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# Intersectionalities of Systematic Barriers Set Upon Underrepresented Students in STEM: Capturing the Potential Benefits of Online Modality

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# Intersectionalities of Systematic Barriers Set Upon Underrepresented Students in STEM: Capturing The Potential Benefits Of Online Modality

by

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## ABSTRACT

The prevalence of racism and microaggressions in STEM disciplines within colleges presents significant hurdles to the academic success and well-being of underrepresented students. Microaggressions, encompassing subtle biases and stereotyping, have a cumulative impact, inducing heightened stress, diminished motivation, and reduced self-efficacy among minority students, thereby impeding cognitive functioning and hindering academic progress (Ogunyemi et al., 2020). The existence of these negative emotional responses creates a less conducive learning environment for academic achievement. Additionally, structural inequalities within STEM institutions contribute to disparities in resource access, limited mentorship opportunities, and support networks crucial for success in STEM fields (Atkins et al., 2020).

This paper aims to explore the profound effects of racism, microaggressions, and microinsults on the academic experiences and outcomes of underrepresented students in STEM, emphasizing the impact on the student psyche. It underscores the importance of fostering inclusive environments and alternative learning mechanisms, such as online education, through a holistic, culturally responsive, trauma-informed, and equitable lens.

The onset of the COVID-19 pandemic has accelerated the adoption of online learning, transforming the educational landscape. This shift, from traditional on-site learning to a hybrid system, has raised questions about its impact on student progress, success, and persistence. Persistence is defined as grade growth, staying in academia, growth in concept retention, and continued desirability of pursuing a career. Does online modality address social, economic, and societal barriers often associated with traditional on-site learning? Does online education influence student persistence, perceived effectiveness, growth, and grasp of concepts? Does it help?

## Dedication

"Bitay Fè Ou Vanse" ~ A Stumble Moves You Forward

An L is not a "loss" but always a lesson. Tap into your energy and you will find what you seek.

I would like to dedicate this thesis to the loving memory of my grandmother Marie Jo' Paris, great grandfather John Paris, Marcus Miller (2003-2011), Laurence McCallister, Patrica Jones, Ian Mouser, Ernie Casciato, George Elliot, Uncle Huru, Raja & Johnny (2020-2023): As you have unexpectedly departed, I extend my heartfelt gratitude for the wisdom, guidance, love, and support you all have shared. It is with deep honor that I reflect on the privilege of having known you in this lifetime.

To my future self~Thank you. Continue to question, continue to dream. ♡

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## Educational Inequities: Historical Legacy of Inclusion & Exclusion

According to the CDC, racism is " a system—consisting of structures, policies, practices, and norms—that assigns value and determines opportunity based on the way people look or the color of their skin" (CDC, 2023*)*. Racism is the act of discriminating against individuals or groups of people on the sole basis of their phenotype, culture, religion, and ethnicity. Systemic racism is a version of racism that is embedded within institutional, social, and individual mental structures along with everyday interactions such as habits and norms. As it may be conscious or unconscious, racism stems from a space of racial differentiation and discrimination; thus, dictating and limiting opportunities and outcomes identified as social determinants of health across generations (Banaji, 2021). This results in conditions that unfairly advantage some and disadvantage others throughout society. Racism is a pervasive issue within STEM fields in academia, contributing to a hostile and exclusionary environment for Black and other underrepresented students (McGee, 2020). Experiences of racial discrimination and bias negatively affect the sense of belonging and academic retention (Smith & Turner, 2015). Black students and other underrepresented students experiencing disability, and economic/financial insecurity often face intersectional challenges related to their identities, such as gender, sexuality, and socioeconomic status, which compound the effects of imposter syndrome and isms. These intersectional experiences can further diminish their sense of belonging and academic retention (Crenshaw, 1989). Within the university context, racial microaggressions rooted in stereotypes give rise to assumptions about admission policies, perpetuate myths about the academic capabilities of specific student groups, foster classroom segregation, and result in students of color feeling personally diminished by White teachers and peers (Solorzano, 2000; Yosso, 2009). These racial stereotypes, reinforced in part through racial microaggressions, constitute subtle yet

persistent forms of racism that exert pronounced adverse effects on the experiences and academic outcomes of students of color in STEM fields. These effects include racial anxiety, minority status stress, and the contemplation of leaving STEM disciplines altogether (Sue et al., 2007).

An article published by the Hechinger Report by Melba Newsome highlights concerns about the declining proportion of Black college graduates in STEM fields. Black graduate rates in STEM fields have either remained flat or declined over the years, making it a worrying trend given the increasing demand for STEM professionals. The COVID-19 pandemic has further compounded the problem, with total Black undergraduate enrollment at universities and colleges decreasing by over 7 percent, potentially leading to even lower representation in STEM fields (Hechinger Report). Some students share that as the only Black student in their class, there are peer-to-peer experiences where they do not feel valued. One bioengineering student shared that within a group project, they were told things like "you can do the typing" and excluded from taking part in the intricate sections of the project-insinuating a lack of intelligence. This student expressed feelings of having to "prove themselves all over again." Factors contributing to the decline in Black graduates in STEM include bans on race-based affirmative action in some states and a dilution of support programs intended to help Black students due to broadening definitions of diversity (Hechinger report). The lack of diversity in STEM fields has consequences beyond economic considerations. It can affect product development and innovation. The declining representation of Black students in STEM fields carries far-reaching implications, not only for individual career opportunities but also for the advancement of science and technology. Efforts to address this issue include not only academic support but also systemic changes to create more inclusive environments in STEM education and professions (Hechinger Report).

Some United States higher education establishments pride themselves on the use of progressive measures of diversity within their mission; although, their academic ecosystem fails to foster a community that reflects cultural, racial, and religious identities within policies, practices, extracurricular opportunities, and staff. In the state of Texas, Texas State University's policy of DEI is as follows "Freedom of thought, innovation and creativity are fundamental characteristics of a community of scholar-discrimination against or harassment of individuals based on race, color, national origin, religion, sex, sexual orientation, age, disability, veterans' status, gender identity or expression are inconsistent with the purposes of the university" (Texas State. 2023, p. 21); yet, Senate Bill 17 implemented by Senator DeSantis removing DEI programming and structures places restrictions on how far this "diversity" equity and inclusion extends.

DEI stands for Diversity, Equity, and Inclusion. It encompasses efforts to create a workplace or community where people of all backgrounds feel valued, respected, and empowered to contribute fully. Challenges in DEI include the perceived privilege some individuals from underrepresented backgrounds receive. Specifically in higher education, this can be found for instance in the misconception among some White identifying students that black and brown students have an advantage in college admissions and tuition due to their culture and ethnicity. Leading to White students submitting false claims of ethnicity to gain admission or financial support. Qualitative research presented by Intelligent discovered that out of 1,250 students surveyed, 34% of White college students admitted to lying about their ethnicity as a racial minority in university applications. Men are the majority in comparison to women. 48% of students claimed to be Native American, as this was the most chosen minority status. Three out of four students who faked and lied about being a racial minority on their applications

were accepted by the colleges (Intelligent, 2021), consequently taking away opportunities from URM students whom such resources were intended for. Racism, microaggressions, and insults have been morphed and camouflaged as impostorism. Some URM students did share that they marked themselves as White due to the stigma associated with Black in society (evil, dark, lazy, poor, etc). This behavior sends the message that White students are disadvantaged. As there are aspects for each student that may place them at a disadvantage in the context of the current academic system, this does not hold true in comparison to the intersectionalities set against URM students. 81% of White students lied on their applications, as they believed it would increase their chances of admission. Additionally, some universities have requested students to fabricate or half-truth their applications; moreover, they misrepresent such institutions as a space of diversity and inclusion. This affects two things. This misunderstanding undermines the authenticity of racial diversity claims by universities and deprives the intended students of opportunities. The notion of cultural privilege in itself is a form of microaggression, invalidating historical oppressions set upon students that are often overlooked. So the question I present to you is, is it cultural privilege or, is it that focus is no longer on those who are used to being focused on? Furthermore, the concept of diversity has expanded to include LGBTQIA+ communities. This is an essential part and step to inclusion; however, it commonly centers privileged perspectives, neglecting the unique experiences of black and brown LGBTQIA+ individuals.

Despite concerted efforts to uplift underrepresented communities, there remains a disparity in representation within STEM disciplines. According to the National Science Foundation, underrepresented minorities, including Black, Latinx, and Indigenous individuals, account for only around 13% of the STEM workforce. Although historically Black colleges and

universities (HBCUs) represent only 3% of higher education institutions in the United States, HBCUs produce nearly 20% of Black college graduates and 27% of African American BAs degrees in STEM fields (Allen et al, 2020). When compared to Black students at similar institutions, HBCU students are more likely to graduate and earn higher wages than Black students at similar non-HBCUs. Additionally, compared to predominantly White colleges (PWIs), HBCUs are expected to do more with less funding. Of the $42 billion in federal research and development funds awarded in 2018, less than 1% went to HBCUs (Thurgood Marshall, 2021). It is worth noting that this disparity may be attributed to systemic factors such as generational wealth disparities, and higher wages by the racial and gender wage gap.

Educational institutions are an environment in which individuals come to learn and advance their knowledge. According to a report by the National Center of Education Statistics and the U.S. Department of Education, historically Black colleges (HBCUs) in 2019 had an undergraduate attendance rate of 12.9% for Black undergraduates in the U.S. with a participation rate of 70% in 2023. Attendance is categorized as the physical presence of a student within the classroom; whereas, participation is the active engagement with activities within their academic work (National Center Of Educational Statistics, 2021). HBCUs host a smaller population of Black undergraduates, a 12.9% comparison to predominantly White institutions (PWI) that host 87.1% of Black undergraduates. Despite a smaller population of Black undergraduates, and representing only 3% of higher educational institutions, HBCUs graduate approximately 21.5% of their Black students (Provasnik et al., 2005) in comparison to a graduation rate of 78.5% of Black students in a PWI. Regardless of the HBCUs' small population, they graduated more of their Black student populations in comparison to predominantly White colleges. Although

university settings may look diverse on the surface, the systems within still perpetuate inequities and an uncomfortable environment for Black students to thrive holistically.

Higher education institutions, exemplified by HBCUs, steadfastly adhere to this overarching mission. HBCUs are higher education spaces curated with Black legacy, culture, and celebration in mind. African American students who graduate from an HBCU, come out with a greater experience than a student of a non-HBCU (Wilson, 2007). According to the Association of American Medical Colleagues and the US Census Bureau, Black, and African Americans make up roughly 11% of the US population, and only 5.7% of US physicians identify as Black and or African American. Despite constituting a mere 3.4% of all four-year, degree-granting institutions in the U.S., HBCUs demonstrated a significant impact. In 2013, they accounted for 17% of the colleges that supplied the highest number of African American applicants to medical school. Furthermore, in 2011, HBCU undergraduate institutions emerged as the leading producers of African American graduates in medical schools (National Center Of Educational Statistics, 2012). Additionally, In that year HBCUs, Xavier University (Louisiana), and Howard University produced 92 African American medical school graduates. This numerical representation surpassed the cumulative output of the top four Predominantly White Institutions (PWIs ) that were known for "producing" African American medical school graduates (Castillo-Page, 2012).

Due to the demand for STEM professionals, steps and funding initiatives have been set in motion to implement this need. Under the Obama Administration, a private investment of $1 billion under the '*Educate To Innovate'* campaign proposed by Former President Barack Obama in 2013, was invested to improve STEM education and inclusivity. Additionally, 350 college and university leaders have committed to providing pathways for underrepresented students to pursue

and successfully obtain STEM degrees (White House, 2016). Early high school education has been reformed to promote inclusivity. STEM education reform is a movement implemented by the need for access and support to encourage positive experience and retention outcomes for underrepresented, low-income students. It is an approach to recognizing student interest rather than the competitive nature of examination (Means. et al., 2017). STEM educational reform is a paradigm shift in finding greater value in students' attempts, engagement, and interest, rather than just test results.

Despite attempts to improve inclusion in higher education, systems have yet to catch up with and represent demographic and cultural shifts completely. As there once were 121 HBCUs initially formed in the 1930s, the 101 that remain, have taken steps to advocate for justice within STEM. Between 2003 and 2015, the United Negro College Fund (UNCF) found that federal funding for HBCUs compared to PWIs increased fourfold, rising from $400 to $1,600 per student (Williams et al., 2019). In the fiscal year of 2018, $400 million, which is less than 1% of the $42 billion in federal research and development funds for universities, went to HBCUs. The following year, this percentage decreased by 13% (Gibbons, 2019; NCSES, 2020). It is worth noting that this disparity may be attributed to systemic and systematic factors such as generational wealth disparities, and higher wages earned by White counterparts due to the gender and ethnicity wage gap.

HBCUs have a history of achieving more with limited resources, but settling for less is no longer acceptable. HBCUs Morgan State University, Coppin State University, Bowie State University, and the University of Maryland Eastern Shore filed a lawsuit against Maryland State holding it accountable for the systemic barriers placed amongst its students in higher education (McGee, 2020). The cut in funding has created barriers to accessibility and quality of education

for communities that can no longer afford it. In 2017, the cost of annual tuition would claim 25% of a Black family's median household income, and 23% of a Hispanic household, in comparison to that of 18% of a White household's, and 15% of an Asian household. Settled by its governor for $200 million, the request of $577 million for these four universities leaves them underfunded and undervalued.

Systematic racism limits accessibility as much as it does presentability; without access, how must students be asked to be completely present mentally, emotionally, and physically? Learning is a product of the system in which it is facilitated in- students are essentially changed, and molded by the experience. The way students learn and retain information is dependent on the teaching experience and environment (Barr & Tagg, 1995). Language and materials, once written for an audience of financial, economic, and systematic privilege, continue to be the structure of material presented year after year. According to the National Center for Educational Statistics (NCES), of the 15.9 million undergraduates who enrolled in Fall 2021, 7.8 million were White, 3.3 million were Hispanic, 1.9 million were Black, 1.1 million were Asian, 0.7 million were of two or more races, 0.1 million were American Indian/Alaska Native. There is not a high enough value to adequately quantify the Pacific Islander population (NCES).

According to the National Science Foundation, underrepresented minorities in STEM include African Americans, American Indians including Native Alaskans, Hispanics, and Native Pacific Islanders, as well as those with disabilities. The NSF does not consider Asian Americans and some Asian ethnic groups depending on region to be underrepresented within STEM; however, this does not negate that Asian Americans and Asian ethnic groups don't face institutional, cultural, or individual racism within colleges or STEM workplaces. Literature reflects that Asian Americans do experience racial harassment, exclusion, and isolation on

campus (Mueses et al., 2009). Asian Americans are continuously reduced to a model-minority stereotype in higher education. This pressure of expectation can hinder a student's progress throughout their academic and professional career; moreover, although Asian Americans have higher retention in education and lead other ethnic groups in education and income, reports from the Equal Employment Opportunity Commission reflect that Asian Americans are less likely than any race to be promoted.

Approximately 40% of US college students face food insecurity (ACHA, 2022). PSU's Homelessness Research & Action Collaborative discovered that pre-pandemic in Fall 2019, BIPOC and LGBTQIA+ students, along with those with disabilities, experienced higher rates of insecurity compared to their White peers. Native American students were especially affected, nearly twice as likely as White students to face homelessness, with over 66% experiencing food insecurity (Townely et al, 2020). Not recognizing students of diverse backgrounds, identities, and lack of access, influences barriers to learning, access, and processes of learning. These intersectionalities have the potential to hinder a student's ability to be fully present in class. Are these environments encouraging or falling short of the needs of students? This paper aims to shed light upon the following issues: BIPOC student experiences, educational ecosystems within postsecondary education in STEM, the importance of diverse learning methods, and support systems off campus.

**Underrepresented Student Experience of Microaggressions & Racism: The Impact of Structural Inequity**

The experiences encountered throughout a students' academic career may differ based on varying circumstances, including but not limited to self-identity (gender, religious cultural/racial identity), disability, food and transportation insecurity, and any other additional elements. These

elements can influence and change a students' perspective, and reality of experiencing college differently in comparison to another student who does not identify with the same groups or markers of identity. Focusing on the racial identity of underrepresented students as it pertains to academia, we must discuss and identify what microaggressions are. Micro is the meaning of to be that of small or minute qualities or variations; moreover, aggression is the unprovoked attack of hostility or confrontation with the intent to dominate or master (Wong et al., 2014). Racial microaggressions are brief and commonplace daily verbal, behavioral, or environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory, or harmful racial slights and insults toward people of color (Sue., 2007). Microaggressions can be statements, actions, and or limitations with the intent of justifying inequitable and differential treatment towards groups or individuals of color in comparison to that of Whites. A wide range of cultural and racial injustices have been grouped under microassaults, microinsults, and microinvalidations. Microinsults insult the receiver by demeaning their heritage and culture; whereas, microinvalidations are behaviors and actions that negate and disregard the receiver's experience unintentionally or via unconscious bias. Intersectionality is a means of overlapping or intersecting social identities and related systems of discrimination experienced at once. Meaning a person can experience a multitude of isms. The cumulative impact of experiencing various forms of discrimination can significantly affect an individual's ability to navigate everyday life and show up as their authentic selves.

Racism and microaggressions impact a person's central identity of themselves, exhausting cognitive functions and behavior. Identity centrality refers to how much a specific aspect of our identity, like race or gender, shapes our overall sense of self. It's about the importance we attach to certain aspects of who we are in defining ourselves. In a study, the mental processes and

actions of 65 Black women were observed by surveying their experiences when exposed to racial microaggressions. Participants were asked to complete a trial of questions to note a baseline of cognitive activity (Banks & Landau, 2021). For example, stimuli were presented in one of four colors (i.e., yellow, red, green, or blue), participants were prompted to quickly indicate the color of the text. Following the survey stimuli, participants were introduced to two researchers, one Black and the other White. Here, participants would undergo exposure (or lack thereof) to microaggressions and microinsults by the White-presenting researcher after the Black presenting researcher left the room. Exposure one takes place as the White researcher answers the phone and pretends to have a conversation on the line about the participant. The experimental group would hear, "Yeah, she is, but I'm okay here by myself" compared to the control group "Yeah, she is and I don't want to keep her waiting." Post-exposure one, the experimental group was given a second exposure during the transition back to a room they previously occupied. These included highly stereotypical questions and statements like "Are you an athlete?" and "I think it's so cool that you girls can do so many different crazy things with your hair." Those in the control group were presented with questions of "What's your major?," and "Where's home for you?" These questions were taken from the research on the Black experience in sharing common microaggressive commentary when encountering collegiate peers. The difference between these two approaches is that one is an attack by perceived bias; the other is a neutral inquiry. Post exposures, all participants were given a second survey to answer. In comparing scores of the first survey stimuli pre-exposure and the second post-exposure, the experimental group gave less favorable ratings of the lab and had a harder time focusing on the questions and fully presenting themself to answer, in comparison to the control group. Participants exposed to microaggressions suffered significantly more cognitive interference than those exposed to the research assistant's

neutral conversational language. Not only had there been an effect on the way these women answered questions correctly; but, also the time it took to take the survey.

It is understood that when an individual identifies themselves to be a member of a specific social group that holds importance to them, they are more likely to report discrimination pertaining to that group (Banks & Landau, 2021). This includes being a witness to conversations or events targeting such groups. Central identity is how we see ourselves. Coined in the field of social psychology, identity centrality refers to the degree to which a particular social identity or role is a fundamental and defining aspect of an individual's self-concept. It involves the significance and relevance of a particular identity in molding an individual's overarching sense of self (Stryker & Serpe,1994). Molded by culture and race, central identity builds a self-image that is subjective to individual perspectives and perceptions. This experiment has become the first known study to demonstrate through direct exposure that racially microaggressive verbal exchanges immediately diminish the cognitive performance of Black college women by challenging the action of stereotyping central identity and sense of self.

**Trapped on Campus: An Academic Culture Of Racism**

Being a student is not only about learning course content and studying subject intricacies, it includes campus life, peer-to-peer interactions, and professor connections (Amerstorfer, 2021). The college experience shapes a student's perspective and ultimately affects future career development. In such spaces that demand and ask for self-advocacy of students, underrepresented students of color are unable to do so due to their perceived hostile racial campus climate, and academic persistence that influences the decline in retention rates (Wright, 2013). Students share the experience of feeling shamed for requesting help and asking questions from faculty. These experiences include being criticized for not knowing the answer or how to do

something. A student shared their experience of attending office hours; a professor responded that if they needed to ask questions and be in office hours, they should consider changing majors. These condescending experiences and events hold true for all academic resources, professors, research assistants, teacher assistants, and advisors. When reaching out for help, despite efforts and levels of academic experience (undergraduate or graduate) students of color did not feel supported or taken seriously. Many felt seen for their color and the bias that comes with socioeconomic backgrounds rather than for their individuality and potential.

In aims to seek an answer of who is most subjected to racial microaggressions (RMAs) and stereotypical race role occurrences based upon race and culture, 4,800 students of color (1,688 of whom were STEM majors) responded to an online survey consisting of 36 questions. These questions were created to highlight students of color's racial experiences that made them uncomfortable and nullified their experience, as well as highlighting students' coping mechanisms to manage RMAs and inequitable academic environments. Participants were asked three open-ended questions (i.e. "When did you feel uncomfortable, insulted, invalidated, or disrespected by a comment that had racial overtones", "When did others subtly express stereotypical beliefs about race/ethnicity", and "When did others suggest they did not belong on campus because of their race or ethnicity?"). Participants were also asked eight place-based questions and 15 demographic questions that had been adapted from the Schedule of Racist Events (Landrine & Klonoff, 1996), the Index of Race-related Stress (Utsey, 1996), and the Racial Life Experiences Scale (Harrell, 1997). These surveys addressed students' experience on three levels: campus, academic, and peer. Level one, campus. Questions for this level were presented to receive an answer on how participants felt when on campus as students of color interacting with campus culture and representation. Level two is academic. Questions for this

level were presented to receive an answer on how participants felt when communicating (no matter the method) with advising (TAs, professors, academic educators, and leaders). Level three, peer to peer. Questions for this level were presented to receive an answer on how participants felt when communicating with fellow students, their interpersonal thoughts, conclusions, reactions, and how these experiences affected students' ability to perform. As Asian students made up 48% of the sample, Black students represented 10%, Latinx 15%, and Native Americans 3% with the remaining 24% identifying as Other Race (Lee, 2020). At all levels, Indigenous and Black students experienced the highest rate of microaggressions. Characterized by gender within their race and ethnicity, Indigenous and Black women experienced higher rates of campus RMA's in comparison to men. Additionally, Indigenous women experience higher rates of academic RMA's than Indigenous men. Indigenous and Black men experienced higher rates of peer-to-peer RMA's. Interestingly enough, all Black students experienced the same rate of academic RMAs when interacting with educational leaders and educators.

At the campus level: Black-identifying participants had a 54% chance of experiencing RMAs than any other racial group. Asians held a 7% rate, Latinx 24% rate while other race students held a 15% rate. Women of all races experienced a 7% higher probability of campus RMAs in comparison to men of the same racial/ethnic group. Women experience higher RMAs even when data looks at different academic classes (freshman, sophomore, junior, senior). Students of color majoring in STEM explain feelings of their on-campus experience as being "humiliated, ignored, rejected, alienated, excluded, different, and second class". Students also share experiences of derogatory name-calling and indifference. The consensus amongst participant data concludes that students' want and desire to be involved on campus during their academic career in institutions has declined. At the academic level: Black students have a 57%

increased probability of experiencing RMAs in comparison to any other racial group. Members identifying as other races had a decreased probability rate of experience at 37%, Latinx at 17%, and Asians at 14%. When taking a view from a gender identity perspective, women's probability increased by 9%. Undergraduates' probability and rate of experiencing microaggressions significantly increased. At the peer-to-peer level: Black-identifying students would face RMAs when interacting with colleagues, 13% more than any other racial group. When taking a view from a gender identity perspective, Asian men's experience increased by 16%. Undergraduate probability decreased by 25% while freshman/first years student probability increased by 82%.

Students shared the experience of being reminded of the integral part their racial identity had on the outcome of success and treatment in every space they occupy as students. This included experiences with a lack of racial diversity in events, clubs, music played, and opportunities given on campus. The lack of cultural diversity within the academic community perpetuates invalidation and a limited sense of belonging. Participating students of color shared that their peers questioned their ability to perform well (academically or recreationally) without giving probable cause for such questions. Racial identity affects the probability and likelihood of regular occurrence of students of color encountering RMAs on campus, amongst professors, advisors, and peers. Black and Latinx students were given the stereotype of being lazy and unprepared, and Asian students were given the stereotype of being expected to succeed and excel (Lee, 2020). Microaggressions, insults, and invalidations like hearing statements from a peer experience like, “Black or Latinx students get into college only because of their race, not based on intelligence” alongside the divisive behavior by academic leadership (“This is not for you”) perpetuate a system where students ultimately leave not because of the lack of ability, but the lack of community. Being “humiliated, ignored, rejected, alienated, excluded, different, second

class", along with other exclusionary behaviors, students of color feel further and further away from the pathway of STEM.

From studies inquiring URM students about their experiences of their relationship with campus culture and their sense of belonging within the STEM fields, the common narrative is that students feel like they are always reminded by their peers and leadership of how much their racial identity affects the outcome of relationships, treatment, and success in every space they as students occupy. The relationship between students and faculty, including advisors, professors, and leaders is pivotal, as it is detrimental to a student's growth, success, and mental health. A Black man studying STEM in college shared their experience, "professors never joke in class with the Black students, their jokes are directed towards White students. You would think they know the White students personally. When professors and TAs favor the White students, that makes you feel uncomfortable, it affects you" (Chelser,1993). According to a US Berkeley report, White and Asian students often assume that Black, Chicano, Latino, and Native American students don't belong in "cal" meaning that university. Students of color reported feelings of conviction that their peers did not think they were competent. Leading to a need to feel that they must constantly prove themselves and overcome the belief among their peers that they are less competent or exceptional compared to other students of color. Looking through the lens of mental health as how one evaluates oneself, internalizing the environment around them and the world they contribute to, these types of experiences can create a potential domino effect in the decline of academic success.

These findings highlight group interaction and the importance of facilitating safe spaces for students to be included and uplifted. In the realm of online learning environments, the

cultivation of group interaction should be increasingly recognized as a cornerstone for effective teaching and learning. The collaborative nature of group activities fosters a sense of community, engagement, and shared learning experiences and we can see this valued within online educational environments as well. Effective online teaching involves creating a supportive and interactive space that encourages meaningful collaboration among students (Palloff et al., 2007). The importance of facilitating safe, appropriate, and culturally responsive spaces for group interaction cannot be overstated. Ensuring an inclusive environment where diverse perspectives are valued contributes to the development of a rich and dynamic learning community (Kuh et al., 2005). This approach aligns with the principles of culturally responsive teaching, acknowledging each student's unique backgrounds and experiences (Gay, 2010). By prioritizing group interaction within these well-crafted environments, educators contribute to creating a positive and uplifting learning atmosphere that enhances student success (Palloff et al., 2007).

Biases in instructional design, content presentation, or assessment methods may further contribute to an unequal learning experience, impacting the academic achievement of underrepresented students. Inclusive learning environments are essential for fostering academic success, but when bias is present, the repercussions for underrepresented students can be profound. Such environments may lead to a diminished sense of belonging, isolation, and hindered academic achievement (Hurtado & Carter, 1999). The impact extends to mental health, as exposure to bias can contribute to stress, anxiety, and imposter syndrome (Cokley et al., 2013). Biased learning spaces may limit underrepresented students' participation in discussions and group activities, impeding the development of critical skills. Stereotype threat further compounds these challenges, potentially undermining academic performance. The consequences

are not only immediate but may lead to higher attrition rates and narrowed career aspirations (Oseguera et al., 2019). Beyond individual impact, biased learning environments contribute to the perpetuation of a lack of diversity in various professions, underscoring the broader societal implications (Page, 2012). Fostering inclusivity and supporting underrepresented students in STEM isn't just about social justice; it's essential for advancing knowledge and innovation for the betterment of society and STEM as a whole.

Coined by Dr. Madeleine Leininger in the field of healthcare and later refined by Dr. Terry L. Cross in the field of theology, cultural competence refers to a cohesive set of behaviors, attitudes, and policies within a system that enables effective interaction in cross-cultural contexts. This approach acknowledges and respects the diverse experiences and responses shaped by individuals' heritage, sexual orientation, socioeconomic status, ethnicity, and cultural background (Leininger et al.,2002; Cross, T. L. (1989). Developed by Gloria Ladson-Billings and Geneva Gay in the education field, cultural responsiveness is where educators integrate the cultural knowledge, experiences, and performance styles of ethnically diverse students into their teaching practices. Could be considered an actionable piece of cultural competence. Awareness and accountability aim to make learning experiences more relevant and effective for all students by taking actionable steps toward cultural competence. To address these challenges, educators and institutions must actively engage in inclusive teaching practices, address biases, and provide support structures to ensure that underrepresented students feel valued, and respected, and have equal access to opportunities (Hurtado, 2005).

## Imposter Syndrome: Implications on Students' Sense of Belonging

A positive racial environment contributes to a strong sense of belonging and is associated with higher grades and graduation rates for students of color (Lee, 2020). The decline in a sense of belonging and academic retention of Black and underrepresented students in STEM fields is a multifaceted issue influenced by factors like imposter syndrome. Imposter syndrome is a barrier introduced by systems that identify and correlate success with specific exclusive attributes. It is characterized by feelings of inadequacy and the fear of being accused of fraud despite evidence of competence. This psychological phenomenon that undermines students' belief in their own capabilities and causes persistent feelings of inadequacy, disproportionately affects underrepresented students in STEM (Cokley et al., 2015).

Imposter syndrome not only affects students' self-perception but, also negatively impacts their academic performance by sapping confidence and motivation (Langford & Clance, 1993). The impact of imposter syndrome extends beyond mere self-doubt, as it often leads to procrastination, perfectionism, and a reluctance to take on challenging tasks in fear of a perceived failure (Cokley et al., 2015). 240 self-identified ethnic minority college students between ages 17 and 39 were examined to understand variance and relations amongst minority status stress, imposter syndrome, and mental health (the big three). These minority students made up approximately 36.6% of the student body, comprising 3 biracial, 50 African American, 76 Latino, and 11 Asian American cultures and nationalities (Cokley, 2015). As the sample size is too small, biracial students were not used when comparing and analyzing races amongst one another. Students completed a demographic form and measures of the big three.

Minority status stress was measured by the Minority Student Stress Scale (MSSS). A scale that measures general student stressors and minority-specific stressors with 37 eligibility screening items (e.g. “Difficulties with having White friends' and “Having to live around mostly White people"). Imposter syndrome was measured by the Clance Imposter Phenomenon Scale (Chrisman et al.,1995). A scale that measures students' self-reflection with a Likert scale ranging from 1 (not true at all) and 5 (very true) with 20 eligibility screening items. Mental health was measured by the Mental Health Inventory-18 (MHI-18) starting with the following prompt: “During the past 4 weeks, how much of the time. Similar to that used to assess imposter syndrome, MHI-18, too, used a Likert scale but with 6 points where 1 represents “all of the time” and 6 “none of the time” with 18 eligibility screening items (e.g.“Did you feel depressed?” And “Have you been nervous?”). Cokleys’study found that Asian Americans reported having a higher GPA than that of African Americans. African-American and Latino students hold no significant differences in GPA scoring (Cokley et al., 2015). African Americans reported having a higher amount of environmental, racial, and intragroup-related stressors in comparison to Asian Americans. The results suggest that it cannot be concluded that there is a causal relationship between psychological distress or decline of mental well-being (i.e. academic performance and perceived performance) and physical well-being (i.e. acute/chronic illness, avoiding harmful behaviors, balanced diet, getting enough sleep) without more investigation; although, research does show that minority status stress in some measure negatively influences mental health outcomes (Jones et al., 2007). It may be that these questions must be further investigated with more specificity and a grander sample size. Minority stress and imposter feelings shared a direct relationship.

Imposter feelings share a direct relationship with psychological distress and a negative or indirect relationship with psychological well-being. As minority stress increases, so does self-reflective decline to imposter feelings. As imposter feelings increase, psychological stress increases. As imposter feelings increase so does psychological distress which negatively impacts psychological well-being, a domino effect. Results of a study also show that Asian Americans, despite a higher GPA, reported a higher sense of imposter feelings than African American and Latino students. The model minority type of imposter feelings influences this negative self-reflective psychology as it asks students to perform at an unhealthy perfectionist level and expectation. Even with a "positive" stereotype, student stressors are increased and so is the negative impact on their psychological health.

A recent longitudinal study published in the Journal of Educational Researcher has highlighted a concerning trend in STEM education. The study examined the educational paths of over 5,600 students (Black, Latinx, and White) who began their college education in the 2003-04 academic year. The purpose of this study was to investigate whether STEM facilitated the same inequitable experiences that other fields of education (business, social sciences, humanities) do and if such experiences affected Black and Latinx students' participation in STEM classes in comparison to White students. Participation was measured by change of major and or leaving college altogether (Riegle-Crumb, 2019). It is understood that differences in findings may be attributed to the lack of academic preparation due to existential and varying circumstances; moreover, the significance of knowledge and prerequisites required asks for students that have already obtained and mastered a certain level of skill (National Academies of Science, Engineering, and Medicine, 2016).

Riegle-Crumb and colleagues analyzed the following three research questions: First, are Black and Latina/o youth who begin college in STEM majors more likely to depart than White students, either by switching fields and earning a degree in a different major or by leaving college without a degree? Second, if so, to what extent do racial/ethnic gaps in STEM persistence remain net of other factors, particularly high school academic preparation? Thirdly, do racial/ethnic gaps in persistence to degree appear to be unique or more pronounced among STEM majors than in others (Riegle-Crumb, 2019)? Key findings from the study show that the initial interest at the outset of college studies reflected little difference in the percentage of Black, Latinx, and White students who declared STEM majors, with approximately 19-20% of each group starting in STEM. Black and Latinx students who initially declared STEM majors were found to leave those majors at significantly higher rates compared to White students. Approximately 37% of Latinx students and 40% of Black students switched majors, while only 29% of White students did the same. These elevated attrition rates may be attributed to the historical persistence of racialized bias primarily towards Black (with lesser impact toward Latinaxs) students. Completion rates for STEM majors were also lower for Black and Latinx students, with 20% of Latinx and 26% of Black STEM majors leaving their institutions without earning a degree, compared to only 13% of White STEM majors. The study did not pinpoint the exact reasons for these disparities but suggested minority students might face challenges related to having to prove their intellectual worth meeting expectations of high academic standards in STEM programs, and the prospectively different and socially secluded experience of being Black within a college STEM learning environment. These questions potentially exacerbate stereotypes about their intellectual abilities. Additionally, minority students may be drawn to majors and careers aligned with social justice issues, which they perceive as incompatible with STEM fields

as it does not provide opportunities for engagement in those social justice issues (Riegle-Crumb, 2019). Further research is needed to better understand the experiences of students of different backgrounds in STEM programs and identify specific factors contributing to these disparities. As the literature reviewed here highlights, multiple forms of racism, including microaggressions and stereotypes both within and beyond the classroom, have profound emotional consequences, leading students of color to feel undervalued and discouraged as their experiences are disregarded, distorted, and stereotyped.

With the purpose of understanding why students of color and specifically women of color are most underrepresented within STEM majors, researchers investigate the intersectionality of race and gender pertaining to the relationship between a sense of belonging (SB) and retention in STEM. 201 current or previous STEM majors in their collegiate senior year were interviewed about their experience. This study is part of a grander study designed to highlight traditionally underrepresented students in STEM fields called the Roots Of STEM Success Project. During the interview process, students were asked questions revolving around their SB (eg, “Do you feel like you belong/belonged in {your STEM major}? Did you ever feel out of place?” and “Has this feeling changed over time, and if so, what led to these changes?”) (Rainey et al., 2018). As researchers inquired about how students' family, childhood, peer-to-peer, and academic experiences influenced the choice to pursue a STEM major, results show that students from all demographics, whether they ended up staying or leaving their major, reported a lower sense of belonging. Of the underrepresented minority students (URM) who stayed in STEM (n=50), roughly 16% reported feeling a lack of SB compared to their White peers at an approximate 5%. Of students who dropped their STEM major, 100% of Asian students and approximately 87% of both URM and White students reported that they felt like they didn't belong. Students who

decided to leave STEM majors from all demographics share a common decline in SB. SB is influenced by a student's social atmosphere, interpersonal relationships, the way students identify and relate with their science field, personal interest, and the influence that has on a person's perception of self-competence (Rainey et al., 2018). As students' perception of competence is subjective, students form perspectives of continuing and leaving STEM majors shared their reasoning and feelings on their academic experience:

A Black man who stayed in their major of information technology shared that at times depending on how the class is set up and who is around them, they "do feel out of place- group project... I didn't really know that much, but with another group project... I felt like I belonged because I had good ideas and contributed to the group and people listened to me... It kind of varies." A White male student majoring in information tech shared how it could be awkward but after time, their SB grew, "At first I was just starting to get used to everything because I didn't know everyone but now I just fall right in." A Hispanic woman majoring in computer engineering expressed her feelings on how she felt her knowledge acquisition was less than her peers saying "My classmates had a lot of practical knowledge and... I didn't have all that knowledge and I was trying to learn it... I think that was a struggle for me." Showcasing the internalized effect of comparison when in an environment that skews the perception of a student's performance despite them scoring high or well. Students who decided to stay in their major share a sense of community, being able to show up as their authentic selves by contributing like this Black female who stayed in her major of biology, "[I feel like I belong in engineering because] it's what I do, and it's kind of becoming who I am. So it's kind of like… taking your major and becoming what it is." Although students decided to stay in their major or college career, some students shared a level of discomfort during their STEM experience, for

example, a student shared that they "sometimes I do feel out of place." The common underlying result of why students of color ultimately decided to leave is attributed to the format of the class, the content, and the safety their environment provided. Another student described mixed feelings of belonging, that varied depending on their self-perceived competence. Amongst students who stayed within or left their STEM major, their experiences all share a common contributing factor: interpersonal relationships. Interpersonal relationships (Table 1) were reported as the main reason for the lack of SB regardless of demographics. Sharing commonalities or being taken seriously by peers affects a student's ability to perform as their whole selves. URM students share difficulties engaging in group works and activities -as they must engage with peers who do not look like them nor share the same life experiences. Another attribute of the disparity is the systemic inequities exacerbated by privilege and the lack thereof. When students are surrounded by constant affirmations and an environment that values them as a student and person as a whole, the psychological effect affects the physical, which here we are speaking of grades and persistence in STEM. When students are not taken seriously or have peers that they can relate to, it becomes a challenge to develop those interpersonal relationships; thus, calling on cultural changes within the college environment and more specifically STEM majors to increase SB to positively impact URM student persistence. A greater SB increases engagement and enhances learning for students of all demographics. This especially benefits women and other underrepresented groups (White House) as it is a cornerstone for the persistence of URM students in STEM fields (Hrabowski & Maton, 2009; Museus & Liverman, 2011; Wilson., 2015). Experiencing racial microaggressions and a negative racial climate can undermine this sense of belonging, potentially leading to lower retention rates among URM students in STEM (Hausmann, 2007; Hurtado & Carter, 1997; Johnson, 2012).

Researchers who encourage students of color to "toughen up" and wear their resilience as “badges of honor” often fail to address the structural constraints perpetuated by everyday forms of racism and discrimination. This oversight leaves many students of color feeling exhausted and questioning their place in STEM fields (McGee, 2015). Students of color pursuing STEM education encounter a profound challenge: reconciling their identities with the prevailing archetype of exemplary STEM students. What makes an exemplary student? Is it the grade? Is it the effort? Where do STEM college values stem from (Pun intended)? Is it the knowledge a student obtains? What does the academic system do to foster an environment where a student can succeed without being distracted by the bias of others?

The roots of exclusion in STEM education can be traced back to a historical context of White male supremacy and scientific racism. Fabrications like stereotypes and racial minimizations were created to mitigate the intelligence of Native and Black peoples to justify the brutality pitted against such communities (McGee, 2016). Research by scholars such as Angela Saini in "*Superior: The Return of Race Science*" and Dorothy Roberts in "*Fatal Invention: How Science, Politics, and Big Business Re-create Race in the Twenty-First Century*" delves into the historical roots of scientific racism and its lingering effects. The distortion of scientific principles to justify racial biases has contributed to systemic inequalities in STEM fields. This bias can manifest in the form of underrepresentation, microaggressions, and a lack of inclusivity for diverse students in STEM classrooms. These racial stereotypes have morphed and evolved into culture, economics, and systems that are embedded within everyday systems. Scientific racism, including eugenics, which thrived in the late 19th and early 20th centuries, propagated socially constructed ideas of Black and Brown genetic inferiority. These ideologies advanced White hegemony in social, material, and scientific domains (Roberts, 2013). Eugenics, conceived for

White middle- to upper-class men and originating in military occupations, exerted a profound influence on U.S. institutions of higher education. These institutions explicitly excluded underrepresented ethnic groups from participating in the production of scientific knowledge (Swartz, 2009). Despite more than a century has elapsed since the introduction of eugenics, the typical STEM college student remains White, male, and middle-class, with some students of Asian descent (National Science Board, 2012). Consequently, STEM higher education remains racially stratified, with Blacks, Latinos/a, and Native Americans strategically placed at the lowest level of a fabricated hierarchy (Martin, 2009; Nelson & Brammer, 2010). Successful minority students often find themselves adopting hybrid identities that meld their STEM pursuits with their racial backgrounds; however, this accommodation comes at the cost of altering their self-defined authentic identities-which are fluid and evolving. An overemphasis on personal grit and resilience, characterized by perseverance and a passion for long-term goals, can be observed among these students (Golden, 2015; McGee & Stovall, 2015). A multitude of historical and contemporary practices have perpetuated disparities in STEM education, particularly affecting Black and Latino/a students. These practices include the absence of a critical mass of STEM Faculty of Color, impostor syndrome, unwelcoming institutional climates, institutional and social barriers within departments, racial/ethnic stereotyping, and a dearth of role models and mentors. High attrition rates among Black and Latino/a students in college STEM fields have been a consequence (Cole & Espinoza, 2008; Malone & Barabino, 2009; Robinson et al., 2016). Research has indicated that Black students, in particular, encounter difficulties in presenting themselves as scientifically adept, while Latino/a students contend with stereotypes that cultivate low expectations, bias, and racial discrimination. Ultimately leading to the depletion of talent in STEM disciplines (Carlone & Johnson, 2007; Sevo, 2009). Moreover, the analysis of tenure and

tenure-track (Kreiger underrepresented minorities in science and engineering faculty at research universities in 2010 revealed severe underrepresentation among Black and Native American assistant professors, indicative of a 7-year hiring lapse in certain disciplines (Nelson & Brammer, 2010). Despite the well-documented racial stratification in STEM, the field has failed to mount a meaningful response. Notably, an influential report raised concerns about the lack of support from STEM faculty and senior leadership, highlighting the need for systemic and systematic change and increased efforts to promote diversity and inclusion within STEM higher education (Cullinane, 2009). Some high-achieving URM students are aware of when and if they are being stereotyped. To address these challenges, URM students may create "counter spaces," safe and supportive environments outside of mainstream spaces in education, to navigate microaggressions and feelings of marginalization (Nkrumah et al., 2022). These students have adopted multitudes of strategies to manage some of the stress caused by these experiences. These strategies include but are not limited to, showing up prepared to be challenged or subjected to the perception of their intellectual capacity, and caring hypervigilance about negative stereotypes placed on Black communities in an attempt to not feed into them. Examples of this are showing up to class early, sitting in the front of the class, and excelling by accomplishing high on the grading scale to negate negative perceptions and “prove” worth (McGee, 2016). It is important to note that in attempts to show up in resistance, some URM succeed in their academic career by doing so while simultaneously showing up in their culture and authenticity and potentially “feeding” into stereotypes. It is important to note that these stereotypes may be so in Western culture, but they may be celebrations and common behavior in the native culture. An example of this is speaking at a louder volume in common areas. This racial battle fatigue (McGee et al., 2016) is a reality URM students face while simultaneously maintaining high achievement within

their classes and majors. Further research is needed to understand the role of counter spaces in URM students' success and belonging in STEM. Along with the sense of not belonging and managing interpersonal relationships, URM students face competition and impediments on programs, resources, and facilities meant to create opportunities for URM students.

Racial microaggressions, insults, stereotypes, and their impact on URM students pursuing STEM majors are significant areas of concern in higher education. The SB of these students is negatively affected; moreover, making the academic experience more challenging than their White counterparts in STEM fields. Inclusive campus cultures are vital for student well-being and academic success. According to the Higher Education Research Institute (HERI), 73% of students emphasize the importance of a welcoming environment. Further research is needed to better understand the dynamics of racial microaggressions, counterspaces, and the campus racial climate in the context of STEM education, to create more inclusive and supportive environments for URM students.

**Proposal Of Inclusive Solutions for Equity Against Racialized Exclusion in Postsecondary STEM Education Across Racial & Socioeconomic Lines**

Imposter syndrome can be addressed and potentially alleviated through various strategies, including paradigm shifts, building self-awareness, seeking support, and developing coping mechanisms. In a study that highlights the effectiveness of intervention strategies which examined the impact of the intervention on imposter feelings with the goal of testing the effectiveness of a brief cognitive-behavioral intervention for reducing imposter feelings, researchers aimed to validate the Clance Impostor Phenomenon Scale (CIPS) and test the effectiveness of a brief brain behavioral intervention for reducing imposter feelings (Chrisman et al.,1995). The intervention involved group discussions, journal writing, and reframing negative

thoughts related to imposter feelings. While the exact details of the interventions may not be provided, some common elements typically found in behavioral interventions for imposter syndrome include group discussion, journal writing, thought process restructuring by self-affirmations, setting goals, and most importantly, being in an encouraging environment.

Specific interventions used in cognitive-behavioral therapy for imposter syndrome can vary, and they may be adapted to the needs and preferences of the participants. The primary goal is to help individuals recognize and manage their imposter feelings, develop a more accurate self-perception, and build self-confidence. Participants who scored high on the CIPS and exhibited imposter feelings were divided into two groups: one receiving the intervention and another acting as a control group. The results of the study showed that the intervention group experienced significant reductions in imposter feelings compared to the control group. Additionally, participants who had undergone the intervention reported increased self-esteem and self-confidence. This study demonstrates that targeted interventions, such as cognitive-behavioral techniques, can be effective in reducing imposter syndrome and improving individuals' self-perception. Underscoring the importance of recognizing imposter feelings and actively working to mitigate their impact on individuals' self-esteem and self-confidence.

In intervention groups, participants undergo a multifaceted approach to address imposter syndrome. Structured group discussions led by a facilitator, encourage individuals to share their experiences, fostering a sense of shared understanding. Journaling is encouraged as a tool for self-reflection, enabling participants to gain insights into their thoughts and feelings. Additionally, Cognitive restructuring techniques are introduced to challenge and reframe negative thought patterns associated with imposter feelings. In partnership with cognitive restructuring, self-affirmation exercises are necessary. Self-affirmation exercises help

participants recognize and celebrate their strengths, accomplishments, and positive qualities; thus, boosting self-esteem. The idea is the holistic upliftment of the individual. Talking about imposter syndrome can lead to journaling to identify what's working, not working, and actionable steps to finding paths that are more trauma-informed and culturally responsive. The purpose of these approaches is to lead with individual empowerment by setting achievable goals and tracking progress that teaches point-in-time realistic expectations while acknowledging successes. For this to work, a supportive environment is non-negotiable. The creation of supportive and non-judgmental environments within the group must be prioritized to ensure individuals feel comfortable sharing their thoughts and vulnerabilities.

The decline in a student's sense of belonging and academic retention of Black and underrepresented students in STEM is influenced by imposter syndrome, racism, institutional responses, and the intersectionalities of these. Addressing seid issues requires a concentrated effort from educational institutions to implement culturally responsive practices that promote equity, inclusion, and a sense of belonging for all students. Culturally unresponsive academic settings can perpetuate stereotypes, microaggressions, and systemic biases that contribute to the development of imposter syndrome. The absence of diverse perspectives and role models can leave minority and underrepresented students feeling isolated and undervalued, intensifying their imposter feelings; thus, fostering culturally responsive and inclusive academic environments is crucial in mitigating imposter syndrome and creating a sense of belonging for all students, regardless of their background or identity. Addressing imposter syndrome through support systems, counseling, and self-compassion practices is essential not only to help students realize their full academic potential but also to promote their long-term career success.

**Online Modality: Potential & The Current Conversation**

Is the administration of virtual education the issue, or is it something else? The pandemic of 2019 challenged the narrative of student success. The normative modality of in-person education methods were forced to morph into an online presence. Online educational methods allow students an alternative way of learning (Basar et al., 2021). As an imperative resource during the pandemic, online modality is increasingly growing. In the latest NC-Sara report, distance education enrolment has drastically increased by a rough 93% in Fall 2020 since enrolment in Fall 2019 (NC SARA, 2021). Underrepresented students often confront a complex intersectionality of challenges encompassing their race, gender, access to basic needs such as food and transportation, and financial insecurity. These multifaceted barriers can significantly impede a student's ability to thrive and reach their full academic potential (Donald et al., 1984). The intersection of these factors creates an environment where students may struggle to focus on their studies due to the pressing concerns related to their well-being and basic needs. For instance, research has shown that food insecurity and financial instability can lead to increased stress and decreased academic performance among underrepresented students (Gundersen et al., 2014). Challenges related to transportation and the need for affordable and reliable transportation options can further exacerbate these issues, making it difficult for students to physically attend classes. Students- particularly Black students, may have caregiving responsibilities and full-time jobs, limiting their ability to attend in-person classes. Approximately 20% of Black students are caregivers, compared to 11% of other race students. 15% of Black students care for adult family members and 11% of students are parents or guardians in addition to that responsibility. Online modality may be a bridge to the gap of the implications of these factors (Gallup, 2022).

Online education can offer a potentially safe space for some underrepresented students to overcome these multifaceted barriers present in traditional, in-person modalities (Allen et al., 2017). Through online learning, students may have the flexibility to manage their education alongside addressing their basic needs and other responsibilities. This flexibility can alleviate some of the stress associated with food insecurity, transportation challenges, and financial instability, as online courses often provide the option to study remotely and at their own pace (Means et al., 2014). Despite being online, this type of educational resource requires teachers to grade with unbiased and create literature and online classroom spaces that uplift every student and their learning language. In a public school with a greater population of Hispanic minority students, 1231 URM and non-URM students were surveyed in 2021. These students were observed to find the answers to questions: Were students' outcomes based on their race, lack of resource circumstance, or both? If there was a difference in students' understanding and perceptions of online courses? How do the varying student conditions and experiences influence those perceptions? How do those perceptions impact future online registration engagement or desire to pursue future academic career opportunities? These questions inquire about demographics, perceptions of online courses, academic career goals, previous online course experience, and course load. Students were recruited via random distribution by professors amongst the student body. In this study, students shared an overall positive outlook on the online course experience, and comparing in-person and online, the experience was less than ideal. Suggestions include an increase in the approach by staff and teachers, as it was “not at the level to cope with the liabilities and maximize the opportunities of online teaching.” Although this was a minority-serving institution, in comparison to their White counterparts, URM students still on average were graded poorly (Sumbera et al., 2022). Calling on increasing encouragement,

support, training, and resources for teachers to create new avenues and learning mechanisms to support their students in these alternative spaces best. While online education is not a one-for-all and comes with its own set of challenges, it can serve as a vital resource for underrepresented students seeking to escape the compounding burdens of intersectionality and create a more conducive learning environment.

A study performed by Doctor Igor Chirikov and colleagues tracked 300 students in Russia. Each student was given either a controlled or randomized test. Students were given options to attend a class virtually, in person, or with a hybrid methodology. Interestingly enough, students who attended the complete online mobile scored 7.2% higher on their in-course assessments; although, some students who used this methodology were slightly less satisfied in comparison to their peers who participated in the in-person or hybrid course experience (Chirikov et al., 2020). At lower costs, students who go to learn only online have an equivalent learning outcome to students who attend in person or have a hybrid schedule. (Mentzer et al, 2023; Chirikov et al., 2020).

Some media networks, teachers, and communities of students consistently express the difficulties that come with the online modality of learning. The constant narrative some media sources have shared is that the most affected populations include communities of color; yet, students are voicing their preference for more flexibility in educational systems. Pew Research Center surveyed 5,000 Black adults inquiring about their perspective on how they think Black people are represented within the media, although the majority of URM students share a different perspective. Almost two-thirds of Black adults (63%) say news about Black people is often more negative than news about other racial and ethnic groups; 28% say it is about equal and 7% say it is often more positive. 57% of participants felt that Black communities were negatively respected

within the media, and 50% shared that stories of Black communities are missing more information when presented. In the most recent How America Pays For College report conducted by Salle Mae, although 75% of students and families prefer face-to-face education, 68% of Black respondents and 60% of Hispanic respondents feel positive about online learning (Sallie Mae, 2023). As there is not enough research on this topic, what exists, research suggests that it is not online education that is the issue, but the lack of resources. Without resources, a student's ability to focus and retain information is displaced, placing them in a constant frantic state of mind.

There is an overwhelming conversation about the barriers that online education has had on Students and teachers-especially those underrepresented. Alternatively, articles within my annotated bibliography highlight the barriers of online modality being attributed to the lack of access to technology devices, internet service, and a reliable connection, not students' ability to succeed virtually. Proposing the opposite question of how barriers to on-site modality have affected students, research suggests a summary of socioeconomic and racial disparities. Online modality has the potential to limit and remove these barriers (Vallespine et al., 2023). Highlighting the importance of online modality and why it should be invested in, to best support all students long-term opens opportunities for students with various home responsibilities, learning languages and processes to approach academia in the best way possible for them. Research has consistently indicated that online educational barriers are often associated with limited access to essential resources, primarily computers and the Internet (Chen, 2013; National Center for Education Statistics, 2019). A study aimed to understand factors that influence students' choices between online and face-to-face classes in higher education found that the preference for online or in-person classes was influenced by various factors, including

convenience, flexibility, and learning style. However, it didn't primarily focus on the digital divide but provided insights into why some students might opt for online courses. It is essential to recognize that the primary obstacle faced by many individuals is access to these virtual learning environments. Pre-pandemic in 2019, 66% of Black households and 61% of Hispanic households have high-speed internet, 79% of Asian and White households. Post-pandemic in 2023 68% of Black households and 75% of Hispanic households have high-speed internet, compared to 84% of Asian households and 83% of White households. Pew Research Center presents data that indicates that 35% of lower-income households with children lack high-speed internet. The lack of accessibility to computers forces students to use mobile devices as a means to an end-reducing student participation in remote learning as technological issues can lower student course satisfaction (Pew Research Center, 2024; Vogels, 2021; Yan et al., 2021).

A study conducted by NCES (2019) found that disparities in internet access and computer availability were significant factors contributing to students' limited participation in online courses. These inequities can disproportionately affect underrepresented populations, exacerbating educational inequalities (Ndibalema, 2022). Therefore, addressing the digital divide and ensuring equitable access to technology is paramount in enhancing the overall effectiveness and inclusivity of online education. NCES additionally explored the availability and utilization of distance education courses for K-12 students in public schools during the 2017-2018 academic year. The study found significant disparities in internet access and computer availability among K-12 students. The digital divide is a major obstacle to students' participation in online courses and its potential impact on educational inequality. Lau's study of schools in Botswana investigated the factors influencing the adoption of online learning in public secondary schools. Focused on understanding the challenges and motivations for educators and students, key

findings include infrastructure limitations, teacher attitudes, and students' access to technology as critical determinants of the adoption of online learning in secondary schools.

Another study examined the impact of the digital divide on underprivileged students' access to technology and its subsequent effects on their educational outcomes. The research emphasized that the digital divide, primarily driven by disparities in technology access, can lead to unequal educational outcomes. It highlighted the importance of bridging this divide to ensure equitable access to educational resources and opportunities. These studies collectively underscore the importance of addressing the digital divide, particularly in the context of online education, to ensure that all students have an equal chance to access and benefit from educational resources and opportunities.

**Culturally Responsive Institutional Strategies:**

101 STEM students and their perceptions of online learning were examined. Presented with a survey, a study looks into the advantages, academic challenges, and solutions that online education may provide. Perceived advantages showed that students felt that watching a pre-recorded lecture video several times increased their advantage. Also, their technological skills increased, as teachers using alternative and innovative ways to connect with their students were helpful. The perceived academic challenges include not being able to concentrate, having other life responsibilities, and slow internet connection. A solution suggested by Vallespine calls for teachers and academic leadership to provide STEM students equitable and more reasonable time to complete assignments, mandatory training for teachers to learn more about online delivery and various teaching methods, and being able to provide computers, internet, or other resources necessary to students who may not have access. This concentrated effort calls for

educators and faculty to acknowledge their biases and the power dynamics within educational systems perpetuating disparities.

Online education offers several notable advantages for Black and Brown students: flexibility, safe spaces, differentiated learning, and fatigue relief. Many minority students are juggling multiple responsibilities, such as part-time jobs, family obligations, and community involvement. In comparison to non-URM students, URM and first-generation students are 46% more likely to be employed and have greater familial responsibilities (Sumbera, 2022 ). Online courses provide flexibility to manage schedules effectively, allowing the pursuit of education while fulfilling other commitments. This adaptability can be especially vital for minority students who might be more likely to work part-time or full-time jobs to support themselves and their families during their educational journey.

Another significant advantage is the potential for online education to create a safe learning environment for Black and Brown students (Harper et al., 2009). Traditional brick-and-mortar institutions can sometimes be marred by incidents of discrimination and bias, impacting students' ability to focus on their studies. In contrast, the digital classroom can provide a sanctuary where students can engage with course materials without the fear of racial prejudice. It fosters an inclusive and equitable atmosphere that allows students to feel valued and heard. Additionally, online courses often bring together a diverse cohort of students from various backgrounds, which can enrich the educational experience by exposing students to a broader range of perspectives and cultures (Means et al., 2013).

Students' points of view about live lectures in comparison to online/accelerated lectures and reasonings, were assessed to investigate medical school attendance. 352 students were sent questionnaires, although only 204 responded. Students questioned were in their first and second

year at Harvard Medical School. Results reflected that 57% of students shared a preference for live (in-person) lectures, 29.4% for recorded, and 3.8% favored both methods. As all students watched the record (online modality) lecture, 88.5% used video-accelerating technologies. In comparison to attending class in person, 79.3% of students voiced that the flexibility that comes with accelerated technologies was beneficial as online modality increased the speed of knowledge acquisition. 67.7% of students shared that their ability to look into other resources had increased, 64.8% of students shared that they felt like they could focus more, and 63.7% of students shared that they could learn more. Overall, students indicated a more prominent preference for online/recorded modalities because of the accessibility and flexibility that came with increasing the lecture speed and its effect on preventing learners' fatigue (Cardall et al. 2008).

While online education offers numerous advantages, it also comes with specific challenges and disadvantages that can disproportionately affect Black and Brown students. It is not strictly homogeneous. What works for one student will not work for another. One of the most pressing issues is the digital divide (Chen & DeNoyelles, 2013). Many minority students lack access to the necessary technology, including computers and high-speed internet connections, which are essential for effective participation in online courses. This digital divide exacerbates existing educational inequalities and limits the ability of some students to engage in online coursework fully. It highlights the urgency of addressing these disparities to ensure that online education is genuinely accessible to all.

Another significant disadvantage of online learning is the potential for isolation and disconnection (Phirangee et al., 2017). Traditional classrooms provide a sense of community and support that can be challenging to replicate in virtual environments. For Black and Brown

students, who may already face feelings of marginalization in predominantly White institutions, this sense of isolation can be further amplified in online courses. Additionally, the quality of online courses can vary widely, with disparities in resources and support available to students (Means et al., 2013). This variability means that Black and Brown students may encounter inequities in their educational experiences, which should prompt institutions to invest in high-quality online education resources and support services to bridge these gaps.

Online education, as a potential alternative modality, offers the advantage of reducing the physical presence of students in traditional STEM classrooms. Research conducted by Allen and Seaman (2017) has indicated that online education can create more inclusive spaces by allowing for asynchronous engagement and reducing the potential for microaggressions that might occur in face-to-face interactions. Additionally, online platforms can facilitate greater access to a broader range of educational resources, potentially mitigating some of the disparities faced by underrepresented students in STEM. Racism and microaggressions have striking repercussions on underrepresented students in STEM as it impacts academic achievement and overall well-being. Adopting online education modalities may offer a promising avenue for mitigating these issues by providing more inclusive learning environments and broader access to educational resources; however, it is crucial to recognize that online education is not a panacea. It should be implemented alongside broader efforts to address racism and discrimination in STEM academia to ensure that all underrepresented students have equal opportunities to thrive in these fields. As the world has modernized, so must academia. The evolution of technology in education is not only a societal necessity but an essential in learning. Calling upon educators and universities to invest in their programs and students, especially in STEM, as there is a gap

between the number of online classes and courses in STEM offered in comparison to other majors (Flowers et al., 2012).

In attempts to address such challenges, institutions must adopt culturally responsive strategies that include mentoring programs, diversity initiatives, and inclusive curricula tailored to the needs of underrepresented students in STEM (Ladson-Billings, 2014). Imposter syndrome is exacerbated by the absence of a safe and inclusive environment, particularly in traditional White-dominated academic settings that often lack cultural responsiveness. Culturally responsive, or otherwise identified as culturally relevant teaching introduced by Dr. Ladson-Billings in 1992 is “a pedagogy of opposition (1992) not unlike critical pedagogy but specifically committed to collective, not merely individual, empowerment (Ladson-Billings,1995). Culturally relevant teaching emphasizes the incorporation of diverse cultural perspectives into educational practices and the tailoring of instruction to resonate with students' backgrounds. Originating within the educational department by Dr. Geneva Gay, cultural responsiveness (CR) is the use of cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them (Gay, 2018). Culturally relevant teaching, further developed as culturally responsiveness fosters an inclusive learning environment, bridging cultural gaps and promoting engagement and understanding among a diverse student body.

Minority and underrepresented students often grapple with the feeling of not belonging due to systemic/systematic and cultural factors that perpetuate a sense of exclusion. Studies, such as those by Smith and Turner (2015) emphasize the detrimental impact of hostile campus climates on the well-being and academic performance of minority students, contributing to the development and perpetuation of imposter syndrome. These environments often fail to recognize

and address the unique challenges and perspectives of diverse student populations, further isolating minority students and intensifying their feelings of not fitting in. Imposter syndrome can contribute to a lack of motivation, causing some students to disengage from their studies and, in severe cases, drop out of their academic programs, as highlighted by Bernard, Dollinger, and Ramaniah (2002). This disruption in academic retention can have long-lasting consequences on career outcomes, as academic performance is often a critical factor in securing employment and career advancement opportunities. Therefore, addressing imposter syndrome that is exacerbated by campus climate is not only crucial for students' mental well-being but also for their academic and career success.

**Concluding Thoughts**

Contrary to the notion that online learning serves as a panacea for issues of discrimination on campus, it is crucial to recognize that it is not a one-size-fits-all solution. While it can address some challenges, a comprehensive approach is required. The literature suggests that implementing online spaces with inclusivity at the forefront, incorporating culturally responsive sustaining practices, and adopting trauma-informed approaches is a pivotal step in the right direction (Brown et al., 2022). Creating safe learning environments in virtual spaces underscores the significance of acknowledging and dismantling discrimination, contributing to a more equitable and accessible educational landscape.

The prevalence of intersectionality of isms and discrimination within the campus environment necessitates a proactive approach from educators and administrators. Acknowledging and addressing individual biases is imperative for fostering an inclusive and comprehensible learning space. Research underscores the significance of educators recognizing their predispositions and actively engaging in efforts to transform themselves. Those with

privilege must recognize their role and leverage their positions in dismantling discriminatory structures by actively supporting initiatives that provide equitable opportunities in STEM (Gosztyla et al., 2021).

By embracing diversity and cultivating an atmosphere of understanding, educators, admin, leadership, etc. are key contributors to creating an educational environment that is conducive to the diverse backgrounds and experiences of students. This commitment must align with emphasizing the importance of inclusive practices for the betterment of the educational system as a whole and most importantly, its students.

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**Table 1.**

(Rainey et al., 2018)

Students Reasons for Not Belonging in STEM By Race and Gender