Research article

Edward C. Fletcher, Jr.* and Amber D. Dumford

Black high school STEM academy student engagement and their access to accelerated coursework

https://doi.org/10.1515/mlt-2025-0001
Received January 5, 2025; accepted April 21, 2025; published online August 25, 2025

Abstract: The purpose of this study was to examine whether high school STEM academy students were more engaged in school in terms of behavioral, cognitive, and emotional engagement, compared to non-academy students. The school highlighted in this study is predominately Black in terms of student population and school personnel; it also houses an academy of engineering. We found that academy students engaged in accelerated coursework and internships at a significantly higher level. Academy students also had significantly higher levels of behavioral, cognitive, and emotional engagement compared to non-academy students. Findings highlight the positive association between academy student participation and higher levels of engagement characterized by their academic and social involvement as well as connectedness to their school.

Keywords: career academy; black high school students; ethnic matching; student engagement

There remain disparities in graduation rates across ethnic and racial backgrounds of high school students. Black students have a national graduation rate of 80 % compared to the overall national average of 86 % across learners from all ethnic and racial backgrounds. The graduation rate for white students is 89 % and 93 % for Asian/Pacific Islanders (Irwin et al. 2022). For many Black students, the contributing factors in their decisions to drop out of high school may stem from not connecting their learning with their career interests as well as the high school curricula being culturally irrelevant. This oftentimes leads to disengagement and lower motivation

***Corresponding author: Edward C. Fletcher, Jr.**, Educational Studies, The Ohio State University, A456 PAES Building 305 Annie and John Glenn Ave, 43210-1132, Columbus, OH, USA,
E-mail: fletcher.158@osu.edu
Amber D. Dumford, Department of Leadership, Policy, and Lifelong Learning, University of South Florida, Tampa, FL, USA

to learn. As a result, dropouts are more likely to encounter health issues, be involved in criminal incidences, depend more on social services, become unemployed, and become incarcerated (Christenson et al. 2001).

Yet, scholars have argued that Black students are often disengaged in high school because they oftentimes do not have access to accelerated learning opportunities (e.g., AP, dual enrollment, International Baccalaureate - IB) (Fletcher 2022; Fletcher and Cox 2012; Fletcher et al. 2018). STEM themed schools and academies have been developed and implemented by school leaders across the country to address the disengagement of students as well as to broaden the pipeline of STEM participants for Black students and other ethnically and racially diverse learners (Fletcher et al. 2020; Lynch et al. 2017). STEM academies, for example, offer students with opportunities to engage in programs of study that feature small learning communities that focus on a career theme (e.g., Engineering, Information Technology) of interest to the student along with a college-preparatory curriculum (e.g., AP, dual enrollment). They also require partnerships with employers and postsecondary education representatives (Castellano et al. 2007; Kemple and Snipes 2000) to support student opportunities (e.g., work-based learning activities such as internships) centered on the career theme.

Using a qualitative approach, Fletcher and Cox (2012) found that high school STEM academies promoted Black students' engagement because of the hands-on nature of the curricula, the college readiness activities they participated in, the meaningfulness of the curricula, and a heightened understanding of core academic subjects. These findings provide some evidence of the potential of implementing career academies as a source to strengthen the engagement of Black students in high school. Yet, there have not been quantitative studies that shed further light on this possibility. There is a paucity of studies not based on deficit theories, perspectives, and frameworks. Thus, it is critical to uncover factors contributing to the high performance and resiliency of Black students in school (Iruka et al. 2014); these narratives are rarely discussed, and related research is scant (Fletcher 2014). Even further, there are limited studies that capture the academic experiences of Black students in high school STEM academies (Fletcher and Carroll 2024). To that end, the purpose of this study was to examine whether academy students were more engaged in school in terms of behavioral (e.g., participating in co-curricular and extra-curricular activities), cognitive (e.g., motivation and investment in learning), and emotional (e.g., sense of belonging and safety) engagement. The school in this study is predominately Black in terms of student population and school stakeholders (e.g., school administrators and teachers) and houses an academy of engineering. Using this school as a site of inquiry, we examined whether students who participated in an academy of engineering had significantly higher levels of student engagement (behavioral, cognitive, and emotional) compared to non-academy students.

1 Research questions

(1) What are the student characteristics, academic performance, accelerated coursework, and internship participation of academy and non-academy students?
(2) Is there a statistically significant difference between academy and non-academy students in behavioral engagement, controlling for student demographics, academic performance, accelerated coursework, and internship participation?
(3) Is there a statistically significant difference between academy and non-academy students in cognitive engagement, controlling for student demographics, academic performance, accelerated coursework, and internship participation?
(4) Is there a statistically significant difference between academy and non-academy students in emotional engagement, controlling for student demographics, academic performance, accelerated coursework, and internship participation?

2 Review of the literature

2.1 Black students' access to accelerated coursework

Systemic racism in the United States has created a myriad of challenges for Black students (Danforth and Miller 2018) as the educational system functions as a larger microcosm of society. As a result, many Black students have negative high school experiences based on a variety of issues, including: participating in schools that lack needed educational resources; being victimized by disproportionate disciplinary actions; lacking access to highly qualified educators; and encountering negative interactions with staff at school (84 % of whom are white) who oftentimes fail to provide them with culturally responsive approaches (Brown et al. 2019; Wright 2019).

Black students oftentimes are not afforded access to accelerated learning opportunities (e.g., AP, dual enrollment, gifted, honors, IB) as well as advanced STEM courses and work-based learning activities (e.g., internships). Kuh (2008) coined the phrase of high-impact, work-based learning and described them as activities which students "invest substantial time and energy to educationally purposeful tasks, interact frequently with their teachers and peers, get feedback often, and apply what they are learning." (p. xi). Many gifted and talented education researchers have argued against definitions and theories of giftedness and biased tests, checklists, policies, procedures, and practices that contribute to the persistent underrepresentation of Black students in accelerated learning. For example, current definitions of giftedness continue to place major emphasis on standardized intelligence tests

reflective of white middle-class values and, therefore, discriminate against students of color who do not necessarily embrace such values; this results in untapped potential (Ford 2013; Wright et al. 2017). Identifying gifted and talented as well as placing barriers for accelerated learning options based on narrow standards that reflect, represent, and enforce the languages, literacies, and cultural practices of the status quo are bound to exacerbate the notion that what Black students learn in their homes and communities are irrelevant for school, substandard, and inferior. This practice of ranking and sorting students based on their skills to think, speak, and act in ways that represent white students undermines the cultural strengths, assets, and ethnic capital of ethnically and racially diverse students – what Yosso (2005) termed cultural community wealth. The education of Black students is often compromised, which gives little opportunity for their gifts and talents to be recognized and cultivated at school. Issues of institutional racism, white supremacy, and white privilege compound to prioritize white knowledge, skills, language, and dispositions within school contexts while discounting what is learned in non-dominant student home environments (Fruchter et al. 2019). These inequities have contributed vast opportunity gaps between Black and white students, and are perpetuated with colorblind mindsets of many school personnel (Joseph et al. 2019).

2.2 Ethnic matching and its impact on black students

Many schools have large percentages of Black student populations, but the ethnic and racial backgrounds of their students are not reflected in their school personnel; this often creates a cultural disconnect or mismatch (Achinstein and Aguirre 2008). Fenwick (2022) discussed the after effects of the historic and legendary *Brown* vs. *Board of Education* decision, explaining how inequities persist as the country has not fully integrated schools. This has resulted in replacing higher proportions of white teachers and school administrators in schools at the expense of Black school educators and school leaders. Within that context, white educators sometimes possess inherent biases and, consequently, provide preferential treatment to white students with whom they share cultural backgrounds, identities, languages, and norms (Danforth and Miller 2018; Johnson and Sondergeld 2020). Researchers have demonstrated that ethnic matching promotes positive school outcomes for Black students and other ethnically and racially diverse learners (Achinstein and Aguirre 2008; Dee 2004; Easton-Brooks 2014; Eddy and Easton-Brooks 2011). Ethnic matching is a term used to describe the practice of having school staff who offer learning opportunities that are more culturally congruent, compatible, responsive, or synchronized with students' home cultures (Achinstein and Aguirre 2008). Researchers (Dee 2004; Easton-Brooks 2014; Eddy and Easton-Brooks 2011) noted that students "when matched with a teacher of the

same ethnicity…ethnic minority students performed higher on academic achievement tests than those ethnic minority students who are not taught by ethnic minority teachers" (Easton-Brooks 2014, p. 101). The culturally matched school staff can then serve as positive role models for their students. According to Achinstein and Aguirre (2008):

> Previous research reports that such a match may promote positive relationships and role models, support students in crossing cultural and linguistic boundaries in school, foster culturally relevant teaching for diverse students' learning, and ease the professional's transition to working in high-minority urban schools. (p. 1506)

Black youth positively benefit from the social support and encouragement they receive from their ethnically matched teachers and school staff members (Brooms 2019; Ladson-Billings 2005).

2.3 Black students' experiences and engagement in STEM academies

Fletcher et al. (2023) examined the supports provided in a high school STEM academy targeted at Black boys. This school's teachers were majority White while the student population was majority Black. Utilizing the frameworks of ethnic matching and culturally responsive instruction and leadership, they found that Black boys who participated in an academy of engineering had enhanced learning experiences because of the caring adults and role models. These school stakeholders taught them navigational life skills. Yet, the school stakeholders were not able to identify targeted supports specifically for Black boys in the academy of engineering that were culturally responsive to their needs. In addition, Fletcher et al. (2023) found barriers to promoting a sense of belonging because of the cultural mismatch between school educators and learners as well as mathematics being used as a gatekeeper for access to the academy by Black students (Fletcher et al. 2023).

2.4 Research on the impact of student participation in STEM academies

Past researchers have identified the career academy as one of the most promising models for enhancing student engagement and facilitating career pursuits (Fletcher et al. 2020; Malcom and Feder 2016; Means et al. 2016). Researchers found that participation in career academies resulted in increased student engagement, attendance, graduation rates, academic achievement, and long-term employment

earnings (Hemelt et al. 2019; Kemple 2008). For example, Hemelt et al. (2019) used an experimental research design through a lottery system. They found that academy students were 8 % more likely than their non-academy counterparts to graduate high school and were significantly more likely to have better school attendance rates. Even further, Fletcher and Cox (2012) found that students who participated in a career academy had increased interpersonal relations and supports from their peers and teachers, enhanced engagement based on their interest in the career themed content, and an elevated sense of belonging in school given the smaller learning community element of the academy model.

2.5 Theoretical framework: student engagement

Researchers have defined the construct of student engagement as the psychological investment and effort that learners exert toward their schooling experience and desired school outcomes, their active and participatory involvement in the learning process and toward school activities, and students' emotions and connectedness to their schools (Boekaerts 2016; Kuh 2001, 2003, 2009; Marks 2000; Newmann et al. 1992; Yazzie-Mintz 2007). Student engagement was constructed based on social cognitive theory: individual's emotions that relate to their attachment to an organization and sense of belonging. Researchers have found that increased student engagement contributes to their persistence in school and disengagement can lead to students dropping out (Appleton et al. 2008; Archambault et al. 2009; Christenson et al. 2001; Finn 1989; Rumberger and Lamb 2003; Tinto 1975; Wehlage et al. 1989). Astin (1984) developed a "theory of involvement," which emphasized students' psychological and behavioral components of time on task and quality of effort as well as various attitudinal and developmental outcomes – persistence and student achievement (Astin 1993, 1977).

The commitment and goals that students develop in school relate to their academic and social experiences in school. Students who have negative experiences are more likely to dropout. Hence, the motivational and behavioral aspects of students' experiences contribute to decisions to dropout of school (Archambault et al. 2009; Christenson et al. 2001; Finn 2006). Appleton et al. (2008) described, "if dropping out involves a gradual process of disengagement from school, school completion is presumably facilitated by continued, if not increasing, engagement over a student's time in school" (p. 381).

In our research project, we operationalized the construct of student engagement, derived from Indiana University's Center for Evaluation, Policy and Education Research, as encompassing three domains: behavioral engagement (students' participation in co-curricular and extracurricular activities as well as their interactions with

adults in and out of school), cognitive engagement (students' motivation and investment in learning), and emotional engagement (students' sense of belonging and safety) (Yazzie-Mintz 2007). Researchers have found significant differences in engagement based on various student demographics (Yazzie-Mintz 2007). Yazzie-Mintz (2007) found gender to be a significant contributor to student engagement with males and ethnically and racially diverse learners (excluding Asian students), those who come from economically disadvantaged backgrounds, and learners who participate in special education programs being less likely to be engaged in school. Further, Yazzie-Mintz (2007) found that 75 % of students indicated that they were bored in class because of a lack of interesting curricular materials. The concept of student engagement has been of interest to researchers as it can be malleable when school personnel and educators are responsive to students by modifying their practices (Appleton et al. 2008).

3 Methods

3.1 Research design

For this study, we used a correlational research approach. Our data source was from the high school survey of student engagement instrument (Fletcher et al. 2020; Yazzie-Mintz 2007). We utilized exploratory factor analysis as our data reduction technique. We also presented descriptive statistics to represent the demographic characteristics of student respondents as well as multiple regression to respond to research questions two through four.

3.2 Data collection procedures

We were granted IRB approval to conduct our study. We utilized the services of the assistant principal at the research site (school) to assist with student participation in the survey. We obtained informed consent for students who were 18 years of age and older and assent for those who were younger than 18 years of age. We also secured a waiver from IRB to obtain parental permission. Students in the school who were in 9th through 12th grades were eligible to complete the survey. The survey was administered electronically through Qualtrics. Survey completion was approximately 10–15 min in duration. Students who finished the entire survey were sent $25 electronic gift cards for Amazon.

3.3 Selection criteria

We used purposive sampling as we selected Stanton Academy (pseudonym) because it housed a distinguished NAF (formerly known as the National Academy Foundation) academy of engineering. Its student demographics were: 99 % Black and 95 % of the student population came from economically disadvantaged backgrounds. We selected Stanton Academy because the academy has high fidelity to the NAF academy model and because of the large percentage of Black students and school personnel.

3.4 Stanton academy

Demographics. Stanton Academy is located in the city of Stanton (population of approximately 124,000) which is 55 % white, 37 % African American/Black, 4 % Latinx, and 3 % Asian. The median income was approximately $42,000, and 19 % of the community members lived below the poverty line. The city of Stanton was home to a historically black college and university.

The Stanton Engineering Academy is a public, comprehensive high school with a distinguished NAF academy embedded within it. It is in an urban area within the Southeastern region of the United States. Stanton Academy was comprised of approximately 1,263 students and 71 teachers (who were majority Black). In terms of gender, 51 % of students were female and 49 % were male. Concerning ethnic and racial background, 99 % of students were Black and 1 % were Latinx. Ninety-five percent of students qualified for free and/or reduced lunch. The graduation rate was 81 %. Stanton Academy used an inclusive, open admissions application system for student participation in the academy.

3.5 NAF

Stanton Academy's academy of engineering is affiliated with the NAF organization. NAF is a non-profit organization that assists schools with building academies, and provides professional development, technical assistance, and career-themed curricula. NAF was established in 1982 and currently has over 600 academies that serve over 100,000 students across the country. The NAF academy model emphasizes four elements. The first element of academy development and structure centers on schools creating smaller learning communities utilizing student cohorts. The second element focuses on integrated curriculum and instruction where the course content has career and core academic instruction undergirded in a career theme (e.g., engineering and IT). A third element is the focus on creating advisory boards made-up

of business and industry and postsecondary representatives to ensure the curriculum is locally relevant and supported. A fourth element is the focus on adding work-based learning activities to promote career awareness and exploration activities in ninth (e.g., field trips) and tenth (e.g., job shadowing) grades, and experiential opportunities (e.g., industry certifications, paid internships) in 11th and 12th grades. NAF also implements quality review visits continually to assess and evaluate the level of implementation of its schools' academies.

3.6 Survey dimensions

To measure engagement, we used a multi-dimensional construct. We focused on: (a) behavioral engagement, which measured students' effort, continuation, and concentration on their studies as well as their levels of participation in school; (b) emotional engagement, which measured students' affective reactions to their schooling environment, including the academy spaces, teachers, administrators, and peers; and (c) cognitive engagement, which measured their commitment, investment, and challenge in the learning process (Fredericks et al. 2004). Demographic questions were also included.

The survey for this study was based on the high school survey of student engagement and previous studies conducted by the researchers (Fletcher et al. 2020). From the previous study, both exploratory and confirmatory factor analyses were used to develop the scales also used in the current study. Overall, fit indices, factor correlations, and individual item factor loadings provided sufficient construct validity evidence for the three scales (Fletcher et al. 2020). To reduce the survey burden and give the researchers the ability to add a new dimension (impact of COVID) and expand on others (bullying and career/college readiness activities), we removed a few items from the engagement dimensions based on fit within the scales (lowest factor loadings) and items that were repetitive (some questions were very similar). The reliabilities of these slightly changed scales are reported in the following sections.

Behavioral engagement. The behavioral engagement scale was comprised of nine items: four items on a 4-point rating scale (1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*); four items on a 4-point rating scale (1 = *0–1 h*, 2 = *2–3 h*, 3 = *4–7 h*, 4 = *8 h or more*); and one item on a 4-point rating scale (1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Agree*, and 4 = *Strong agree*). Behavioral engagement assessed the participation of students in extracurricular activities or work in and outside of school/class (e.g., working for pay; doing volunteer work; working on a paper or project that required you to interact with people outside of school (for interviews, observations, etc.) and frequency of interactions with adults (e.g., discussed ideas from readings or classes

with teacher outside of class; talked to an adult in school about how to apply to college; talked to an adult in school about career goals), and how much they go to school to participate in athletics. The internal consistency was (α = 0.67).

Cognitive engagement. The cognitive engagement construct was comprised of 10 items: nine on a 4-point rating scale (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly Agree*) and one item on a 4-point scale (1 = *None*, 2 = *Some*, 3 = *Most*, 4 = *All*). Cognitive engagement assessed the academic effort of students in and outside of school (e.g., I put forth a great deal of effort when doing my school work; In how many classes do you give your maximum effort?), achievement motivation (e.g., I am motivated by the desire to get good grades; I am motivated by my desire to learn), and classroom behaviors (e.g., I go to school because of what I learn in class; I put forth a great deal of effort when doing my school work). The internal consistency for this scale was (α = 0.92).

Emotional engagement. The emotional engagement construct was comprised of 10 items on a 4-point rating scale (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly Agree*). Emotional engagement referred to a student's sense of belonging within the school (e.g., Overall, I feel good about being in this school/academy; I am an important part of my school/academy community) relations with others, such as teachers, counselors, peers and other adults (e.g., I feel supported by my teachers; I feel supported by administrators (principal, assistant/vice principal)), and a sense of safety at school (i.e., I feel safe in this school/academy). The internal consistency was (α = 0.91).

3.7 Data analysis

To answer the first research question (*What are the student characteristics, academic performance, dual enrollment, and internship participation of academy and non-academy students?)*, we compared group differences using *t*-tests (for continuous variables) and chi-squared analyses (for categorical variables) on key student characteristics (gender, race/ethnicity, eligibility for free or reduced-price lunch, and grade level), academic performance (GPA), dual enrollment, and internship participation.

For research questions two through four, we first compared group differences using *t*-tests on the three areas of engagement (behavioral, cognitive, and emotional). In addition, we produced a series of three ordinary least squares regression models to determine if differences exist between academy students and their non-academy counterparts, within the three areas of engagement. The

independent variables included five student demographic variables (gender, ethnic and racial backgrounds, free/reduced lunch, grade in school, and primary language spoken at home), academic performance (GPA), dual enrollment, and internship participation. All categorical independent variables were dummy-coded prior to entry in the model.

4 Results

The final analytical sample included 172 students. Of those students, 100 identified as non-academy students (58.1 %) and 72 as academy students (41.9 %). The demographics, academic achievement, and engagement of these students are described in the following subsection. Additionally, the results from all statistical analyses will be discussed. Finally, we will explore the results in relation to the four research questions (Table 1).

Table 1: Summary of participants' demographic background by academy participation.

	Academy (N = 72)	Non-academy (N = 100)	χ^2	*p-Value*
Gender			2.97	NS
Female	58.3 %	63.0 %		
Male	38.9 %	37.0 %		
Nonconforming	2.8 %	0.0 %		
Ethnic and racial background				
AmerInd/Alaskan	0.0 %	1.0 %	4.44	NS
Asian or Asian American	0.0 %	1.0 %		
African American/Black	91.7 %	88.0 %		
Hawaiian/Pacific Islander	0.0 %	0.0 %		
Latinx	0.0 %	2.0 %		
White	2.8 %	1.0 %		
Multi-racial	5.6 %	6.0 %		
Other	0.0 %	1.0 %		
Grade level			5.25	NS
9th	12.5 %	17.0 %		
10th	18.1 %	9.0 %		
11th	19.4 %	13.0 %		
12th	50.0 %	61.0 %		
Free/reduced price lunch			1.27	NS
No	9.7 %	6.0 %		
Yes	72.2 %	71.0 %		
Don't know	18.1 %	23.0 %		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; NS = Non-statistically significant.

4.1 Student demographics

We provide a comparison of the demographic characteristics of academy and non-academy students in Table 2. There were no statistically significant differences between the two groups for the characteristics considered (gender, race/ethnicity, grade, and free/reduced lunch status). Females were the majority of respondents for both groups (58.3 % and 63.0 %, respectively). In addition, the vast majority of both academy (91.7 %) and non-academy students (88.0 %) were African American/Black. Thus, there is some discrepancy in the self-reported data from the participants and the overall demographics of Stanton Academy: 99 % Black and 1 % Latinx. Finally, over half of the respondents in both groups were in the 12th grade and were eligible for free/reduced-price lunch.

4.2 Academic performance and engagement

When compared to non-academy students, the academy students had higher GPAs (M = 3.38 and M = 3.06, respectively), participated in more acceleration coursework (AP (81 % and 60 %, respectively), dual enrollment (63 % and 42 % respectively), and IB (44 % and 28 %, respectively)), and were more likely to complete an internship (60 % and 39 %, respectively). With the exception of earning an industry credit, all of these differences were statistically significant. The effect sizes of the statistically significant differences also all suggest nontrivial differences and would be considered medium effect sizes by Cohen's standards (Cohen 1988). For full details, see Table 2.

Academy students had higher levels of engagement on all three scales when compared to their non-academy peers: behavioral engagement (M = 2.62 and M = 2.31, respectively), cognitive engagement (M = 3.22 and M = 2.92, respectively), and

Table 2: Summary of *T*-tests and effect sizes comparing academy students with non-academy students on academic achievement (GPA), acceleration coursework participation, and internship completion.

	Academy (N = 72)	Non-academy (N = 100)	*t*	Effect size *d*
GPA	3.38	3.06	2.92**	0.454
Advanced placement	0.81	0.60	2.97**	0.460
Dual enrollment	0.63	0.42	2.71**	0.420
International Bac. (IB)	0.44	0.28	2.26*	0.352
Industry certification	0.50	0.46	0.45	0.072
Internship	0.60	0.39	2.76**	0.432

*p < 0.05; **p < 0.01; ***p < 0.001.

emotional engagement (M = 3.05 and M = 2.08, respectively). These differences were all statistically significant and the effect sizes of these differences also all suggest nontrivial differences and would be considered medium (Cohen 1988). See Table 3 for more details. While these are substantial differences, caution must be taken because these results do not control for the differences in academic performance of those students who chose to participate in an academy and those who do not. The next analyses, linear regression models, will control for at least a part of this with student GPA.

The results from the regression models indicated that participation in an academy influences high school students' engagement, even after controlling for student gender, ethnic and racial backgrounds, free/reduced lunch eligibility, grade in school, academic performance (GPA), acceleration coursework participation, and internship completion. Statistically significant differences were found in all three of the three engagement indicators (cognitive, behavioral, and emotional). Those students participating in an academy reported higher levels of cognitive engagement (β = 0.203; p < 0.01), behavioral engagement (β = 0.213; p < 0.01), and emotional engagement (β = 0.180; p < 0.05), than their non-academy counterparts.

Individual statistically significant beta weights for all variables in the three models are reported in Table 4. In addition, the variance explained for each model is listed. The predictor variables accounted for 17.4–27.2 % of the total variance on the engagement indicators. The Variance Inflation Factor (VIF) values for each predictor variable in these regression models were all well below 5 (ranging from 1.0 to 3.8), suggesting that multicollinearity was not an issue in the models (Field 2009). Because the vast majority of students reported their race/ethnicity as Black or African American, there were few cases in the other seven categories, and thus, all seven were collapsed into one for the regression analyses.

Response to Research Question 1: What are the student characteristics, academic performance, accelerated coursework, and internship participation of academy and non-academy students?

There were no statistically significant differences between academy and non-academy students in our sample for the characteristics considered (gender, race/ethnicity, grade, and free/reduced lunch status). Academy students reported

Table 3: Summary of T-tests and Effect Sizes Comparing Academy Students with Non-Academy Students on Engagement.

	Academy (N = 72)	Non-academy (N = 100)	t	Effect size d
Behavioral	2.62	2.31	4.08***	0.632
Cognitive	3.22	2.92	3.28***	0.507
Emotional	3.05	2.80	2.83**	0.438

*p < 0.05; **p < 0.01; ***p < 0.001.

Table 4: OLS regression models for three engagement scales.

	Behavioral engagement		Cognitive engagement		Emotional engagement	
	β (beta)	*p-Value* (Probability value)	*β (beta)*	*p-Value* (Probability value),	*β (beta)*	*p-Value* (Probability value)
School[a]						
Academy	0.213	**	0.203	**	0.180	*
Gender[b]						
Female	−0.047		0.077		0.045	
Nonconforming	−0.031		−0.233	**	−0.264	***
Grade[c]						
10th	−0.074		−0.182		−0.095	
11th	0.055		−0.118		−0.096	
12th	0.173		−0.074		−0.106	
Ethnicity/ Race[d]						
Black	0.087		0.056		−0.009	
Free/Reduced price Lunch[e]						
Yes	−0.123		−0.205		0.248	
Don't know	−0.115		−0.214		0.223	
Academic achievement						
GPA	0.176	*	0.208	**	0.126	
Accelerated coursework participation[e]						
AP	−0.109		0.091		0.153	
Dual enrollment	−0.030		−0.024		−0.028	
IB	0.289	**	0.006		0.053	
Industry Cert.	−0.086		−0.107		−0.096	
Internship participation[e]						
Yes	0.141		0.074		0.048	
R^2	**0.272*** **		**0.213** **		**0.174***	

[a]Reference group: Non-Academy. [b]Reference group: Male. [c]Reference group: 9th. [d]Reference group: white, American Indian/Alaskan Native, Hawaiian/Pacific Islander, Asian, Latinx, Multi-Racial, and Other combined. [e]Reference group: No. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

significantly higher levels of academic achievement (GPA) and participation in Advanced Placement (AP), dual enrollment, International Baccalaureate (IB), and internships than their non-academy peers.

Response to Research Question 2: Is there a statistically significant difference between academy and non-academy students in behavioral engagement, controlling for student demographics, academic performance, accelerated coursework, and internship participation?

For behavioral engagement, academy students reported significantly higher levels of behavioral engagement than their non-academy counterparts (β = 0.213; $p < 0.01$), even after controlling for student demographics, academic performance, acceleration coursework, and participation in an internship. In addition, academic performance was positively related to behavioral engagement ($\beta = 0.176$; $p < 0.05$) and students who earned an industry certification reported higher levels of behavioral engagement with the school/academy overall (β = 0.289; $p < 0.01$).

Response to Research Question 3: Is there a statistically significant difference between academy and non-academy students in cognitive engagement, controlling for student demographics, academic performance, accelerated coursework, and internship participation?

For cognitive engagement, academy students reported significantly higher levels of cognitive engagement than their non-academy counterparts (β = 0.203; $p < 0.01$), even after controlling for the other student characteristics and activities. In addition, gender nonconforming students (β = –0.233; $p < 0.01$) reported lower levels of cognitive engagement than their male peers. Finally, students' academic performance was positively related to cognitive engagement (β = 0.208; $p < 0.01$).

Response to Research Question 4: Is there a statistically significant difference between academy and non-academy students in emotional engagement, controlling for student demographics, academic performance, accelerated coursework, and internship participation?

For emotional engagement, academy students reported higher levels of emotional engagement than their non-academy peers ($\beta = 0.180$; $p < 0.05$), even after controlling for student demographics, academic performance, acceleration coursework, and internship participation. Additionally, gender nonconforming (β = –0.264; $p < 0.001$) indicated lower emotional engagement than their male peers.

5 Discussion

Given the disparities in graduation rates for Black students and their Asian/Pacific Islanders and white counterparts (Irwin et al. 2022), there is a heightened importance for implementing educational initiatives and strategies that will engage Black students in school and help prevent them from dropping out of high school. In this study, we found that students in a high school STEM academy were significantly more likely to have higher behavioral, cognitive, and emotional engagement in school, compared to non-academy students. Even further, academy students had significantly higher GPAs, involvement in accelerated coursework (e.g., AP, dual enrollment, IB), and completion of internships. It is also important to highlight that academy and non-

academy students did not significantly differ in their demographics (e.g., ethnic/racial background, gender, socioeconomic status).

The finding that academy students were significantly more likely to be behaviorally engaged emphasizes that academy students at Stanton Academy reported higher levels of participation in co-curricular and extracurricular activities as well as their interactions with adults who are internal and external to the school for their own individual development (Fredericks et al. 2004; Mahoney and Cairns 1997; Posner and Vandell 1999). According to Finn (2006), students who have higher levels of behavioral engagement are significantly more likely to have higher academic achievement in core academic subject areas as well as significantly more likely to persist in completing their academic coursework. In fact, Hemelt et al. (2019) found that academy students were more likely to have higher attendance and graduation rates. Within the context of this study, it is also quite feasible that students who are more motivated to achieve in school are more likely to seek out opportunities to elevate their learning and thereby enroll in the academy to experience the educational activities that the academy has to offer as well as challenge themselves to take part in accelerated nature of the academy curriculum. On that note, heightened and frequent interaction with adult role models by way of the advisory board and work-based learning activities (e.g., internships) are critical elements of the academy model and are likely to bolster higher levels of behavioral engagement for academy participants (Fletcher et al. 2018, 2020; Loera et al. 2013).

The finding that academy students were significantly more likely to be cognitively engaged in school may also be attributed to the motivation and investment that the academy students had in their education and overall learning. Given the real-world nature of the academy curriculum and its contextual relevancy to students' career interests, it is quite plausible that students who engage in the academy found the content meaningful to their lives and interests. Similarly, Fletcher and Cox (2012) found Black male students participated in the academy because of the hands-on nature of the courses as well as the relevance and meaningfulness provided regarding their career interests.

As for our final kind of engagement, emotional engagement, it is critically important as it reveals students' overall beliefs and attitudes toward their school environment and their sense of belonging and identity within it (Appleton et al. 2008; Goodenow 1993). Thus, the finding of academy students being significantly more likely to be emotionally engaged is likely due to the structure of the academy model. Academies are designed as smaller learning communities and the enactment of student cohorts that have higher levels of personalization among students and teachers as well as students' peers. Researchers have pointed to the smaller learning community aspect of the academy model to promote a sense of belonging and a sense of family, safety, and inclusion for academy students given the smaller learning

community and having students who share career interests with each other (Fletcher et al. 2020).

We also want to highlight that Stanton Academy was predominately Black with high percentages of Black school administrators, teachers, and students. They also had Black STEM professionals represented on their advisory board who served as mentors to the academy of engineering students. To that end, it is quite plausible that the ethnic matching of students, school personnel, and community members who engaged with the academy of engineering could have influenced the high levels of engagement from academy students. To that end, our findings support prior studies that point to mutually beneficial relationships, culturally relevant supports, and positive role models for ethnic matching of students (Achinstein and Aguirre 2008; Brooms 2019; Ladson-Billings 2005).

5.1 Recommendations for practice

Given the positive association of academy participation and higher levels of student engagement, we recommend that school administrators examine whether the academy model might contribute to the engagement and increased connection of students in their schools, as researchers have found in prior studies (Fletcher et al. 2020; Hemelt et al. 2019; Kemple 2008; Malcom and Feder 2016; Means et al. 2016). The academy model is built on the development of career-themed curricula, connections between the career themes and core academics (including accelerated coursework), advisory boards that link students to business and industry as well as postsecondary partners within the career context, smaller learning communities, and work-based learning opportunities (e.g., internships) for students. Like prior studies, our findings suggest that Black students benefit from the aforementioned academy elements (Fletcher and Cox 2012; Fletcher et al. 2020; Lynch et al. 2017). Higher levels of student engagement for Black students often contribute to higher academic achievement and graduation rates (Archambault et al. 2009; Christenson et al. 2001; Finn 2006). Researchers have also found that high school students' participation in NAF academies and high-impact activities (e.g., NAF curricula, dual enrollment, internships) that are germane to the academy model was positively and significantly related to college matriculation (Fletcher et al. 2025).

We also believe that the findings of our study have implications for the preparation of teachers, school leaders, and other school personnel within colleges and schools of education. We recommend that teacher educators and education faculty help their students understand their roles and the importance of emphasizing Black students' participation in accelerated coursework as well as their behavioral, cognitive, and emotional engagement. To that end, future educators and school

personnel might learn to emphasize their future students' understanding of the importance and opportunities that exist related to engaging with adults outside of school when working on class projects as well as volunteer and service-learning activities. As it relates to cognitive engagement, future educators and school personnel might learn ways to foster their students' motivation and investment in learning. For emotional engagement, it is important for future educators and school personnel to help their students' connectedness to school, build relationships with teachers, school counselors, and their peers, and increase their sense of safety.

5.2 Limitations

We caution readers in generalizing our results and extrapolating to other schools and settings with differing student demographics, particularly given that we only collected data from one school site and that the nature of our analysis was correlational. It is also possible that academy and non-academy students differed on other constructs not measured in this analysis. Thus, other confounding variables could help explain the differences in student engagement between the two types of students. In addition, it is important to point out that the measures in our analyses were based on self-reports from students in the school. The generalizability of our findings depends on the degree that other schools share similar characteristics (e.g., academies with open admissions as well as similar student and school personnel demographics).

In addition, further qualitative studies are warranted as this study does not capture the voices of students, teachers, and other school personnel and stakeholders. These data can add rich depth into the experiences and engagement of Black students within the context of this school.

6 Conclusions

The key findings in our study were that Black students who engaged in a high school STEM academy were significantly more likely to have higher behavioral, cognitive, and emotional engagement in school, compared to non-academy students. They also benefited from significantly higher GPAs, involvement in accelerated coursework, and completion of internships. We believe that this study contributes to the knowledge base as it showcases a predominately Black school with a high percentage of Black school personnel who provide their students with access to STEM programs and other accelerated course opportunities (e.g., AP and dual enrollment). In the case of Stanton Academy, academy students reported higher levels of engagement characterized by

their academic and social involvement as well as connectedness to their school. This is important given the positive association between higher levels of engagement and persistence to graduation. The broader implications of this study emphasize the viability of the academy model and its role in increasing the engagement, sense of connection, and participation in accelerated coursework for Black students in schools.

References

Achinstein, B. & J. Aguirre. 2008. Cultural match or culturally suspect: How new teachers of color negotiate sociocultural challenges in the classroom. *Teachers College Record* 110(8). 1505–1540.

Appleton, J., S. Christenson & M. Furlong. 2008. Student engagement with school: Critical conceptual and methodological issues of the construct. *Psychology in the Schools* 45(5). 369–386.

Archambault, I., M. Janosz, J. Fallu & L. Pagani. 2009. Student engagement and its relationship with early high school dropout. *Journal of Adolescence* 32(3). 651–670.

Astin, A. W. 1977. *Four critical years*. San Francisco: Jossey-Bass.

Astin, A. W. 1984. Student involvement: A developmental theory for higher education. *Journal of College Student Development* 25. 297–308.

Astin, A. W. 1993. *What matters in college? Four critical years revisited*. San Francisco: Jossey-Bass.

Boekaerts, M. 2016. Engagement as an inherent aspect of the learning process. *Learning and Instruction* 43. 76–83.

Brooms, D. 2019. "I was just trying to make it": Examining urban black males' sense of belonging, schooling experiences, and academic success. *Urban Education* 54(6). 804–830.

Brown, B. A., P. Boda, C. Lemmi & X. Monroe. 2019. Moving culturally relevant pedagogy from theory to practice: Exploring teachers' application of culturally relevant education in science and mathematics. *Urban Education* 54(6). 775–803.

Castellano, M., J. R. I. I. I. Stone, S. C. Stringfield, E. N. Farley-Ripple, L. T. Overman & R. Hussain. 2007. Career-based comprehensive school reform: Serving disadvantaged youth in minority communities. St. Paul, MN: National Research Center for Career and Technical Education. Retrieved from: http://www.nrccte.org/.

Christenson, S. L., M. F. Sinclair, C. A. Lehr & Y. Godber. 2001. Promoting successful school completion: Critical conceptual and methodological guidelines. *School Psychology Quarterly* 16(4). 468–484.

Cohen, J. 1988. *Statistical power analysis for the behavioral sciences*, 2nd edn. Hillsdale, NJ: Lawrence Erlbaum Associates.

Danforth, L. & J. Miller. 2018. African American males from female-headed households: Using family resilience to navigate their way to college. *Journal of Family Social Work* 21(1). 63–79.

Dee, T. S. 2004. Teachers, race, and student achievement in a randomized experiment. *The Review of Economics and Statistics* 86(1). 195–210.

Easton-Brooks, D. 2014. Ethnic-matching in urban schools. In H. R. Milner IV & K. Lomotey (eds.). *Handbook of urban education*, 97–113. Routledge.

Eddy, C. & D. Easton-Brooks. 2011. Ethnic matching, school placement, and mathematics achievement of African American students from kindergarten through fifth grade. *Urban Education* 46(6). 1280–1299.

Fenwick L. T. 2022. *Jim Crow's pink slip: The untold story of black principal and teacher leadership*. Cambridge, MA: Harvard Education Press.

Field, A. 2009. *Discovering statistics using SPSS*, 3rd edn. London: Sage Publications.

Finn, J. 1989. Withdrawing from school. *Review of Educational Research* 59(2). 117–142.

Finn, J. 2006. *The adult lives of at-risk students: The roles of attainment and engagement in high school (NCES 2006-328)*. U.S. Department of Education, National Center for Education Statistics.

Fletcher, E. 2014. *Inside the black box: African American male students' educational experiences and outcomes as a result of participation in career and technical education*. In J. Moore & C. Lewis (eds.). *African American male students in PreK-12 schools: Informing research, policy, and practice*, 243–265. United Kingdom: Emerald.

Fletcher, E. C., Jr. 2022. Access to and equity in rigorous career and technical education programs: Trends, issues, and future directions in the field. *Career and Technical Education Research* 47(3). 17–27.

Fletcher, E. C., Jr. & T. K. Carroll. 2024. Community cultural wealth and science, technology, engineering, and mathematics (STEM) identities as motivators for black boys to participate in a high school academy of engineering. *Education in Science* 14. 873.

Fletcher, E. C., Jr. & E. D. Cox. 2012. Exploring the meaning African American students ascribe to their participation in high school career academies and the challenges they experience. *High School Journal* 96(1). 4–19.

Fletcher, E., N. Warren & V. Hernandez-Gantes. 2018. Preparing high school students for a changing world: College, career, and future ready learners. *Career and Technical Education Research* 43(1). 77–97.

Fletcher, E. C., A. D. Dumford, V. M. Hernandez-Gantes & N. Minar. 2020. Examining the engagement of career academy and comprehensive high school students in the United States. *The Journal of Educational Research* 113(4). 247–261.

Fletcher, E. C., Jr., E. Hines, D. Ford, T. Grantham & J. Moore. 2023. The school stakeholder community as a source of capital for the talent development of black students in a high school engineering career academy. *European Journal of Training and Development* 37(3/4). 387–403.

Fletcher E. C., Lee I. H., Tan T. X. & Li G. 2025. Examining the NAF academy elements associated with college matriculation for high school graduates. *Innovative Higher Education* 1–25. https://doi.org/10.1007/s10755-025-09795-z.

Ford, D. Y. 2013. *Recruiting and retaining culturally different students in gifted education*. Waco, TX: Prufrock Press.

Fredericks, J., P. Blumenfeld & A. Paris. 2004. School engagement: Potential of the concept, state of the evidence. *Review of Educational Research* 74(1). 59–109.

Fruchter, N., M. Hester, C. Mokhtar & Z. Shahn. 2019. Is demography still destiny? Neighborhood demographics and public high school students' readiness for college in New York city. Annenberg Institute for School Reform.

Goodenow, C. 1993. Classroom belonging among early adolescent students: Relationships to motivation and achievement. *The Journal of Early Adolescence* 13(1). 21–43.

Hemelt, S., M. Lenard & C. Paeplow. 2019. Building bridges to life after high school: Contemporary career academies and student outcomes. *Economics of Education Review* 68. 161–178.

Iruka, I., D. Winn & C. Harradine. 2014. *High achieving African American boys: Factors that contribute to their excellence in the early years*. In J. Moore & C. Lewis (eds.). *African American Male students in preK-12 schools: Informing research, policy, and practice*, 27–59. United Kingdom: Emerald.

Irwin, V., J. De La Rosa, K. Wang, S. Hein, J. Zhang, R. Burr, A. Roberts, A. Barmer, F. Bullock Mann, Dilig, & S. Parker. 2022. Report on the condition of education 2022 (NCES 2022-144). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved [date] from: https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2022144.

Johnson, C. & T. Sondergeld. 2020. Outcomes of an integrated STEM high school: Enabling access and achievement for all students. *Urban Education* 13(3). 1–27.

Joseph, N., M. Hailu & J. Matthews. 2019. Normalizing Black girls' humanity in mathematics classrooms. *Harvard Educational Review* 89(1). 132–155.

Kemple, J. J. 2008. *Career academies: Long-term impacts on labor market outcomes, educational attainment, and transitions to adulthood*. New York: MDRC.

Kemple, J. J. & J. C. Snipes. 2000. Career academies: Impacts on students' engagement and performance in high school. Retrieved from Manpower Demonstration Research Corporation website. http://www.mdrc.org/publications/41/full.pdf.

Kuh, G. D. 2001. Assessing what really matters to student learning: Inside the national survey of student engagement. *Change* 33(3). 10–17.

Kuh, G. D. 2003. What we're learning about student engagement from NSSE. *Change* 35(2). 24–32.

Kuh, G. D. 2008. *High-impact educational practices: What they are, who has access to them, and why they matter*. Washington, DC: Association of American Colleges and Universities.

Kuh, G. D. 2009. The national survey of student engagement: Conceptual and empirical foundations. In R. Gonyea & G. Kuh (eds.). *Using student engagement data in institutional research. New directions for institutional research, No. 141*, 5–20. San Francisco: Jossey-Bass.

Ladson-Billings G. 2005. *Beyond the big house: African American educators on teacher education*. New York City, NY: Teacher College Press.

Loera, G., J. Nakamoto, Y. Oh & R. Rueda. 2013. Factors that promote motivation and academic engagement in a career technical education context. *Career and Technical Education Research* 38(3). 173–190.

Lynch, S., E. Burton, T. Behrend, A. House, M. Ford, N. Spillane, S. Matray, E. Han & B. Means. 2017. Understanding inclusive STEM high schools as opportunity structures for underrepresented students: Critical components. *Journal of Research in Science Teaching* 55(5). 712–748.

Mahoney, J. & R. Cairns. 1997. Do extracurricular activities protect against early school dropout? *Developmental Psychology* 33(2). 241–253.

Malcom, S. & M. Feder (eds.). 2016. *Barriers and opportunities for 2-Year and 4-Year STEM degrees: Systemic change to support students' diverse pathways*. Washington, DC: National Academy of Sciences.

Marks, H. 2000. Student engagement in instructional activity: Patterns in the elementary, middle, and high school years. *American Educational Research Journal* 37(1). 153–184.

Means, B., H. Wang, V. Young, V. L. Peters & S. Lynch. 2016. STEM-focused high schools as a strategy for enhancing readiness for postsecondary STEM programs. *Journal of Research in Science Teaching* 53(5). 709–736.

Newmann F., Wehlage G. & Lamborn S. 1992. The significance and sources of student engagement. In F. M. Newmann (ed.), *Student engagement and achievement in American secondary schools*, 11–39. New York City, NY: Teachers College Press.

Posner, J. & D. Vandell. 1999. After-school activities and the development of low-income urban children: A longitudinal study. *Developmental Psychology* 35(3). 868–879.

Rumberger, R. W. & S. P. Lamb. 2003. The early employment and further education experiences of high school dropouts: A comparative study of the United States and Australia. *Economics of Education Review* 22(4). 353–366.

Tinto, V. 1975. Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research* 45(1). 89–125.

Wehlage G., Rutter R., Smith G., Lesko N. & Fernandez R. 1989. *Reducing the risks: Schools as communities of support*. London, England: The Falmer Press.

Wright, C. G. 2019. Constructing a collaborative critique-learning environment for exploring science through improvisational performance. *Urban Education* 54(4). 1319–1348.

Wright, B. L., D. Y. Ford & J. L. Young. 2017. Ignorance or indifference? Seeking excellence and equity for under-represented students of color in gifted education. *Global Education Review* 4(1). 45–60.
Yazzie-Mintz, E. 2007. Voices of students on engagement: A report on the 2006 High school survey of student engagement. Center for Evaluation & Education Policy. Indiana University.
Yosso T. 2005. Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race, Ethnicity and Education* 8(1). 69–9.