Contextual Factors that Influence STEM Majors & Standardized Test Scores for Mississippi High School Students

NICHOLAS HILL, CLAFLIN UNIVERSITY
DORIAN WILLIAMS, DILLARD UNIVERSITY
MAURY GRANGER. JACKSON STATE UNIVERSITY

Project Funding

This project is partially funded through a National Science Foundation - Excellence in Research Grant: a joint collaboration between Claflin University, Howard University (PI **Dr. Omari H. Swinton**) and Jackson State University.

Correspondence information:
Nicholas J. Hill, PhD, (Dean)
nhill@claflin.edu

Major Research Question of the Grant

What are the effects of attending an HBCU on graduation?

What are the effects of attending an HBCU on graduating in a STEM discipline?

What are the effects of attending an HBCU on attending graduate school?

Primary Research Focus for Research STEM and SAT takers

Research Question Two: What are the effects of attending an HBCU on graduating in a STEM discipline?

- What are the Factors that influence majoring in Stem for Highschool Students?
- What individual, family and school level contextual factors impact the likelihood of student's performance on standardized tests, specifically the (SAT).
  - (1) internal (Individual);
  - (2) external to the individual with majority of factors at the family level and;
  - (3) external family, majority of school level activities but within the school environment.

- From 2011-2014, four (4) HBCUs were among the Thirteen (13) largest producers of Black baccalaureates in STEM disciplines.
  - Howard - 5th, North Carolina A&T - 7th, Florida A&M - 9th and Spelman - 13th
- From 2011-2014, three (3) HBCUs were leading producers of Black applicants to medical schools.
  - Howard - 1st, Xavier - 2nd and Spelman - 6th

Literature: HBCU and STEM - Investigating the efficiency of the role for HBCUs to produce graduates

Literature: College SAT Test Takers

Correlation between SAT scores, and parental income and education, and race.

- 1 Espenshade and Chung, 2010
- 2 Geiser and Stantelices, 2007
- Hannon, 2015

First Generational College Students & Students in Lower socioeconomic status

- 1 Geiser and Studley , 2002
- 2 Bridgeman and Wendler, 2005
- 3 Choy, 2001

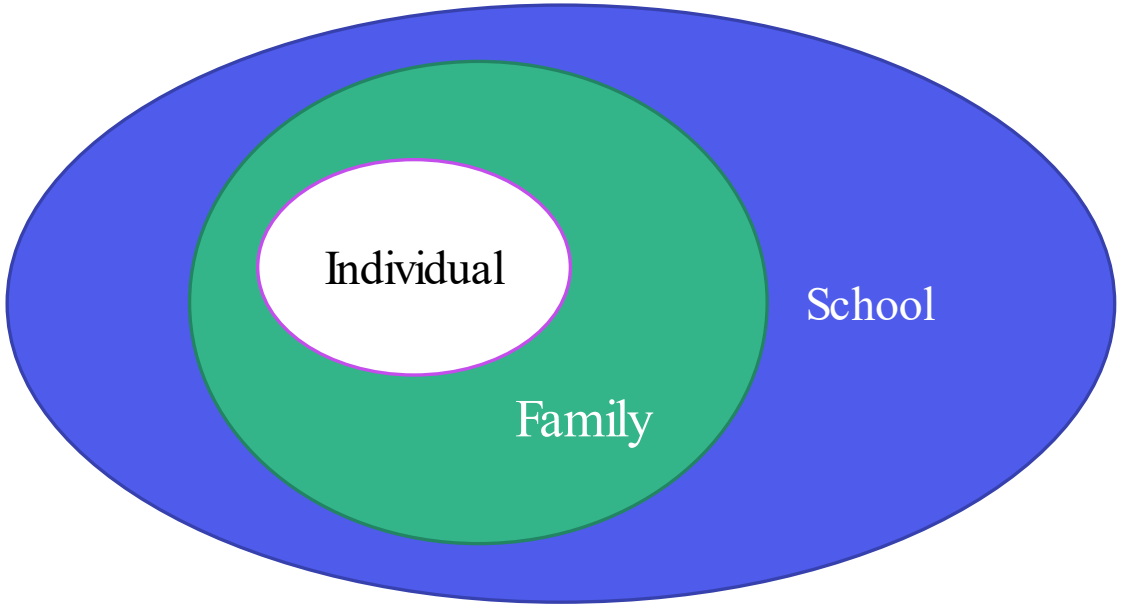
Students' Interest and Motivations for STEM

- Race
  - Although White and Asian males are traditionally well-represented in the STEM fields, White students have the lowest levels of interest in science, in comparison to other racial and ethnic groups, while Asian students have the highest levels of interest (Elliott, Strenta, Adair, Matier, & Scott, 1996).
  - Despite Latino and African American students exhibiting similar and sometimes higher levels of interest in STEM fields than White students, fewer enter into and persist in STEM majors in college (Hurtado, Pryor, Tran, Blake, DeAngelo, & Aragon, 2010)
- Gender
  - Female (White) have lower rates of interest in science than Male (White) (Seymour & Hewitt, 1997)

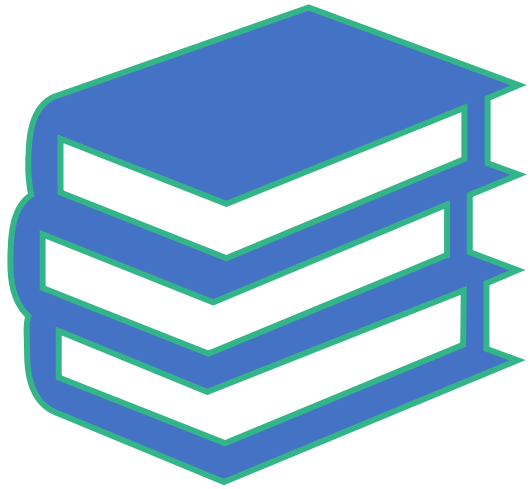
Article Comparison (Lichtenberger & George-Jackson, 2013)

- Male high school students were significantly more likely to have an early interest in STEM relative to their female peers,
- African American high school students had higher interest compared with White students.
- Low-income students were significantly more likely to be interested in STEM majors than higher income students,
- Teacher academic qualifications had a negative but significant relationship with an early interest in STEM, teacher experience had a small but significant positive relationship.
- High school course taking in science and performance on science and math standardized tests were significantly and positively related to an increased interest in STEM.

Contextual Factors that Influence STEM and SAT Scores



Internal – Environmental – External



Data of Mississippi Public Education

Mississippi Public School Enrollment Demographic Data

Ethnicity	2015-16	2016-17	2017-18	2018-19	2019-20
Asian	< 5%	< 5%	1.07%	1.09%	1.11%
African American	51.12%	48.87%	48.54%	48.12%	51.04%
Hispanic or Latino	< 5%	< 5%	3.75%	3.99%	4.23%
American Indian or Alaskan	< 5%	< 5%	0.24%	0.23%	0.24%
White	44.76%	44.35%	44.19%	44.02%	43.72%
Two or More Races	< 5%	< 5%	2.14%	2.49%	2.98%
Native Hawaiian	< 5%	< 5%	0.06%	0.06%	0.07%

Mississippi Public Statewide Assessment in Mathematics and Science by Ethnicity

		Mathematics Proficiency				Science Proficiency		
Ethnicity	2015-16	2016-17	2017-18	2018-19	2015-16	2016-17	2017-18	2018-19
Asian	36.4%	34.0%	34.0%	35.0%	35.0%	37.3%	35.8%	34.5%
African American	**15.6%**	**18.6%**	**25.1%**	**27.3%**	**31.4%**	**35.0%**	**40.7%**	**32.3%**
Hispanic or Latino	27.2%	30.0%	35.0%	32.0%	39.4%	42.0%	43.9%	39.4%
American Indian or Alaskan	34.6%	28.8%	32.6%	35.0%	45.5%	41.8%	46.1%	38.0%
White	34.7%	36.1%	41.0%	45.0%	46.4%	47.6%	47.6%	47.80%
Two or More Races	28.8%	31.1%	35.0%	31.0%	38.8%	44.5%	45.7%	45.0%
Native Hawaiian	22.0%	36.9%	32.6%	35.0%	39.9%	41.2%	36.8%	35.0%

Mississippi Public Universities' enrollment for first-time college attendees majoring in STEM Programs

Institutions	2015-16	2016-17	2017-18	2018-19	2019-20	% of Total
Alcorn State University	246	213	300	256	222	7%
Delta State University	73	69	65	50	63	2%
Jackson State University	486	512	366	327	306	11%
Mississippi State University	1476	1611	1478	1547	1555	42%
Mississippi University for Women	48	57	19	21	12	1%
Mississippi Valley State University	98	113	133	125	117	3%
University of Mississippi	817	879	940	791	643	23%
University of Southern Mississippi	350	361	446	467	404	11%
Total	3594	3815	3747	3584	3322	100%
Mississippi Public HBCUs						**21%**

Mississippi State Board of Education Funding

- In 2018 and 2019, Mississippi State Board of Education (SBE) implemented the K-8 STEM Initiative Enhancement Project Grant.

- In 2019, this grant was given to fifteen (15) Mississippi schools with the intent to establish and/or enhance existing STEM-related programs in Kindergarten through 8th grade.

- Priority will be given to schools implementing engineering, computer science, robotics, and other project-based STEM activities to expand the current Mississippi College and Career Ready framework for math and/or science K-8.

College Board Data Set (ETS)

College Bound Seniors years 2004 to 2007,-Afric
American students only, with the following information:

- SAT scores.
- Student Questionnaire responses,
  - Individual Activities
  - School Activities

Data Description (ETS) Individual Level Data

Variable	Source	Type	Variable Description
STEM	ETS	Dichotomous	A dichotomous variable of whether a student is a STEM major. Is based on the list of majors that the participant selected as their major.
Sex	ETS	Dichotomous	Whether participant identifies as Male (1) or Female (0)
Verbal SAT	ETS	Scale	Continuous variables of the scores on Verbal SAT
Math SAT	ETS	Scale	Continuous variables of the scores on Math SAT
Writing SAT	ETS	Scale	Continuous variables of the scores on Writing SAT
Total SAT	ETS	Scale	Combined Verbal, Math, and Writing SAT scores
GPA	ETS	Ordinal	Participant's Cumulative Grade Point Average: 1 (F, 0.00), 2 (D, 1.33) 3 (D+, 1.33), 4 (C-, 1.67), 5 (C, 2.00), 6 (C+, 2.33), 7 (B-, 2.67), 8 (B, 3.00), 9 (B+, 3.33), 10 (A-, 3.67), (A, 4.00), or (A+, 4.33)

Data Description (ETS) Individual Level Data

Years in English	ETS	Scale	Continuous variable of number of years taken the subject
Years in Math	ETS	Scale	Continuous variable of number of years taken the subject
Years in Science	ETS	Scale	Continuous variable of number of years taken the subject
Honors Course	ETS	Dichotomous	Whether participant took a STEM subject honors course
Student Help	ETS	Dichotomous	Whether participant needs help with study skills
Degree Goal	ETS	Nominal	What are the degree goals for the student 1 (Certificate) to 5 (Doctoral)
4yr College	ETS	Dichotomous	Whether participant wants to attend a 4-year college
2yr College	ETS	Dichotomous	Whether participant wants to attend a 2-year college
*College Years Preference	ETS	Dichotomous	Whether participant states a 2-year or 4-year preference
Certain about Major	ETS	Nominal	Whether participant is certain about their major 1 (Not Certain), 2 (Fairly Certain), or 3 (Very Certain)

Data Description (ETS) Family Level Data

Variable	Source	Type	Variable Description
Family Income	SAT	Ordinal	Combined family income: 1 (<10K), 2 (10K-15K), 3 (15K-20K), 4 (20K-25K), 5 (25K-30K), 6 (30K-35K), 7 (35K-40K), 8 (40K-50K), 9 (50K-60K), 10 (60K-70K), 11 (70K-80K), 12 (80K-100K), or 13 (>100K)
Financial Aid	SAT	Nominal	Whether participant intends to receive financial aid: 1 (Do not know), 2 (No), or 3 (Yes)
Work a Job in College	SAT	Nominal	Whether participant intends to work in college: 1 (Do not know), 2 (No) or 3 (Yes)
Parents Education	SAT	Nominal	Highest level of parents' education: 1 (Grade School), 2 (Some High School), 3 (High School Diploma), 4 (Business School), 5 (Some College), 6 (Associate Degree), 7 (Bachelors Degree), 8 (Some Graduate), or 9 (Graduate School)

Data Description (ETS)
School Level Data

Variable	Source	Type	Variable Description
Sports Participation	SAT	Dichotomous	Whether participant was involved in a sport (36 options) during high school
Arts/Music Participation	SAT	Dichotomous	Whether participant was involved in arts, music instrument or vocal during high school

Descriptive Statistics of Sample

	Full sample	STEM	Non-STEM
STEM	0.27		
SEX	0.42	0.35	0.44
SAT Reading	432.8	429.9	434.4
SAT Math	429.6	427.5	430.9
SAT Writing	426.4	428.6	426.4
GPA	7.98	8.09	7.96
Honors	0.27	0.3	0.27
Number of Years in English	3.8	3.79	3.8
Number of Years in Math	3.69	3.7	3.69
Number of Years in Science	3.31	3.34	3.3
Study Help	0.42	0.45	0.42
Degree Goal	4.02	4.1	4
College 4-Year	0.9	0.92	0.9
College 2-Year	0.11	0.13	0.11
College 2&4 Year	0.93	0.95	0.92
Certain about Major	2.41	2.48	2.38
Family Income	6.22	5.71	6.34
Financial Aid	2.74	2.76	2.74
Work in College	2.51	2.55	2.5
Parents Education	5.62	5.49	5.65
Sports	0.66	0.65	0.66
Arts and Music Activities	0.8	0.82	0.8
N	558583	145006	385606

Estimated Model

A Logistic Regression is utilized for this study and is consistent with the works of Lichtenberger & George-Jackson, 2013. It tests what factors are important to Black students interested in going into STEM.

$$\text{Stem} = f(\text{Individual, Family, School})$$

An Ordinary Least Squared (OLS) model is utilized for this study to examine what contextual factors influence the scores seen on the SAT test for Black Students.

$$\text{SAT Scores} = f(\text{Individual, Family, School})$$

Comparison of Research Article results for majoring in STEM

SAT Variable (DV STEM)	SAT Odds Ratio	ACT Odds Ratio	ACT Variable (DV STEM)
Sex	.0791***	1.302***	Gender: Male
Writing SAT	0.994***	0.966***	ACT English
Math SAT	1.009***	1.033***	ACT Math
Verbal SAT	0.995***	0.982***	ACT Reading
GPA	**1.027*** **	**0.945**	***HS GPA (Average of 3 categories)**
Number of Years in English	0.943***	0.887***	Semesters of English
Number of Years in Math	**1.036*** **	**1.016**	**Semesters of Math**
Number of Years in Science	1.114***	1.198***	Semesters of Science
Study Help	**1.015**	**0.942***	**Need Study Help**
Degree Goal	**1.046*** **	**0.597*** **	**Highest Expected Degree (Average of 2 categories)**
College Years Preference	**0.936*** **	**1.456*** **	**College Pref. Voc/.Tech/4yr**
Certain about Major	1.115***	1.192***	Field of Study
Financial Aid	**0.947*** **	**0.982**	**Expected to Received Aid**
Work a Job in College	**1.004*** **	**1.040**	**Expected to Work During College**

Factors that Influence SAT Scores

	SAT Total	Verbal SAT	Math SAT	Writing SAT
Sex	1.568***	0.351***	2.463***	-0.999***
GPA	3.506***	1.060***	1.227***	1.201***
Honors	14.259***	4.747***	5.324***	4.263***
Number of Years in English	-0.05	0.072**	-0.807***	0.276***
Number of Years in Math	2.596***	0.573***	1.700***	0.459***
Number of Years in Science	2.179***	0.873***	0.732***	0.693***
Study Help	-1.731***	-0.906***	-0.464***	-0.560***
Degree Goal	1.660***	0.543***	0.489***	0.541***
College Preference	4.406***	1.526***	1.051***	1.679***
Certain about Major	-3.744***	-1.116***	-1.117***	-1.134***
Family Income	0.960***	0.377***	0.302***	0.334***
Financial Aid	0.241**	0.313***	0.046*	0.114***
Work in College	0.121*	0.070***	-0.058***	0.038
Parents Education	1.726***	0.670***	0.501***	0.602***
Sports	-1.568***	-0.814***	0.158***	-0.607***
Arts and Music Activities	2.389***	0.876***	0.291***	1.073***
Constant	61.292***	20.112***	19.810***	20.189***
N	129459	299131	299131	129459

Conclusion - Factors that Mississippi Schools should consider for Black Students

1. STEM Factors
    1. Schools should consider the impact of activities and programs that emphasize Stem Achievement, this includes honors and AP courses.
    2. Schools should consider increasing exposure to academic counseling specializing in career paths.
2. Factors that Effect SAT Scores
    1. Schools should provide increased academic counseling earlier for students to enroll in more math and science courses. (Career Pathway Initiatives)
    2. School emphasis on the Arts should be encouraged for this student population.

Questions and Suggest Feedback for Consideration