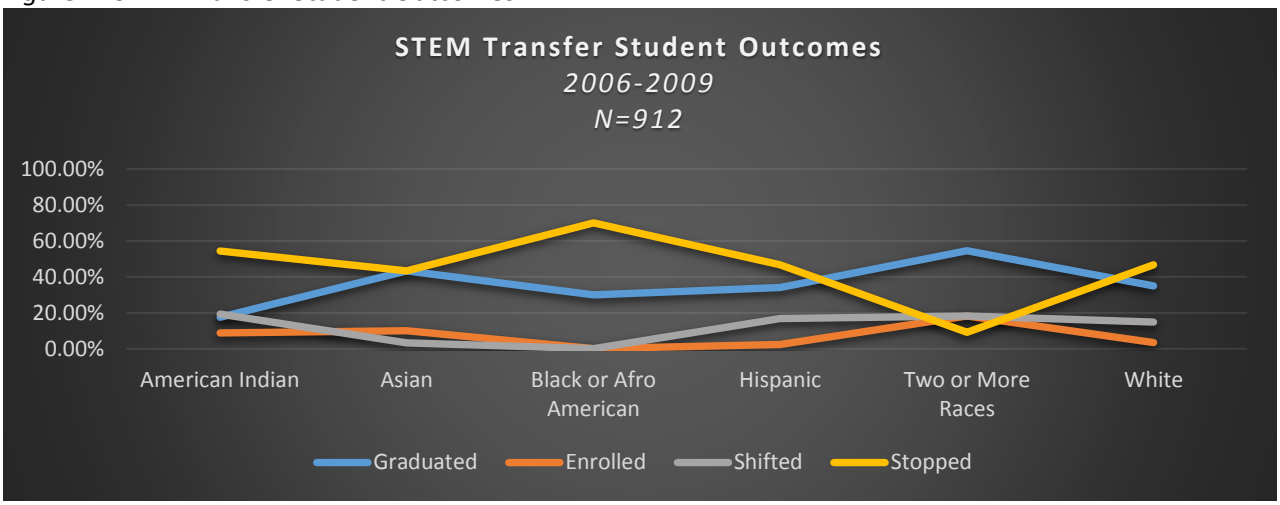


Figure 2 displays the demographics and enrollment outcomes for the 912 transfer students in STEM-related fields between Fall 2006 and Spring 2009. The vast majority were White *(458, 50.22%)* and Hispanic *(291, 31.91%).* White and Hispanic made up about 82% of this transfer group. There were only 57 American Indian students *(6.25%),* 34 students with unknown races *(3.73%),* 30 African American *(3.29%)* and 30 Asian *(3.29%).* There were 11 students with two more races *(1.21%)* and only 1 nonresident *(0.11%).*

Figure 2. STEM Transfer Student Outcomes



**Note: Non-resident Alien and Race/Ethnicity Unknown were excluded due to missing data*

About one third of White and Hispanic transfer students graduated with a STEM degree, with almost 3% of Hispanics and 4% of White students still enrolled in pursuit of a STEM degree. In sum, half of transfer students (47.59%) stopped attending UNM and about one third graduated with a STEM degree. It is critical that almost half of transfer students stopped out of the University.

Results

For each of the research questions, descriptive statistics were conducted. Categorical data analyses were performed for first two research questions and predictive analysis and mediator analysis for the third research question.

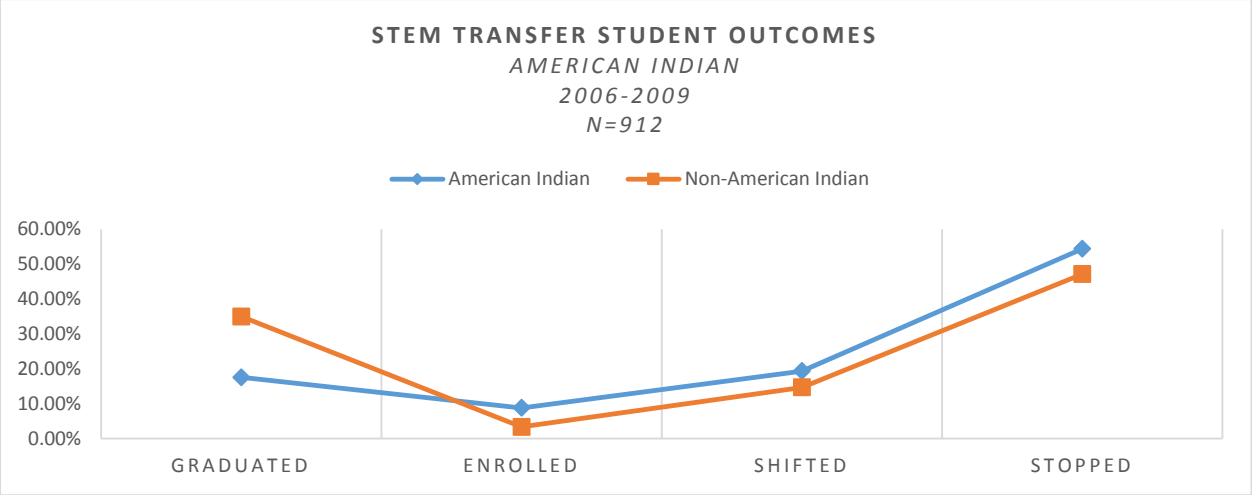
1. Are there associations in STEM transfer students between ethnicity, gender, family background and their student success outcomes?

With the vast majority of traditionally underrepresented students at UNM, different ethnic groups were compared on student success outcomes *(See Appendix A).* The following summary highlights the key findings and related policy implications based on statistical and practical significance.

American Indian

Almost 74% of American Indians were first-generation and over 85% were Pell eligible students. Over 64.29% were both Pell eligible and first generation. Comparing American Indian students with their peers, there were more non-American Indian graduating, 34.97% compared to 17.54% American Indian students indicated in **Table 2**. American Indian students who transferred to UNM were half as likely to graduate compared to their peers and were more likely to shift out of STEM degrees than their peers (19.3% for American Indian versus 14.62% for their peers). American Indians were also more likely to stop attending UNM than their peers (54.39% versus 47.13% for their peers). American Indians had lower graduation rate and higher stop rate than their peers. These findings are consistent with national reports (Chen & Carroll, 2005; Nuñez, Cuccaro-Alamin & Carroll, 1998; Warburton, Bugarin, Nuñez & Carroll, 2001).

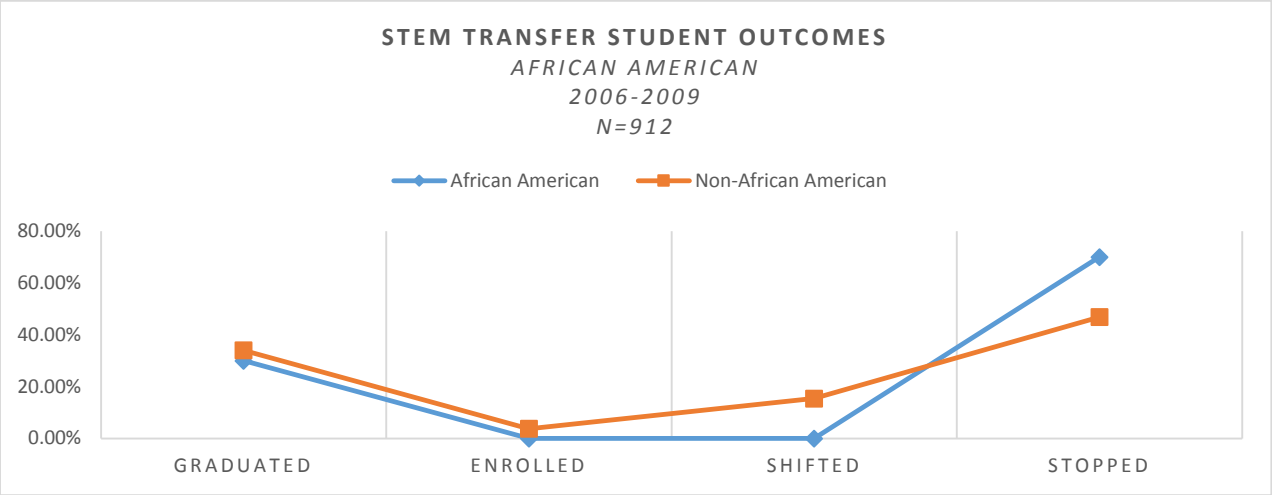
Figure 3. American Indian Student Outcomes



African American

Comparing African American students with their peers, they have slightly lower graduation rates (30% for African American versus 34.01% for their peers). African American students had a much higher stop rate (70%) than their peers (46.83%).

Figure 4. African American Student Outcomes



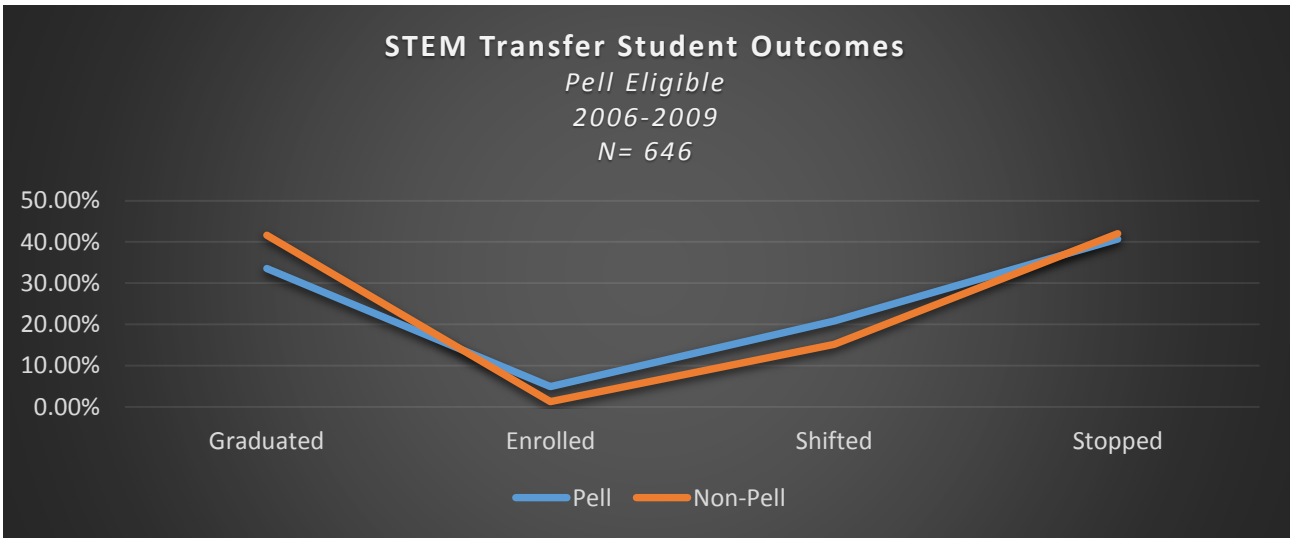
Like American Indian students, most African American students were first-generation (64%) and 79% were Pell eligible.

**Policy implications:* UNM needs to continue to strengthen its policies or do necessary interventions to support the traditionally underrepresented students and help them succeed.

Family Background: Pell Eligibility

Transfer students who were Pell eligible were significantly more likely to have lower graduation rate and higher stop rates. When parental education was controlled for, a significant association between Pell status and student success outcomes was indicated. Of the transfer students in this study, a majority of them were Pell eligible. The non-Pell students had higher graduation rates (41.6% versus 33.58% for Pell students), however the Pell eligible students had higher STEM enrollment rates (4.9% versus 1.26% for the non-Pell students). They also had higher shifting rates, (20.83% versus 15.13% for the non-Pell students).

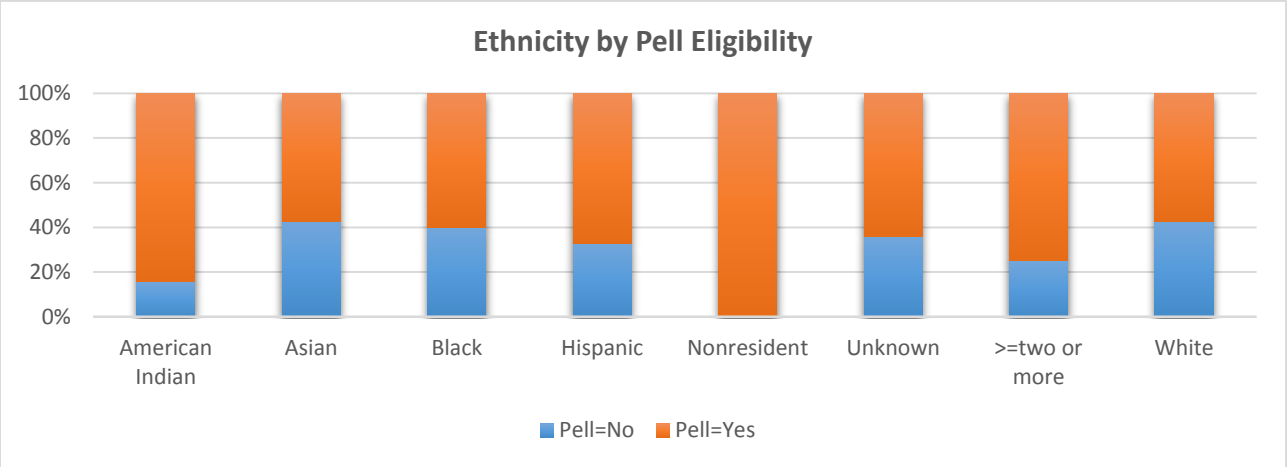
Figure 5. Pell Eligible Student Outcomes



A majority of the students with Pell eligibility were American Indian, Hispanic and White. Out the American Indian transfer students, about 84% were eligible for Pell. About 67% of Hispanic, 60 % of

African-American and 50% White students were eligible for Pell. Thus, traditionally underrepresented students were more likely to be Pell eligible.

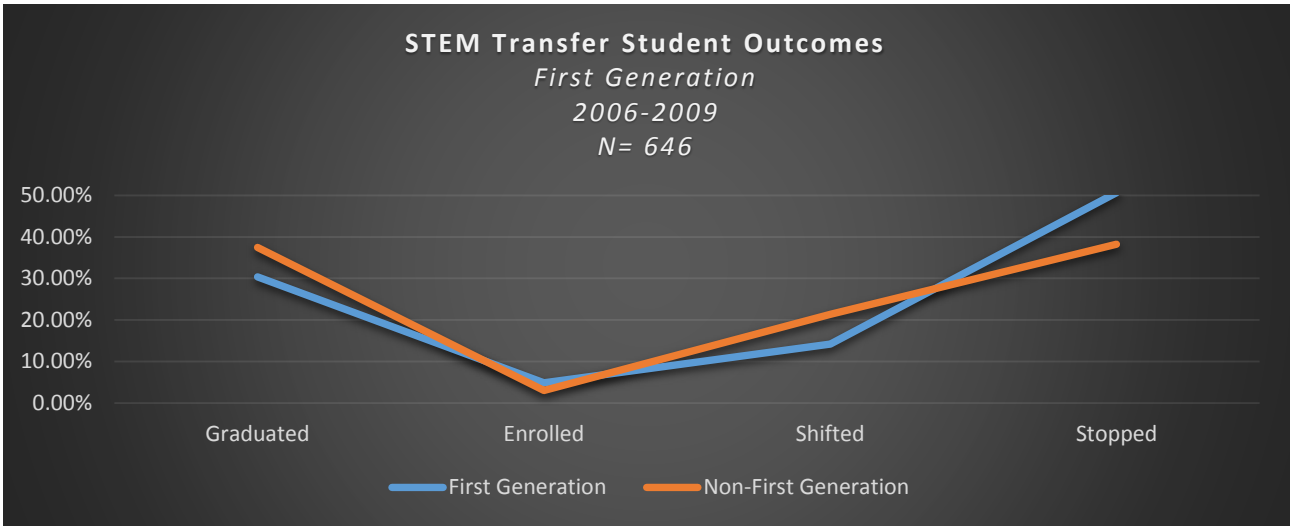
Figure 6. Ethnicity by Pell Eligibility



Family Background: First-Generation

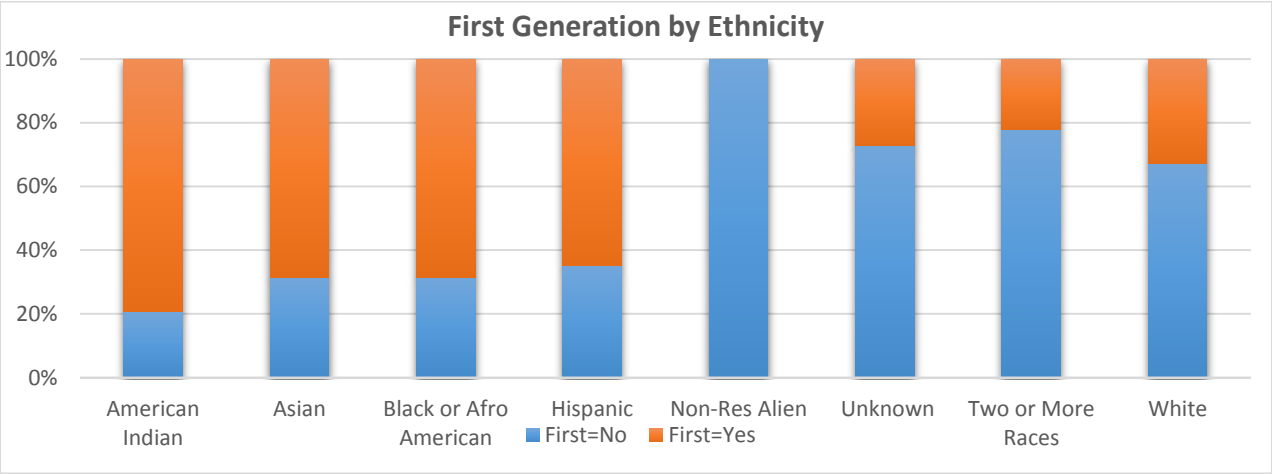
The graduation rate for non-first generation students was higher (37.45% for non-first generation versus 30.36% for first generation). Their stop rate was lower, 38.2% for non-first generation students versus 50.61% for those from first generation families. Their shifting rate was higher, 21.35% versus 14.17% for those from first generation families. Students from non-first generation families have more positive outcomes with STEM enrollment.

Figure 7. First Generation Student Outcomes



First-generation students were more likely to stop out. However, the trend for stop rate went in the opposite direction when students were not first-generation, thus indicating that first-generation students need support to complete their degrees.

Figure 8. First-Generation by Ethnicity



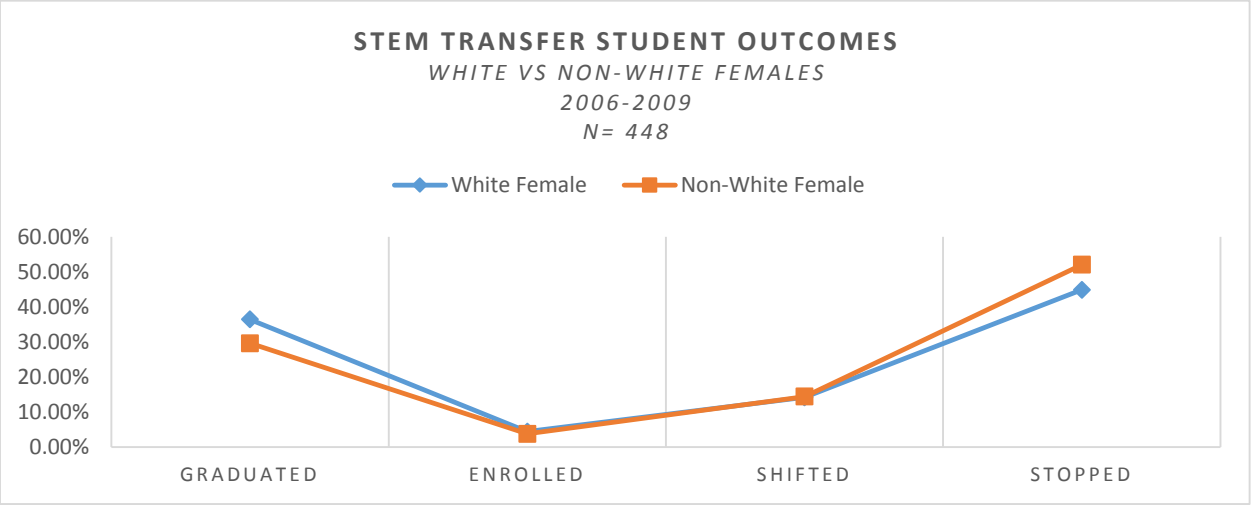
There were more transfer students who were Pell eligible regardless of first generation status. Pell eligible students have a less likely chance of graduating, more likely to stop out of STEM interacted significantly with first-generation status. First-generation students were less likely to graduate with STEM degrees. With Pell being held constant, the association between first generation and outcomes were significant statistically.

**Policy implications:* UNM needs to continue the financial support for traditionally underrepresented students and monitor the outcomes longitudinally for Pell eligible students. More comprehensive research is necessary regarding the impact of Pell grant or other related financial aid on student academic performances (i.e., GPA, registration and degree completion).

Non-White Females & STEM

Meaningful significances with non-White females emerged despite statistically insignificant results in regards to STEM outcomes (p-value >0.05). Non-White females were more likely to have lower graduation and higher stop rates than White females. NCES reported that the graduation rate was 63% for female versus 56% for male (NCES, 2015). In our study, non-White females were more likely to be first-generation with over 71% compared to their White female peers (28.57%). Of those almost 72% were Pell eligible. Almost 52% of students were from both first generation family and with Pell eligibility. In general, White females tended to have more positive outcomes and higher graduation rates and lower stop rate at UNM.

Figure 9. White Female Vs. Non-White Female STEM Outcomes

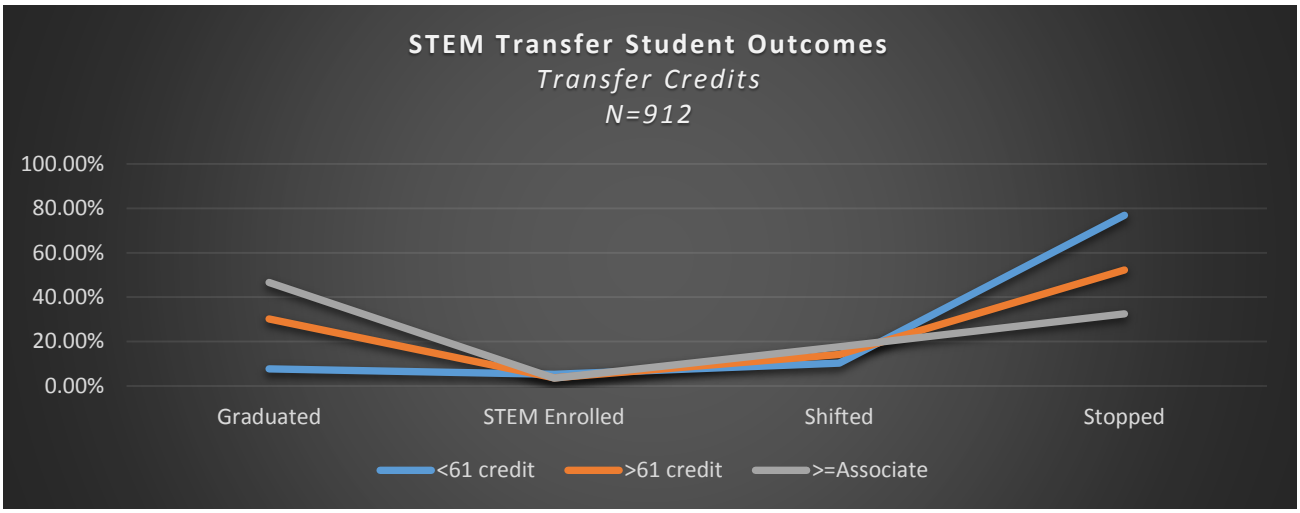


**Policy implications:* As far as STEM majors are concerned, UNM needs to pay attention to non-White females.

Transfer Credits

As transferred credits increased from less than 61 credits, at or more than 61 credits to those with an Associate's degree, the transfer students tended to have higher graduation rates (from 7.69% to 30.11% to 46.56%), lower stop rates (from 76.92% to 52.21% to 32.44%), and higher shifting rates (from 10.26% to 14.08% to 17.56%). The STEM enrollment rate was roughly around 4% for the three groups and STEM enrollment counts for each group were relatively small (from 2, 22 to 9). There was a statistically significant correlation between different transfer groups and outcomes $p < .01$.

Figure 10. STEM Outcomes by Transfer Credit Hours



**Policy implications:* To increase graduation rates, it is more desirable to admit students with more transferred credits or even students with degrees such as associate degree or professional degree. Second, to retain transfer students, after the transferred students start at UNM, the university should do necessary interventions with students who had less transferred credit hours.

2. What are the odds (or chances) of having different student success outcomes with different ethnic groups, gender, students with different SES?

To get an odds ratios, ordinal logistic regression was conducted. In Appendix B, the tests on odds ratio are summarized. The following is a summary of the key findings. The statistical significance was based on the confidence interval (CI) of odds ratio with CI excluding 1.0 as being significant.

We had more detailed information on which outcomes the groups differed with each other, using statistical tests on odds ratio. American Indian, Black, first generation students, Pell eligible students and first generation students were significantly less likely to have positive student success outcomes. Comparing American Indian to their peers, American Indian had significantly low likelihood of graduation vs all other outcomes (STEM enrollment, shifting or stopping, see Appendix B. Comparing African-American students with their peers, African-American students had a significantly low likelihood of shifting vs stopping. Comparing first generation with non-first generation, first-generation students had a significantly lower likelihood of graduating, STEM enrolling or shifting vs stopping. In other words, first-generation students were significantly less likely to graduate. Comparing Pell eligible students with not Pell eligible students, Pell eligible students had significantly low likelihood of graduation vs all other outcomes (STEM enrollment, shifting or stopping). The students with 61 credits or more transfer credits had 3.223 higher odds of graduation versus other outcomes, thus having students with a high amount of transfer credits positively impacts their STEM success.

The results from odds ratios were similar to the results from tests on associations between outcomes and different grouping variables. Basically, first-generation students and traditionally underrepresented students (such as American Indian, Black) had significantly lower odds of having positive STEM student success outcomes. First generation students and Pell eligible students tend to have a lower likelihood of STEM success.

**Policy implications:* Different types of interventions need to be developed to target traditionally underrepresented students in STEM. Sharing information and leveraging across programs, will help to accumulate effective strategies and solve the issue gradually. UNM needs to continue its efforts and strength its policies in different areas to improve the academic performances of traditionally underrepresented students.

3. What are the predictors of transfer student academic performance as indicated by cumulative GPA as well as by STEM degree outcome (Yes vs No)?

To predict student UNM cumulative GPA and STEM degree outcome, multiple regression and logistic regression were applied. Pearson correlation matrix presented in Appendix C indicates that the following variables were significantly correlated with UNM GPA: (1) STEM degree outcome, (2) transfer GPA, (3) ethnicity/race, (4) gender, (5) first generation, (5) Pell eligibility. The correlations between independent variables were small with the highest correlation between outcome and transfer GPA being 0.21. Figure 11 shows the mean GPAs for college and transfer.

Multiple Regression

The selected variables for predicting UNM GPA included transfer GPA, STEM degree outcome, ethnicity/race, lottery, gender and first-generation. The prediction equation for UNM cumulative GPA is:
*UNM cumulative GPA = 0.336*transfer GPA + 0.415*learning outcome + (-0.142)*ethnicity/race + (-0.113)*lottery + 0.097*gender + (-0.072)*first-generation*

Table 1

Model Parameter Estimates—Mean and Standard Deviation

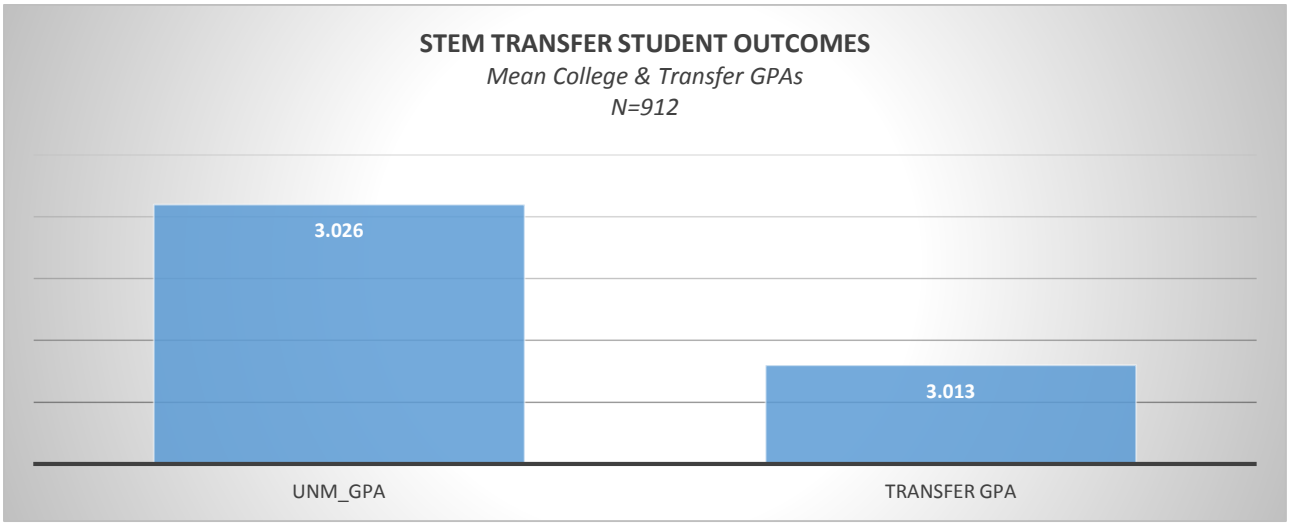
Variable	Estimate	Std Error	tValue	*P*-Value	Standardized Estimate	VIF
Intercept	1.430 (0.191)	0.169 (0.010)	8.506 (1.263)	<0.0001** (0)	0	0
Transfer GPA	0.434 (0.056)	0.051 (0.003)	8.602 (1.141)	<0.0001** (0)	0.336 (0.040)	1.122 (0.035)
Outcome	0.226 (0.020)	0.021 (0.001)	10.817 (1.011)	<0.0001** (0)	0.415 (0.032)	1.082 (0.029)
race	-0.134 (0.037)	0.036 (0.002)	-3.690 (1.022)	0.010 (0.037)	-0.142 (0.039)	1.082 (0.028)
lottery	-0.207 (0.068)	0.070 (0.004)	-2.985 (0.987)	0.031 *(0.084)	-0.113 (0.037)	1.060 (0.023)
gender	0.139 (0.056)	0.054 (0.003)	2.575 (1.044)	0.072* (0.150)	0.097 (0.039)	1.036 (0.017)
1st generation	-0.104 (0.053)	0.055 (0.003)	-1.880 (0.961)	0.165*(0.228)	-0.072 (0.036)	1.080 (0.027)

*Note: Regression coefficients that reached statistical significance *p < .05, **p < .01

An increase in one unit of transfer GPA was associated with 0.336 increase in expected UNM GPA. Hispanic students had a significantly lower UNM GPA than their White peers by 0.142, $p < .01$. Female students had a significantly higher UNM GPA by 0.097 compared to their male peers. First-generation students had a significantly lower college G.P.A. in comparison with their peers.

STEM transfer students with high transfer GPAs tended to have higher UNM GPA and STEM students who graduated with STEM degrees tended to have higher UNM GPA.

Figure 11. Mean GPAs: College & Transfer



There was not a statistically significant mediator based on the variables in the regression model. Thus, there was no impact of an additional variable accounting for the relationship between the predictor and outcome.

**Policy implications:* Upon their entrance into the university, the university should consider administering some type of instrument to measure how motivated students are to perform better and to get a degree. With this instrument, we can investigate where the students stand in terms of GPA and

degree. Subsequent interventions and programs can follow for the ultimate goal of helping students succeed.

Conclusion & Future Directions

Descriptive and predictive analyses were conducted to investigate the differences in student success outcomes of STEM transfer students and how this varied within specific populations (gender, ethnicity/race, etc.). There are four different success outcomes relevant to this research—(1) graduate with STEM degrees, (2) continuously enrolled in STEM majors, (3) identify those that change out of STEM majors and (4) identify those that stopped attending UNM. The results from this study cross validated many of the existing research findings such as the low performance of students from specific family backgrounds and ethnic groups. More comprehensive research is absolutely necessary for UNM to understand the impact of financial aid (including Pell), first-generation status and non-cognitive skills on student academic performances measured by GPA, continuous registration and degree outcomes. Students from traditionally underrepresented students were more at risk of not having positive student success outcomes. It was consistently found that traditionally underrepresented students and students from first-generation and Pell eligible backgrounds were more likely to have low graduation rates and low STEM enrollment rates. These groups of students include American Indian, African American, first-generation and Pell eligible students. The students that identified as American Indian and African American were more likely to be Pell eligible and first-generation students. Thus, more interventions targeted to best support these students in regards to STEM is critical. Transfer students with more credit hours were more likely to succeed and graduate with a STEM degree. Students with a lower number of credit hours when transferring to UNM were not as successful overtime and thus interventions to help transfer student complete at least 60 credits hours or an equivalent of an Associate's degree are beneficial for long-term student success.

Future research should develop some composite measures of family background such that more comprehensive analyses of the impact of this variable is viable. A more comprehensive and intensive study could be done on STEM students and all UNM degree seeking students, comparing first-generation with non-first generation, Pell eligible with non-Pell eligible students in terms of their UNM GPA and degree outcomes. Much literature has demonstrated both with theory and with large datasets that student self-efficacy, a concept in motivation, contributes significantly in academic performance (Lent, Brown & Hackett, 1994, 2000, 2002; Wang, 2013; Wang & Wickersham, 2014). Bandura (1997) points out that people with a stronger sense of self-efficacy are more likely to overcome challenges to complete tasks. They have higher aspirations, make stronger commitment and persist. After setbacks, they regain their sense of competency quickly. They show stronger academic interest, motivation and higher achievement (Bandura, 1997). UNM has implemented an innovative assessment measuring non-cognitive skills such as academic skills, student self-efficacy, social support and self-management skills. If academic skills, self-efficacy, social support and self-management skills contribute to student achievement based on the literature, it would be beneficial to understand the interaction of these skills with family background, gender, ethnicity/race, etc for STEM transfer students. In addition more evaluation on the STEM Gateway model and transfer student initiatives at UNM should be evaluated further. Findings and results from this research will assist with developing more holistic interventions, program designs and institutional effectiveness.

References

Balli, S. J. (1996). Family diversity and the nature of parental involvement. *Educational Forum* 60: 149–155

Ballou, D., Sanders, W., & Wright, P. (2004). Controlling for student background in value-added assessment of teachers. *Journal of Educational and Behavioral Statistics, 29*, 37–65.

Bandura., A. (1997). *Self-efficacy: the exercise of control*. New York, NY: Freeman

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182.

Breckenridge, D. M., Wolf, Z. R., & Roszkowski, M. J. (2012). Risk assessment profile and strategies for success instrument: Determining prelicensure nursing students' risk for academic success. *Journal of Nursing Education, 51*, 160-166.Carrick, J. A. (2011). Student achievement and NCLEX-RN success: Problems that persist. *Nursing Education Perspectives, 32*, 78-83.

Chen, X. & Carroll, C.D. (2005) *First-generation students in postsecondary education: a look at their college transcripts*, NCES 2005–171, Department of Education, National Center for Education Statistics, Washington D.C: US Retrieved from http://nces.ed.gov/pubs2005/2005171.pdf

Choy, S. (2001). *Students whose parents did not go to college.* 2001–126, Washington D.C., Retrieved from http://nces.ed.gov/pubs2001/2001126.pdf

Cohen, R. A. (2006), "Introducing the GLMSELECT PROCEDURE for Model Selection," Proceedings of the Thirty-first Annual SAS Users Group International Conference. Cary, NC: SAS Institute Inc.

Cook, R. D. & Weisberg, S. (1982). *Residuals and influence in regression*, New York, NY: Chapman & Hall

DaDeppo, L. M. W. (2013). Integration factors related to the academic success and intent to persist of college students with learning disabilities. *Learning Disabilities Research and Practice*, *24*(3), 122–131

Davis-Kean, P. E., & Sexton, H. R. (2009). Race Differences in Parental Influences on Child Achievement. *Merrill-Palmer Quarterly. 55* (3): 285-318.

Department of Homeland Security (2012). *STEM list*. Retrieved from http://www.ice.gov/sites/default/files/documents/Document/2014/stem-list.pdf

Domina, T. (2005). Leveling the home advantage: assessing the effectiveness of parental involvement in elementary school. *Sociology of Education*. 78 (3): p233-249.

Dubow, E F., Boxer, P. & Huesmann, L.R. (2009). Long-term effects of parents' education on children's educational and occupational success. *Merrill-Palmer Quarterly.* 55(3): 224-249.

Efron, B. (1982). *The jackknife, the bootstrap and other resampling plans*. Philadelphia: Society for Industrial Mathematics.

Efron B., & Tibshirani, R. J. (1993). An introduction to the bootstrap (Monographs on Statistics and Applied Probability No. 57). New York: Chapman&Hall.

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: A meta-analysis. *Educational Psychology Review, 13* (1), 1–22.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice and performance. Journal of Vocational Behavior, 45 (1), 79–122.

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. Journal of Counseling Psychology, 47 (1), 36–49.

Lent, R. W., Brown, S. D., & Hackett, G. (2002). Social cognitive career theory. In D. Brown (Ed.), Career choice and development (pp. 255–311). San Francisco: Jossey-Bass

Hunter, J & Schmidt, F. (1990). Methods of meta-analysis: correcting error and bias in research findings. Beverly Hills, CA: Sage.

Miranda, M.L., Kim, D., Reiter, J., Galeano, M.A.O., & Maxson, P. (2009). Environmental contributors to the achievement gap, *NeuroToxicology*, 30: 1019-1024

National Center for Educational Statistics (2012). *Improving the measurement for socioeconomic status: a theoretical foundation*. Washington D.C. Retrieved from http://nces.ed.gov/nationsreportcard/pdf/researchcenter/socioeconomic_factors.pdf

National Center for Educational Statistics (2015). *Institutional Retention and Graduation Rates for Undergraduate Students*. Washington D.C. Retrieved from https://nces.ed.gov/programs/coe/indicator_cva.asp

Neter, J., Kutner, M., Wasserman, W. & Nachtsheim, C. (1996) Applied linear statistical models. Boston, MA: McGraw-Hill.

Nuñez, A., Cuccaro-Alamin., S., Carroll, C. D. (1998). First-generation students: undergraduate students whose parents never enrolled in postsecondary education NCES 98-082. Washington, D. C., Retrieved from http://nces.ed.gov/pubs98/98082.pdf

Prophet StatGuide, Northwestern University (1997). Retrieved from http://www.basic.northwestern.edu/statguidefiles/linreg_ass_viol.html

Sandy, J. & Duncan, K. (2010). Examining the achievement test score gap between urban and suburban students. *Education Economics*. *18* (3): 297-315.

Seldomridge, L. A., & Dibartolo, M. C. (2004). Can success and failure be predicted for baccalaureate graduate on the computerized NCLEX-RN? *Journal of Professional Nursing, 20*, 361-368.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: a meta-analytic review of research. *Review of Educational Research. 75* (3) : 417—453

University of New Mexico Project for Inclusive Undergraduate STEM Success.

University of New Mexico (2014). STEM Research Gateway research briefing: stop, shift or graduate: degree outcomes lens. Retrieved from http://stemgateway.unm.edu/documents/SSGReport1.pdf

U.S. Census Bureau. (2010). *Overview of race and Hispanic origin: 2010 Census brief*. Retrieved from http://www.census.gov/prod/cen2010/briefs/c2010br-02.pdf

Wang, X. (2013). Modeling entrance into STEM fields of study among students beginning at community colleges and four-Year institutions. *Research in High Education*. 54:664–692

Wang, X & Wickersham, K. (2014). Postsecondary Co-enrollment and Baccalaureate Completion: A Look at Both Beginning 4-Year College Students and Baccalaureate Aspirants Beginning at Community Colleges. *Research in High Education*. 55:166–195

Warburton, E.C., Bugarin, R., Nuñez, A. & Carroll, C.D (2001). *From Bridging the Gap Academic Preparation and Postsecondary Success of First-Generation Students*, NCES 2001–153, Washington, D. C., Retrieved from http://nces.ed.gov/pubs2001/2001153.pdf

Zhang, Q & Sandez, E. (2013). High School Grade Inflation from 2004 to 2011 (ACT Research Report Series, 2013-3). Iowa City, IA: ACT

Appendix A

Test Results for Association between Different Groups and Outcomes.

Research Interest	Test	Test Statistics	CI for *p*-value	Significance	Comparisons between Groups
Association between ethnicity and outcomes	MH Chisquare (simulation based)	φ =0.125 P= 0.187 for χ^2	0.177—0.197 for p-value	No	No association between different ethnic groups and outcomes.
Association between American Indian, NonAmerican Indian and outcome	Mantel-Haenszel Chi-Square	φ =0.108 p= 0.047 for χ^2	Not applicable	Yes	American Indians had lower graduation rate and higher stop rate than non-American Indians. More American Indian students were first generation and Pell eligible.
Association between Hispanic, NonHispanic and outcome	Mantel-Haenszel Chi-Square	φ =0.056 P= 0.990 for χ^2		No	Hispanic and non Hispanic had the similar outcomes
Association between African American, Non African American and outcome	Fisher exact	φ =0.100 Fisher exact: p=0.019 for χ^2	Not applicable	Yes	African American had slightly lower graduation rate and higher stop rate.
Association between male, female and outcome	Mantel-Haenszel Chi-Square	φ =0.042 p= 0.486 for χ^2	NA	No	The male had a slightly higher percentage with graduation and shifting, and lower percentage of stop and enrollment.
Association between White female, Nonwhite female and outcome	Mantel-Haenszel Chi-Square	φ =0.080 p= 0.079 for χ^2	NA	No	Nonwhite female had lower graduation rate and higher stop rate than white female.
Association between White male, Nonwhite male and outcome	Mantel-Haenszel Chi-Square	φ =0.057 p=0.306 for χ^2	NA	No	White male had lower graduation rate and higher stop rate than non-white male.
Association between 1st generation or not and outcomes	Mantel-Haenszel Chi-Square	φ =0.148 p=0.035 for χ^2	NA	Yes	Students from not first generation families tend to have more positive outcomes with higher graduation rate and lower stop rate.
Association between Pell, not Pell and outcome	Fisher' exact test with some cell of N<5	φ =0.130 p=0.0102 for χ^2		Yes	Pell students had lower graduation rate, higher Shifting rate and lower stop rate than non Pell students

Research Interest	Test	Test Statistics	CI for *p*-value	Significance	Comparisons between Groups
Association between first generation, Pell and outcomes, controlling first-generation	Fisher' exact test with some cell of N<5 Exact MHCHI	1st gen=0, φ =0.239 Fisher's exact p=0.003; 1st gen=1, φ =0.101 Fisher's exact p=0.595 Relationship between Two Tables: p=0.124		1st gen=0, Yes; 1st gen=1, No; Relationship of 2 tables: No.	Not 1st generation students were more likely to graduate, less likely to stop & more likely to shift. The test of association on these two tables showed that when we move from students from better educational background to first generation students, their Pell status was not associated with the outcomes.
Association between first generation, Pell and outcomes, controlling Pell	Fisher' exact test with some cell of N<5	Pell=0, φ =0.169 Fisher's exact p=0.2467; Pell=1, φ =0.225 Fisher's exact p=0.0025; Relationship between Two Tables: p=0.0031	NA	Pell=0, No; Pell=1, Yes; Relationship between 2 tables: Yes	Not Pell students had higher graduation rate. The statistical test showed that, when we moved from students without Pell to those with Pell, family education background was statistically associated with outcomes in a significant way.
Association between different transfer groups and outcomes	MHCHI/MC, exact scorr	φ =0.162 P<0.0001 for χ^2	<0.0001 to 0.0005 for p-value	Yes	Students with less transfer credit hours were less likely to graduate and more likely to stop at UNM.

Note : φ denotes Cramer's V, a measure of association/correlation between categorical variables. *P*-value is for Chisquare χ^2

Appendix B

Summary of Odds Ratios

Ethnicity	Model	Model Fit	Outcome	Odds Ratio (CI)	Significance
American Indian vs Non American Indian	Partial proportional odds	Perfect fit	Graduated vs any outcomes	0.396(0.183, 0.762)	Yes
			Graduated, enrolled vs shifted, stopped	0.577 (0.305, 1.034)	No
			Any outcomes vs stopped	0.748 (0.434, 1.280)	No
Hispanic versus Others	Proportional odds model	Assumption is reasonable. Model fit statistics are good	See the above	1.020(0.786, 1.324)	No
Black versus not Black**	Exact generalized logit model	Perfect fit	Graduated/Stopping	0.590 (0.235, 1.368)	No
			Enrolled/Stopping	0.425*(0.000, 2.010)	No
			Shifted/Stopping	0.102*(0.000, 0.473)	Yes
Female versus male	Proportional odds model	Assumption is reasonable. Model fit statistics are good	See “American Indian vs Non American Indian”	0.909(0.711, 1.160)	No
Not White female vs White female	Proportional odds model	Assumption holds. Model fit statistics are very good	See “American Indian vs Non American Indian”	0.742 (0.530, 1.037)	No

Ethnicity	Model	Model Fit	Outcome		Odds Ratio (CI)	Significance
Not White male vs White male	Proportional odds model	Assumption holds. Model fit statistics are very good	See "American Indian vs Non American Indian"		1.210 (0.845, 1.732)	No
1st Generation vs Not 1st Generation	Partial proportional odds	Perfect fit	See "American Indian vs Non American Indian"		0.728 (0.503, 1.050)	No
					0.801 (0.559, 1.144)	No
					0.603 (0.424, 0.856)	Yes
Pell versus not Pell	Partial proportional odds	Perfect fit	See "American Indian vs Non American Indian"		0.710 (0.510, 0.987)	Yes
					0.834 (0.603, 1.155)	No
					1.056 (0.763, 1.461)	No
1st generation versus not 1st generation, control Pell**	Exact generalized logit model	Perfect fit	1st generation vs not 1st	See "Black versus not Black"	0.580 (0.372, 0.903)	Yes
					1.639 (0.547, 4.909)	No
					0.432 (0.252, 0.738)	Yes
			Pell vs not Pell	See "Black versus not Black"	0.812 (0.518, 1.274)	No
					3.952 (0.866, 18.039)#	No
					1.858 (1.040, 3.318)	Yes
Transfer groups	Proportional odds model	Assumption holds. Model fit statistics are very good	>61 credit vs < 61 credit		3.223 (1.587, 7.247)	Yes
			Degree vs < 61 credit		6.848 (3.301, 15.660)	Yes

Note: significance is based on whether the 95% confidence interval includes 1.0 or not. If it excludes, we conclude that it is significant.

*indicate the unbiased median estimates.

**indicate cells with counts of zero or counts of less than 5.

denote a too wide interval. This is unreliable estimate. Caution is necessary to interpret this

Appendix C

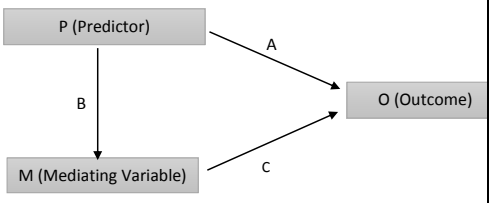
Pearson Correlation Coefficients									
Prob > |r| under H0: Rho=0									
	GPA	Outcome	Transfer GPA	Gender	First Generation	Pell Eligibility	lottery	log_EFC	race
GPA	1	0.439	0.403	0.101	-0.105	-0.086	-0.038	0.071	-0.164
		<.0001*	<.0001*	0.002*	0.018*	0.028*	0.335	0.069	<.0001*
STEM Degree outcome	0.439	1	0.220	-0.023	-0.093	-0.040	0.036	0.010	-0.028
	<.0001*		<.0001*	0.487	0.035*	0.310	0.363	0.794	0.403
Transfer GPA	0.403	0.219	1	0.070	-0.0009	-0.140	0.195	0.070	-0.091
	<.0001*	<.0001*		0.034*	0.985	0.0003*	<.0001*	0.074	0.006*
gender	0.101	-0.023	0.070	1	0.030	0.027	-0.085	0.001	0.084
	0.002*	0.487	0.034*		0.497	0.492	0.031*	0.977	0.012*
First Generation	-0.105	-0.093	-0.0009	0.030	1	0.173	-0.0513	-0.141	0.244
	0.018*	0.035*	0.985	0.497		0.0003*	0.285	0.003*	<.0001*
Pell Eligibility	-0.086	-0.040	-0.140	0.0271	0.173	1	-0.119	-0.539	0.109
	0.0283*	0.310	0.0003*	0.492	0.0003*		0.002*	<.0001*	0.006*
lottery	-0.038	0.036	0.195	-0.085	-0.051	-0.119	1	0.136	0.019
	0.335	0.363	<.0001*	0.031*	0.285	0.0024*		0.0013*	0.623
log_EFC	0.072	0.010	0.069	0.001	-0.141	-0.539	0.136	1	-0.150
	0.069	0.794	0.074	0.977*	0.0032*	<.0001*	0.0013*		0.0001*
Ethnicity/race	-0.164	-0.028	-0.091	0.084	0.244	0.109	0.019	-0.150	1
	<.0001*	0.403	0.006*	0.012*	<.0001*	0.006*	0.623	0.0001*	

Note: the significant test results at alpha level of 0.05 were indicated by

Appendix D: Terminology

Variables	Definition
Transfer cohort/group	transfer students who applied, were admitted and registered for the classes at the time of admission at the University of New Mexico (UNM) between fall, 2006 and spring, 2009
Graduation rate	percentage of students who got STEM degree, calculated using the number of graduates divided by the total number of students or the total number of students in some specific group of interest
STEM enrollment rate	percentage of students who continued their STEM programs by spring, 2014, calculated using the number of students in this cell divided by the total number of students or the total number of students in some specific group of interest
Shifting rate	percentage of students who shifted out of STEM programs into other non STEM programs, calculated using the number of students in this category divided by the total number of students or the total number of students in some specific group of interes
Stop rate	percentage of students who stopped attending UNM, calculated using the number of students in this category divided by the total number of students or the total number of students in some specific group of interest
Student demographic information	gender, ethnicity/race, estimated family contribution (EFC) from FAFSA **Family background:** first generation and Pell eligibility
Academic information	transfer GPA, UNM cumulative GPA, STEM major information at the time of entry, most recent major information by spring 2014, their graduation; recent enrollment
Lottery Scholarship Recipient	inclusion of lottery was in response to the interest across the state of New Mexico in the role of lottery in student success outcomes and was only used in prediction analysis
Mediator	a variable that describes how, rather than when, effects will occur by accounting for the relationship between the independent and dependent variables
Transfer GPA	calculation of transfer GPA was performed to align transfer GPA approximately on the same scale as UNM GPA

Appendix E: Statistics

Method of Analysis	Definition	Hypothesis/Example
Categorical data analysis	Categorical data analysis is applicable for response measures which are categorical in nature.	**H_0:** there is no association between the independent variable(s) of interest and the dependent variable. **H_1**: there is association between the independent variable(s) of interest and the dependent variable.
Odds Ratio (OR)	A measure of association between two outcome groups. The odds ratio represents the odds or chance that an outcome will occur given one group, compared to the odds of the outcome given another group.	*As an example, we have a mentoring program at UNM and we are interested in student graduation in 6 years with or without the mentoring program. We have one group of 100 students participating in a mentoring program and another group of 100 not participating (everything else being equal). We can compare the graduation rate of the two groups.* • Case 1: at the end of 6 years, 60 students out of each group graduated. Therefore, the graduation rate is 60% for each group. When we compare the two ratios, we get odds ratio of 1. This means the two groups had the same percentage of graduation. Participating in the mentoring program or not does not affect their graduation. There is no association between mentoring and graduation.
Mediation Model	A a *mediator* explains the relationship between the two variables. A typical example of a moderator is a significant interaction term.	
Multiple regression and logistic regression	Used to predict the value of a variable based on the value of two or more other variables. The variable we want to predict is called the dependent variable and the predictors are the independent variables Bootstrapping allows assigning measures of accuracy *(defined in terms of bias, variance, confidence intervals, prediction error or some other such measure)* to sample estimates.	**H_0:** the regression coefficient, β, is not significant from 0. **H_1**: the regression coefficient, β, is significant from 0.

Appendix E: Statistics

Method of Analysis	Definition	Hypothesis/Example
Confidence Interval (CI)	Confidence interval (band, limit) indicates how confident we are with our outcome. The 95% confidence interval indicates that, if we do resampling a certain amount of times and repeat the test each time, we get an estimate of the 'true' value 95 out 100 times. Ideally, we expect our estimates from different resampling results to be close as possible. In other words, confidence interval (CI) is an indicator of how close/reliable our estimates are.	For the confidence interval of odds ratio, the test statistic will still be nonsignificant if the confidence interval includes 1.0. When 1.0 is in the confidence interval, it means that the two groups have the same odds of getting the result. On the other hand, if 1.0 is excluded in the confidence interval, it indicates a significant result.
Significance	• p-value is smaller than the pre-specified alpha level (0.05), we would conclude there is a significant statistical result. • obtained confidence interval (CI) excludes the odds ratio of 1.0, we would conclude that there is a significant statistical result. • test result is somewhat marginal (close to the alpha level), we would conclude that there is a marginally significant result. • practical significance might conclude the difference (e.g, 10.0) is practically meaningful even if the test is not significant.	