Predictors of Success in a STEM Gateway Mathematics Course for HBI Summer Bridge Students

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This study examined the predictive factors of success in a STEM gateway mathematics course among first-year students at an historically Black institution (HBI). The study consisted of 758 students; 49% males and 51% females who participated in a pre-college summer bridge program between 2007-2010. The results suggest that females were more likely to be successful in mathematics than males. Students who were successful in the mathematics midterm examination were more likely to be successful than students who were unsuccessful. The findings are important in making administrative decisions to improve students retention and graduation rates.

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Transition from high school to college can be very challenging, especially for African American students who might not be adequately prepared (Kline & Williams, 2007). Black male students are less likely to pursue higher education than their female counterparts and are generally inadequately prepared academically for postsecondary education (Hodges, 2011; Strayhorn, 2008). In fact, Adelman (2006) stated that students requiring remedial assistance to participate in college-level courses are less likely to complete degree programs.

Greene and Winters (2005) indicated that in 2002 only 23% of African American students were ready for college. As a result, higher education institutions were faced with the task of implementing programs that facilitate degree completion (Amelink, 2005). Since 1960, many institutions including historically Black institutions (HBIs) have conducted pre-college programs to close the gaps in academic preparations between racial and ethnic groups, and to increase success of low-income students in colleges and universities (Jager-Hyman, 2004; Edwards, 2010). Pre-college summer bridge programs typically run from three to six weeks and include a residential component (Kezar, 2000). These summer programs often provide social support and exposure to a college preparatory curriculum for students in elementary through high school. Many of these programs, such as Upward Bound and Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP) also provide academic support and college advising (Gullatt & Jan, 2003).

Washington, Pretlow, and Mitchell (2011) found that there were many developmental summer bridge programs designed to strengthen academic skills for incoming college freshman. Varde (2004) argued that participation in pre-college programs can improve student competency in college-level mathematics and increase retention and graduation rates among minority students. Over the years, HBIs have played a major role in expanding the educational opportunities for Black students enrolled in postsecondary education. HBIs make up less than three percent of the colleges and universities nationally and enroll approximately 16% of undergraduate students (Palmer, Davis & Gasman, 2011). HBIs are more supportive and nurturing towards the success of African American students than predominantly white institutions (Palmer, Davis & Maramba, 2010). The social and cultural climates on HBIs contribute to a large extent to the academic growth and development of Black students (Lee, 2002). The completion rate for Black students enrolled at HBIs are much higher because Black students are exposed to positive role models who provide students the opportunity to participate in leadership roles (Palmer et al, 2010)

Whereas many researchers (e.g., Burton & Ramist, 2001; DeBerard, Spielmans, & Julka, 2004) have focused on predictors of academic success in college, few studies have examined the factors that predict academic success in gateway courses for science, technology, engineering and mathematics (STEM) majors; especially for unprepared students in summer bridge programs at

historically Black institutions (HBIs). It is critical to determine if summer remedial program participation is beneficial to underprepared students, and to identify the predictors of academic success in order to guide admissions and reforms to increase retention and graduation rates for African American students, especially in STEM majors. The purpose of the present study, therefore, was to determine if success in a first-year college-level mathematics course can be predicted by gender, socioeconomic status (SES), high school grade point average (HSGPA), combined math-verbal Scholastic Achievement Test (SAT score), and academic major for a group of pre-college students who participated in a summer bridge program that was designed to provide remediation courses to underprepared high school graduates.

Conceptual Framework

The Input-Environment-Output (I-E-O) model, developed as a framework for assessments in higher education guided this study (Astin & Sax, 1998). According to the I-E-O model, students enter academic settings with certain inputs and their competency within higher education develops as a result of their interaction with the college or university environment, thereby leading to educational outputs (House, 1999; Thurmond & Popkess-Vawter, 2003). Input variables, include students' demographics, financial status, career choice, educational background, life goals, reasons for attending the selected institution and behavior patterns, providing a basis on which subsequent gains in education can be evaluated as a result of exposure to post-secondary environment. These environmental variables may be conceptualized as anything within the university milieu that may affect student outcomes; they often include the curriculum, college experiences that are internal and external to the classroom, intervention programs, interactions with faculty and staff, institutional climate, teaching style and extra-curricular activities. Within the I-E-O model, outputs are considered to be educational outcomes, often in the form of grade point average (GPA), exam scores, post-tests and degree completion (Astin, 1993; Thurmond & Popkess-Vawter, 2003).

Input Variables

According to Astin and Sax (1998), input characteristics are crucial in predicting students' success in college in order to determine their impact on the environment and output variables. The pre-college academic input variables used in this study include students' HSGPA along with combined verbal and mathematics SAT scores. Pre-college demographic variables include gender and SES.

SAT. The SAT is one of the most reliable predictors of African American success in college (Burton & Ramist, 2001) and is one of the most widely used methodologically sound instrument used in the United States to predict students' success in college (Geiser & Santelices, 2007; Kobrin, Patterson, Shaw, Mattern&Barbuti, 2008). Despite its wide use as a predictor of college success, the validity of the SAT has been criticized by some researchers (e.g., Geiser & Santelices, 2007) as not being the most effective predictor of academic success. Wainer (2011), argued that students who take the SAT are not given the opportunity to demonstrate what they know and can do and that the content of the SAT is not aligned to the curriculum shared by many schools across the United States. HBIs tend to focus less on using SAT scores as the main requirement for college enrollment due to issues related to validity and the history of cultural biases (Special Report, 2000).

HSGPA. Despite some criticisms of HSGPA as an unreliable predictor of academic success in post-secondary education (Camara, Kimmel, Scheuneman, & Sawtell, 2003; Hollingsworth, Walker, & Anderson, 1997) because of inconsistent grading standards among high schools (Camara & Michaelides, 2001), other researchers have found it to be a more reliable predictor than SAT scores (Burton & Ramist, 2001; Espenshage & Chung, 2010). Geiser and Santelices (2007) stated that HSGPA was the best predictor for both first-year students' commutative grades and graduation. Congruent with Espenshage and Chung's (2010) findings, Geiser and Santelices (2007) also indicated that high school GPA is the most reliable predictor of first-year students' overall grade point average (GPA) for African American students in postsecondary institutions.

SES. Students' socioeconomic status (SES) is often measured by a combination of factors that include family income; and parental occupational and educational levels (Jeynes, 2002). Researchers (Jeynes, 2002; Eamon, 2005) reported that students' preparedness for college and university is predicted by their parents' SES. The Pell grant is often used as a proxy for SES; Pell grant is a need-based assistance program which is made available to students from low SES by the federal government. While 24% of all African Americans lived below the poverty threshold in 2004 (U.S. Census Bureau, 2005), 41% were Pell Grant recipients between 2007 and 2008 (Institute for College Access and Success, 2011). Walpole (2008) findings revealed that African American students from low SES are more likely to spend less time studying, or consulting faculty members. Walpole argued that obtaining a job is one of the deterrents that prevent African Americans at HBIs from studying and achieving good grades.

There is a 40% academic gap in the retention rates of students from low SES families when compared to students from higher SES (Haverman & Wilson, 2007). According to Adelman (1999), SES was the only demographic characteristic significantly related to earning a bachelor's degree in college.

Gender. Gender is an important predictor of academic success in college (King, 2006) and has been the focus for much educational research over the past few decades (Smith & Schumacher, 2005). Males historically have outperformed females in first-year college mathematics courses (Wainer & Steinberg, 1992). Similarly, males' scores in post-secondary mathematics courses, in general, have been found to be slightly higher than those of females (National Center for Education Statistics, 1997; Weinstein & Laverghetta, 2010). The reasons given for the disparity include males' superiority in advanced problem-solving (Doolittle & Welch, 1989) and stronger spatial and mathematical reasoning skills even when females possess exceptional computational skills (Coley, 2001; Niederle & Vesterlund, 2010).

Although the gender achievement gap in mathematics has decreased in recent years (Simon, 2006), some researchers maintain that some of the differences may be the result of the academic socialization process, whereby males more often are encouraged to pursue careers that require advanced math skills. Turner and Bowen (1999); and National Center for Education Statistics (1997) report that whereas females are more likely than males to enroll in college, males are more likely to perform better in STEM courses, which may make them more likely to pursue STEM careers than females (Simon, 2006).

The large majority of students enrolledin HBIs are females who have devoted more time and effort to their academic pursuits than males (Harper, Carini, Bridges, & Hayek, 2004). However, Black male students are more likely to form social relationships with faculty members to compensate for their lack of academic preparedness (Harper, et al., 2004). Consistently, in 2008, more females than males were enrolled in higher education across all racial and ethnic groups. However, gender gap was largest for Black undergraduates, with females accounting for approximately 64 % of the undergraduate enrollment (Aud, Fox & KewalRamani, 2010). Over the years, African American women have experienced manyobstacles in American academia, such as those related to gender and racism; however, these obstacles continue to persist. Why are African American women attending and performing better in colleges and universities than their male counterparts? For African American women, attending college or university is not just obtaining a degree; it is the opportunity to be heard and respected by their male counterparts (Glavan, 2009).

Environmental Variables

Environmental variables include the experiences that students gain while attending university that can impact the outcome measure (Astin, 1993). Academic major and midterm grades are the two environmental variables addressed in the study

Academic Major. Although it is not mandatory for students in colleges and universities to select a major field of study prior to enrollment, students who declare a major course of study in their first year have been found to be more successful in university courses than students who do not (Price, 1999). A large proportion of Black students at HBIs who have undeclared majors have low retention rates or generally are transferred from their original institutions (St. John & Henderson, 2010). However, students who major in STEM fields have been found to be more successful in college with higher first-year grade point averages (GPAs) than students who major in the social sciences, education, or humanities (Pascarella & Terenzini, 2005). Minority and low income students tend to experience difficulties majoring in SETM courses due to the lack of preparation during high school (NSF, 2006). Despite students' participation in these pre-college programs, Black students from HBCIs continue to be disproportionately represented in major STEM fields (Kim & Conrad, 2006).

Midterm Grades. In most colleges and universities, students receive a letter grade that is based on their academic performance in the classroom at the midpoint of the semester or quarter. These grades are designed to be an accurate reflection of student performance and can be used as an effective diagnostic tool to predict students' success or failure at the end of the course (Cueso, 2004). Therefore, it is important to identify students with poor midterm grades to determine more effective strategies to ensure student success (Cueso, 2004). Similarly, midterm grades can also be used to implement intervention efforts, particularly when large numbers of students earn low midterm grades. Such interventions may include supplemental instruction and tutoring activities (College Board, 2009).

Output Variables

According to the I-E-O model (Astin, 1993), outputs are measured in order to determine the impact of the input and environmental variables and often include indicators of success or failure. Within the model, output variables often include grade point average (GPA), exam scores, and degree completion (Thurmond & Popkess-Vawter, 2003). In the current study, final grade in a first-year introductory mathematics course was the output variable.

Success in Mathematics. Students' performance in mathematics has been the focus of research (Stylianides & Stylianides, 2007); primarily because success in these courses is a consistent predictor of success in other STEM courses (Sadler & Tai, 2007). Though there have been grading inconsistencies in mathematics assessment at the both national and international level (Kilpatrick, Swafford & Findell, 2001), success in first-year mathematics courses is critical to future success, perhaps because these courses often serve as a gateway to other STEM courses, and success in these courses can serve to either confirm or call in

to question choice of major (Wheatly, Klingbeil, Jang, Sehi & Jones, 2007). Despite the implications of assessment at the end of a first course in mathematics, certain input and environmental factors, as discussed above, have been found to contribute to success in college mathematics courses. Among these factors are the number and types of mathematics courses taken in high school, SES, gender, and choice of major (ACT, 2004; Culpepper, Basile, Ferguson, Lanning, & Perkins, 2010). The skills developed in mathematics courses are critical to students' ability to connect mathematical ideas, think logically, reason, problem solve, and communicate mathematics principles to other individuals (Kilpatrick et al., 2001) allowing students to graduate and move into the industrial and technological arenas (Maryland State Department of Education, 2001). African American students consistently experience difficulties in mathematics (Perie, Grigg & Dion, 2005). Low performance by African American students in mathematics is correlated with students' attitude towards the course (Greenwood, 1997). A consequence of this results in failure and lack of interest in any course that includes mathematics (Bramlett & Herron, 2009). Given the importance of success in mathematics, the present study was guided by the following research question: Can success in a first-year college mathematics course, a gateway course for STEM majors, be predicted from the input variables, SAT combined mathematics and verbal scores, HSGPA, SES, and gender and the environmental variables, major and midterm grade?

Methods

Data Source

Data for this study were provided by the Office of Student Retention and the Office of Institutional Research at an HBI located in the Mid-Atlantic region. Information from students' application forms, the College Board and academic transcripts were entered into the university data system. In order to conduct this investigation, IRB approval was obtained from the university's Institutional Review Board. The university's policy in relation to human subjects and confidentiality was observed. Students' personal information, names and addresses were removed by the Office of Institutional Research before the data were provided to the researcher.

Participants

Data from students who successfully completed the summer bridge program, 2007-2010, and subsequently enrolled at the university were provided by the Office of Institutional Research. The students in the summer bridge program were selected to participate because they failed to meet the university's

minimum admissions requirements which include HSGPA of 2.0, and a combined verbal reasoning and mathematics score of 850 on the SAT or a 17 on the ACT. Once the students completed the six week program and earned at least a C grade in reading comprehension, English, mathematics and vocabulary, they were guaranteed admission to the university. Nine hundred seventeen students completed the program and were enrolled in the university between 2007 and 2010. Of those participants whose data were provided, 129 were excluded from the analysis because they withdrew from the university, had no grades listed in the data file, were part-time students, or did not enroll in the required first-year-mathematics course under investigation in this study. The values of the missing data could not be obtained by any other means; as a result, the cases were removed, (Scheffer, 2002) suggestions for dealing with missing cases. In this study, the students were enrolled in a first-year introductory mathematics course which is required by STEM and Psychology majors during the subsequent semester after completion of their summer bridge program. The study consisted of 758 students, 49.3 % males and 50.7% females. The mean age of the participants was 18.37 years (*SD* = 1.61), majority African Americans (92%), while the remaining eight percent were from other racial/ethnic groups.

Input Measures

SAT Scores. The SAT is composed of three sections; verbal reasoning, mathematics and writing. The SAT Writing was not utilized in the analysis because the university does not require these scores for admission. The SAT verbal and mathematics are continuous variables which were entered into the model together.

HSGPA. Students' HSGPA were obtained from high school academic transcripts, a continuous variable. This was measured on a four-point scale with the maximum of 4.00.

Gender. Information containing students' gender was obtained from student's academic transcript as well as from the university's application form. Gender was coded as a dummy variable (1=female, 0 = male); with male being the reference category.

SES. In this analysis, receipt of Pell Grant was used as a proxy for students' SES. Students who received Pell Grants were classified as being from lower economic status, and students who were not eligible for Pell Grant were classified as being from higher economic status. The SES variable was codedas:1 = low SES, 0 = high SES (reference category).

Environmental Variables

Academic Majors. Students academic majors were measured using three different categories: STEM, other majors and undeclared majors. STEM majors include Biology, Physics, Chemistry, Engineering, Psychology and Mathematics. Other majors encompass areas such as History, English, Journalism and Hotel Management. The variable 'academic major' was transformed and recoded into 1 = STEM (reference category), 2 = other major and 3 = undeclared major.

Midterm Grades. Students' midterm grades were assigned grades 'A through F'. Successful in the midterm mathematics examination was measured consistently with the university's definition of success. Midterm grade was transformed and measured as 0 = dummy variable for grades 'A through C' = successful and 1 for grades 'D and F' = unsuccessful. Successful midterm grade was used as the reference category.

Output Variable

Success in Math. Success in mathematics was measured using successful and unsuccessful. The mathematics course covered topics in algebra, trigonometry and analytical geometry. This course is a gateway course for students pursuing STEM majors. Students' grades were coded 1 = successful and includes grades 'A through C' and 0 = unsuccessful for grades 'D and F'.

Data Analysis

Prior to conducting logistic regression, a preliminary analysis was conducted to test the assumptions of logistic regression. First, a diagnostic test was conducted to identify any extreme values on the predictor variables. Standardized residuals were examined to detect the presence of outliers. Thirty cases with values greater than three were excluded from the analysis to ensure that the model fits the data (Mertler & Vannatta, 2011). Second, the assumption of multicollinearity was evaluated in order to determine which independent variables were highly inter-correlated. The variance inflation factor (VIF) was used to test the assumption of multicollinearity for each variable. Values of the VIF were lower than 10 for each variable (Mertler & Vannatta, 2011). As a result, there were no unacceptable multicollinear relationships among the variables. Thus, the assumption of multicollinearity was not violated. Third, in order to examine the fit of the model, the Hosmer and Lemeshow test statistic was observed. The HosmerLemeshow test ($p > .05$) indicates that students' performance in mathematics was not significantly different from those predicted by the model and the overall fit of the model was good.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 16. Binary logistic regression was utilized in order to predict the probability of success in an introductory mathematics course. Logistic regression was used in this analysis to facilitate the dichotomous state of the outcome variable (success in mathematics). Variables were added to the model using the Enter method prior to checking their level of significance. Independent variables with *p-values* greater than 0.1 were removed from the model and variables with the largest *p-values* were removed first leaving all significant predictors in the model (Pampel, 2000). Descriptive statistics were used to report the characteristics of the students in the study (see Table 1). Frequencies and percentages were included, while means and standard deviations were reported for the continuous variables in the study. In order to examine the impact of the input variables on success in mathematics, the coefficient B, standard error, Wald's test, confidence interval, and odds ratio were identified and reported. Odds ratios with values greater than one revealed a positive relationship between the variables (Pampel, 2000). Odds ratios with values less than one correspond with the odds of being unsuccessful in mathematics. In addition, continuous variables, such as high school GPA and SAT mathematics and verbal scores were interpreted in relation to the unit change in the variables.

Table 1

Students' Input Characteristics

Variables	n	%	M	SD
Gender				
Males	374	49.3		
Females	384	50.7		
SES				
Lower	370	48.8		
Upper	388	51.2		
HSGPS			2.65	0.92
SAT Math Scores			465	141.88
SAT Verbal Scores			445	140.26

Note. N= 785; SES= socioeconomic status; HSGPA= high school grade point average

Results

This study investigated the role of input and environmental characteristics in predicting successful completions of a gateway mathematics course of precollege summer bridge participants at an HBI. Table 1 indicates that students who were from low SES encompass 51.1% (*n*= 401) of the sample, while 48.9% (*n*= 384) were from higher SES. Table 1 also shows that for HSGPA, m = 2.65 (*SD* = 0. 92), the mean SAT math score 465 (*SD* = 141.88); mean SAT Verbal was 445 (*SD* = 140.26). Academic major was separated into three categories (STEM, other majors and undeclared). Three hundred eighty (50.1%) students declared STEM majors, while 38.3% (*n*= 290) declared other majors. Of the sample, 11.6% (*n*= 88) of the students were undecided about their choice of academic majors (see Table 2). The distribution of midterm grades is displayed in Table 2; the results show that majority (60%) of the students received grades 'A through C' and forty percent (*n*= 302) received grades 'D or F' on their midterm exam. Overall, seventy-five percent of the students were successful in passing the mathematics course, while 25% were unsuccessful (see Table 2). However, 40% of the students who were unsuccessful at midterm received a passing grade on the final exam. Contrastingly, 1.8% of the students who passed the midterm were unsuccessful on the final exam.

The logistic regression that was specified to predict success in the first-year mathematics course included three significant predictors: HSGPA, gender and midterm grade. Results of the logistic regression are displayed in Table 3. The overall model was statistically reliable in distinguishing between students who were successful and those who were not successful in the mathematics course. The Hosmer and Lemeshow Test indicated an acceptable fit of data $\chi^2(7, N = 758) = 10.14$, $p = .18$, with Nagelkerke $R^2 = .58$. The overall correct classification was impressive; 83.1% of the students who participated in the university's pre-college summer bridge program were correctly classified; 81.9% of the cases were correct for success in mathematics, while 86.8% were correct for students who were unsuccessful. The Wald criterion demonstrated HSGPA, gender, and midterm grades made significant individual contributions to success in the first-year STEM mathematics course with grades 'C' or better. Table 3 shows logistic regression coefficients, Wald statistics, odds ratios and 95% confidence intervals for odds ratios for all variables that were included in the regression. The odds ratio of 1.33 for HSGPA with a 95% confidence interval (CI) ranging from 1.01 to 1.74, indicating that for every one point increase in HSGPA, students were 1.33 times more likely to receive successful final grades in the mathematics course. Similarly, the odds ratio for gender indicated that females are 1.65 times more likely to be successful than males. Finally, the odds ratio for midterm success and the 95% CI of (39.44, 173.791) shows that students who were successful at the midpoint of the semester were 82.74 times more likely to

receive an A-B- or C final grade compared to those students who were unsuccessful at the midterm.

Table 2

Students' Environmental Characteristics

Variables	n	%
Academic Major		
STEM	380	50.1
Other Majors	290	38.3
Undeclared	88	11.6
Midterm Mathematics Grades		
A	147	19.4
B	136	17.9
C	173	22.8
D	106	14.0
F	196	25.9
Final Mathematics Grade		
A	211	27.8
B	166	21.9
C	192	25.3
D	32	4.2
F	157	20.7

Note. N= 758; A through F are students letter grades assigned after completion of their midterm and final examinations

Table 3

Logistic Regression Predicting Students Success in First-Year College Level Mathematics

				Odds Ratio	95% C.I. for Exp (B)	
Predictors	*B*	S.E.	Wald χ^2	Exp (B)	Lower	Upper
HSGPA	.284	.138	4.217*	1.329	1.013	1.742
Gender						
Female	.502	.229	4.185*	1.651	1.055	2.585
Male (Ref.)						
Midterm Grade						
Success	4.416	.378	136.433**	82.744	39.440	173.591
Unsuccessful(Ref.)						
Constant	-1.355	.380	12.751	.258		

Note. N= 758; HSGPA = high school grade point average; classification for the model = 83.1%.
** $p<.01$, * $p<.05$.

Discussion

The study utilized the I-E-O model for investigating the role of predictors of success for an introductory STEM mathematics course for students who participated in the university's pre-college summer bridge program between 2007 and 2010 at a HBI. Students' participation in the pre-college summer-bridge program has contributed to their success in the STEM mathematics gateway course at the HBI in question. Success in mathematics was predicted by student's HSGPA, midterm grade and gender. However, it is evident that Astin's

I-E-O model is outdated, yet essential in guiding the study given the limited number of variables that were available at the Office of Institutional Research at the HBI. The findings revealed that there were no significant effects of the SAT mathematics and verbal scores on student success in mathematics. Wainer (2011) argued that the SAT is not aligned to the present high school curriculum in the United States and as a result is not reliable in predicting students' success in college. The idea that the SAT is one of the most reliable predictors of African American students' cumulative grades in college (Burton & Ramist, 2001) was inconsistent with the findings in this study. The HSGPA is one of the two input characteristics that significantly predict students' success in mathematics. These results support Burton and Ramist (2001) and Espenshade and Chung's (2010)

findings that HSGPA is a better predictor of success for both first-year and fourth-year college grades than the SAT. In addition, Geiser and Santelices (2007) delineated that high school GPA was the most reliable predictor for first-year GPA among African American students in postsecondary institutions.

It is of interest to note that the usual disparity between males and females in mathematics success was reversed. Contrary to Doolittle and Welch's (1998) findings, females were more successful in completing the mathematics course than males. Gender gap in the final math grade could be explained by differences in HSGPA. Fifty-five percent of the students who entered the summer bridge program with a HSGPA below 2.00 were males. In addition, the overrepresentation of African American females in higher education has contributed to the gender differences in first year mathematics success at this HBI. Likewise, Aud et al. (2001) pointed out that Black females accounted for 64% of the undergraduate national enrollment in 2008, resulting in gender gaps between Black male and Black female students. However, Harper et al. (2004) argued that Black male students compensate for their grades by interacting socially with faculty members. However, this did not hold true at this HBI as gender differences were reversed and females were more successful in passing the first-year mathematics course than African American males. Previous research indicated that SES was the only input demographic characteristic that significantly impacted students' success in college (Adelman, 1999), but this was not found to be a significant predictor in this study. Inclusion of other input demographic variables such as parents' education and income would be valuable in future studies to examine the full impact of SES on students' success in mathematics.

The study was limited to two environmental variables (academic majors and midterm grades); however, only midterm grades were significant in predicting success in the STEM mathematics course. Academic major made no significant contribution to predicting students' success in the first-year introductory mathematics course in this study. The findings did not corroborate with researchers (Price, 1999; & Thurmond et al., 2003). The significance of midterm grade and its large effect size reinforces the research of Cueso (2004) who found that midterm grades can be used as an effective tool to predict students' performance in final examinations. Midterm grades provide university instructors with useful information to guide intervention and implementation of strategies to assist low performing students. Research using midterm grades as predictors of academic success in colleges and universities is limited. However, midterm grade is the most reliable environmental predictors in this study and should be investigated further.

Limitations of the Study

The results from the study may not be generalizable across other pre-college summer bridge programs because the uniqueness of each program may result in different course-taking choices. Also, the admission requirements for programs differ. In this study, students' admission was based on priority of application. In addition, the study did not compare success of pre-college summer bridge participants with that of non-participants. As a result, it is difficult to indicate if the predictors of success would be similar for both groups of students. The study was also limited to certain input and environmental variables. The inclusion of other environmental variables such as, extra curricula activities, satisfaction with interaction with faculty and staff, teaching styles and climate of the institution could prove to be valuable. It is important for HBIs to collect a wide variety of cognitive and non-cognitive data from first-year undergraduate students as they transition from high schools into postsecondary institutions. This will assist institutions to make informed decisions relating to the success of African American students in HBIs.

Educational Significance

The pre-college summer bridge program is funded by the university; therefore, it is in the best interest of the university to acknowledge the input and environmental factors that are predictive of student success in the introductory mathematics course. The findings revealed that approximately 75% of the students were successful in passing the STEM mathematic gateway course. It is of interest to note that these students entered the program without having the required qualifications. However, they were able to access the resources that the program offered in order to be successful in passing the introductory mathematics course, which is mandatory for students pursuing STEM disciplines. One possible explanation for this relates to the fact that the social and cultural climates on the HBIs under study have contributed to the academic growth and development of Black students (Lee, 2002). These students were exposed to positive role models who provided students the opportunity to succeed. The results from the research can be used to make admissions decisions, implement appropriate interventions and provide academic support for incoming undergraduate students with similar characteristics. Midterm grade was by far the most effective predictor of mathematics success. The findings could be used to enhance the development of future academic programs that will assist low performing students who are in jeopardy of failing. In addition, the university needs to use the findings from this paper to evaluate current strategies for accelerated learning in mathematics in order to expand opportunities for Black students in STEM required fields and HBIs.

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