# A Proposal to Understand and Address Factors for Low-Income Black Students in Pursuing STEM Fields

AbuBakr Sangare; SAi Scicomm Summer research Internship Program 2022

## Introduction:

Recent diversity, equity, and inclusion (DEI) efforts at the institutional level have shown an increasing light on the lack of representation that many underrepresented groups have in many fields. Despite efforts to increase diversity in Science, Technology, Engineering, and Mathematics (STEM) fields, particularly, there remains a persistent underrepresentation of Black students. Black students, at the undergraduate level, transfer out of STEM majors at a rate significantly higher than their white peers (Flynn, 2016). While the problem is clearly defined, acknowledged, and recognized, the specific factors contributing to the underrepresentation of low-income Black (LiB) students in STEM fields remain poorly understood. LiB students in STEM often face numerous barriers to success, including a lack of financial resources, inadequate academic preparation from secondary education institutions, and limited access to mentorship as well as support systems—all of which manifest in a uniquely challenging experience for LiB students.

Much of existing research focuses on the numerical discrepancies which quantify the lack of representation for underrepresented minority students (urms) as well as Black students. However, there has been less attention given to the compounding barriers and nuances which qualify each respective identity group on bases of class, race, and ethnicity—much less the interplay that the intersection of multiple identities may have on an individual. Most DEI efforts in STEM are aimed towards increasing participation, retention, and ultimate success of urm students. While these efforts may be beneficial at face value, the unintentional underlying assumption in many cases is the subtle notion that urm groups are treated as a broad 'other' homogenous group which is defined primarily by what it is not—most often, urm is defined as students who harbor any identity or identities that are not White, despite the inclusion of low-income or first generation white students oftenly. This proposal aims to address this gap in the literature by investigating the factors that hinder or facilitate the participation of LiB students in STEM fields, specifically.

Paradoxically, the urm-based approach and understanding to addressing the needs of marginalized students creates a homogenous, despite the incredible nuances between communities and the broad urm definition capturing an intrinsically heterogeneous community, *other* group. Within this creation of the sense of the other, the needs of specific community populations are lost. In this proposal, **I hypothesize that there exist specific, characterizable, and addressable needs of low-income Black students that are overlooked at the institutional level**. I aim to test this by employing a pseudo-ethnographic approach to characterize the lived experiences of LIB students (**aim 1**) and to identify, analyze, and assess the efficacy of current mentorship models implemented by current DEI programs aimed to recruit urm students as it

relates to LIB students (**aim 2**). Success of this proposal will provide essential knowledge to better implement practices and programs to truly allow for a retained increase and retention yield of low income-black students in STEM fields.

## Central Driving Question:
- What are the lived experiences of low-income black students that influence interest in STEM related fields?

**Specific Aims: Aim 1 – Characterize and quantitatively Capture the Lived Experiences of Low-Income Black College Students in STEM related fields.** The particular goal of this aim, at its root, is to quantify human experience from the vantage point of LiB students. To first create a basis of understanding and data, I propose an ethnographic study. This study will function as both an observational study and a survey. 3 key school demographics will be targeted: 1) a large state-school 2) a small liberal arts college and 3) an elite-very selective research university. By selecting these three university types, I hope to gain insights into the encompassing landscape of student experiences at the collegiate level. Within each study, I will ask to observe STEM course office hours, study sessions/recitations, and programming available to support students—all while tracking with and engaging Black students, pursuing STEM and non-STEM degrees, present at their respective institutions. I will also interview my interlocutors and learn of their experiences in STEM. The goal within this is to identify key access points wherein they engaged with STEM coursework. By observing Black students of different economic backgrounds and academic interests, I hope to landscape sentiment across disciplines to identify key factors. In working with low-income Black students across disciplines, described as Black students who receive a Federal Pell Grant, I will inquire as to their unique experiences and ask, from their perspective, what it is they think are the best practices to support LiB students in STEM. To qualify these sociological findings with a quantifiable metric, I introduce two novel variables: The STEM-opportunity score and the disadvantage-STEM score. The two are calculated as follows:

**(1) STEM-opportunity (SOS) score:**
$$SOS = (highschool\ quintile\ +\ birth\ quintile)\ \pm\ 5n$$

Where *n* is the number of parents who currently hold a STEM-related profession that requires substantial STEM coursework at the collegiate level (ex. Engineer, medical doctor, nurse, etc.). Highschool quintiles will be calculated on the basis of the mean economic household income as per the given zip code, giving a value ranging from 1 (the lowest mean household income) to 5 (the highest mean household income). Birth quintiles will similarly be obtained by the zipcode the student was born into (based on what hospital they were born in). Mean household income as reported per zip code and the quintile ranges per year will be accessed through publicly available data at https://data.census.gov/.

**(2) Disadvantage–STEM (DAS) score:**

$$DAS = \left( \frac{20 - (SOS)}{12} \right)$$

The DAS score will allow for a simple metric to assess and qualify sociological findings wherein scores range from 0 to 1 where 0 is the least disadvantaged and 1 is the most disadvantaged.

These values are indeed not the most refined variables for predictive STEM success and retention. However, in tandem to the sociological findings from the detailed ethnographic studies, these variables will give some substantial roots in assessing my central hypothesis. Discrepancies between Black students of different economic backgrounds will provide quantifiable support towards the intersectional approach. Additionally, analysis will also include whether or not a student has switched out of STEM—allowing for the observation of whether or not a correlational relationship exists between the above defined variables and STEM retention for Black students.

**Aim 2 – Understand mentorship models implemented by diversity, equity, and inclusion-based programs are doing and ascertain areas for improvement.** It is widely viewed that the most combative tool to the issue of a lack of representation for Black students in STEM are recruitment, support, and retention based-DEI programs. However, there is much conversation surrounding the efficacy of these programs—some programs such as the Biology Scholars Program at the University of California, for example, are praised and touted for their "success" whereas other programs are called into question (Matsui, 2018). Interestingly, the metric wherein "success" is defined can be somewhat arbitrary at times whereby success is often measured solely as STEM retention. Acknowledging the underlying assumption that a STEM degree is the end all be all Black students who enroll in these sorts of programs, I aim to add a nuanced definition of success for these programs as a satisfaction rating. To complete the central aim of understanding current mentorship models, I propose the creation of a centralized database whereby data and information from school-specific DEI programs will be collected. To do this, I will create a mass-survey to send to deans whose primary roles are to support urm students and ask what mentorship models they primarily employ to support their students. Potential mentorship models include one-on-one mentoring, near-peer mentoring, and/or group mentoring. In surveying the Black students who participate in their respective college's programs directly, I ask for a rating, 1 through 10, wherein they feel their participation in the program brought them success. I will define success as explicitly "the degree to which you feel your participation within this program best equipped you to pursue the educational goal you believe is best for you." By employing a student-perspective first framework, the actual efficacy of programs will be able to be measured in tandem to the mentorship models employed. These data will allow for analysis on their efficacy in a novel way, and will create a robust framework for assessing the best practices.

**Intellectual Merit:** The novelty of this proposed study would provide crucial nuances in understanding sociological factors that impact black students and will allow for more successful DEI efforts long-term. While there is much research which has been done to quantifiably measure STEM inequities, there has not been nearly as much done on the basis of robustly understanding the ways in which sociological factors affect STEM participation from the student's perspective. This proposal aims to bridge that gap and employ a student-perspective first oriented lens to understand the lived experiences of low-income Black students in STEM.

**Broader Impacts:** The broader experimental goal of this study is rooted in quantifying the unquantifiable—specifically by seeking to address and map determinants that influence Black students' decisions, interests, and ultimate pursuit of STEM-related fields in higher education. Moreover, by better understanding and characterizing key underlying social determinants, current widely accepted practices can be revised for more impactful impacts on LiB students. Completion of this study would allow the creation of actionable recommendations, steps, and practices to address educational inequities and ultimately increase the participation of low-income Black students in STEM.

## Citations

Flynn, D. T. (2016). STEM field persistence: The impact of engagement on postsecondary stem persistence for underrepresented minority students. *Journal of Educational Issues*, *2*(1), 185. https://doi.org/10.5296/jei.v2i1.9245

Matsui, J. T. (2018). "outsiders at the table"—diversity lessons from the biology scholars program at the University of California, Berkeley. *CBE—Life Sciences Education*, *17*(3). https://doi.org/10.1187/cbe.17-12-0276