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Exploring Success Factors for Underserved Graduate Students in STEM

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Abstract

Inequalities in enrollment in STEM persist for those entering higher education as first-generation college students, underserved racial and ethnic groups, female and nonbinary individuals, and those from lower socioeconomic backgrounds. The current study aims to better understand the relationship students have with graduate school success factors by redistributing the Graduate Student Success Survey+ (GSSS+) at an R2 institution in the southeastern United States. Exploratory factor analysis was used to test the survey's validity, with 242 participants. A 7-factor, 40-item model was developed, comprising the following subscales: mentor support, peer support, imposter phenomenon, financial support, microaggressions (related to race and gender), access and opportunity (for research, writing, and presentations), and resilience. Item analysis identified perceived barriers (e.g., microaggressions, imposter phenomenon, and financial stress) for underserved students (i.e., females, underserved racial and ethnic groups, and part-time students). Regression analysis on resilience revealed a positive relationship with mentor support, peer support, and financial support. A negative relationship with resilience was associated with a greater perception of imposter phenomenon. Findings from this study underscore the need for additional support from mentors and other university entities to foster a stronger sense of resilience in students, along with increased opportunities for participation in research, academic writing, and publication.

Keywords: graduate education; mentor support; peer support; imposter phenomenon; microaggressions; financial support

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1. Introduction

Obtaining a graduate degree provides greater job security and potential for advancement, in addition to personal growth and fulfillment [1]. Incorporating students from diverse backgrounds can improve various fields of study, particularly science, technology, engineering, and mathematics (STEM) [2–4]. However, underrepresented students enter higher education while navigating the intersectionality of racial, gender, first-generation status, and socioeconomic inequalities [5–10]. An array of factors has been identified that influence success in graduate school, including microaggressions, mentor support, imposter phenomenon, and financial support, which differentially affect students from underrepresented groups (e.g., [11–13]). Despite identifying the barriers, a dearth of information still exists on how to best support underrepresented students in graduate education [14,15].

The barriers that underserved students face are especially concerning in the STEM field. A career in STEM can play a crucial role in social mobility and contribute to the

success of students from disadvantaged backgrounds. A variety of socio-cultural factors influence students' identities, impacting the barriers they may encounter. These barriers can be mitigated through structural support from institutions, such as mentorship and cohort-style programs. The type of support students need may be dependent on a variety of factors, such as being a part-time student or identifying as a member of an underserved racial group at a primarily White institution (PWI). Developing a stronger understanding of students' experiences can illuminate supports to enhance student learning and create a more inclusive graduate school climate (e.g., [16]).

1.1. Purpose Statement

This research project distributed the Graduate Student Success Survey+ (GSSS+, Table A1) at an R2 institution located in the southeastern United States. R2, or Research Activity 2, is a classification for doctoral-granting universities with high research activity, whereas R1, or Research Activity 1, is a classification for very high research activity [17]. R2 institutions award a minimum of 20 research doctoral degrees annually and spend at least $5 million annually on research and development. The institution at which the survey was distributed can also be described as a PWI, as the student population primarily consists of students who identify as White. The purpose of this research was to understand the barriers and supports students encounter in graduate school (i.e., financial support, mentor support, peer support, microaggressions, imposter phenomenon, access and opportunities to conduct research and write academic papers, and resilience). The study also aimed to understand how these supports vary across different groups (e.g., racial/ethnic groups, gender, first-generation status, program type). The survey was previously distributed to 23 universities in Fall 2022 and tested for validity and reliability [18]. The prior iteration was distributed primarily at R1 institutions and did not include responses from professional students or those in non-research graduate programs (e.g., EdD or MAT). The current iteration aimed to gather insights from a wider array of students (e.g., medical and EdD) to gain a deeper understanding of the various types of support available across programs. The current study also provides insights from an R2 institution, which can be especially insightful in supporting research-based graduate students, compared to previous work at R1 institutions.

1.2. Literature Review

Earning a graduate degree is a challenging task, and completion rates have been documented to vary between subgroups based on race and gender (e.g., [7,19]). Attrition rates for professional programs, such as law school and medical school, are estimated to be between 5 and 15% [20–22]. In stark contrast, Ph.D. programs' attrition rates peak at 50% [20,22,23]. The attrition rates for underrepresented students (e.g., females in STEM, underserved racial and ethnic groups, or first-generation students) are even higher [21]. Many universities share concerns over attrition rates for doctoral programs; however, there is a deficit of research about retaining candidates once they begin doctoral programs [24]. Furthermore, the research on graduate students generally focuses on one factor (e.g., sense of belonging, microaggressions, or imposter phenomenon), missing the complexity of the graduate school experience [25–27].

The supports students need vary between students because the graduate school experience is impacted by many personal factors, such as gender or marital/family status, as well as student status (e.g., part-time, international, or program type). The complexity of the experience necessitates the importance of a holistic approach for analysis. Prior research has investigated the graduate school experience through several studies. Common feelings that doctoral students face include isolation, confusion, and feeling overwhelmed [28]. West

et al. [29] established that students struggled with time management between the challenges of doctoral studies and life obligations (e.g., working full-time, caring for family members, childcare demands, or financial stress). These findings were supported by Pyhältö et al. [30], who identified the required skills for doctoral students to include: motivation, self-efficacy beliefs, and time management. Through a critical literature review, Brill et al. [31] confirmed that providing effective mentorship for faculty and students alike was a successful approach to improve graduation success.

1.2.1. Mentor Support

Mentor support and peer support have been identified as valuable resources to assist students in navigating program milestones [32]. Faculty mentoring can foster interactions between students and institutions [33] while also supporting students in developing critical thinking and making informed academic decisions [34]. West et al. [29] identified three types of support that faculty advisors can provide, including coaching, psychosocial support, and networking. Mentor support may need to be tailored to the needs of students. Ku et al. [35] suggested that international professors in the United States (U.S.) can act as effective ambassadors for the additional challenges international students encounter (e.g., different learning styles and language barriers). Peer relationships were another source of support for students, helping graduate students navigate program challenges [36]. Peer-mentoring experiences offered instructional, writing, and emotional support for students [24].

Mentorship is often cited as a mechanism to increase the rate of degree recipients in underserved groups. However, concerns arise when there is a disconnect between the mentor's background and that of the students. A prior study sought to understand the impact of mentorship in Black males pursuing a STEM PhD [37]. Sixteen Black males participated in one-hour interviews, revealing that mentoring was connected to race, career development, and the development of a scientific identity. One participant expressed that a good mentor had realistic expectations, was adaptable, and willing to grow. Another participant expressed frustrations with his advisor, citing erratic guidance, a lack of focus, and unpredictability. This study highlights a psychological effect called onlyness [38], or the psychological burden of navigating a racially politicized space occupied by few others from one's racial or ethnic group. Participants explained that many of the non-Black male mentors showed sensitivity to societal stereotypes of Black males' achievement in higher education. However, the lack of visibility of Black males, even at Historically Black Colleges and Universities (HBCUs), was a concern conveyed among participants, indicating the need for additional support in the area of mentorship for underserved students.

Beyond graduate students, mentoring serves as a mechanism to recruit, retain, and promote females in STEM faculty positions, which is critical for minimizing gaps in diversity in higher education. Buzzanell et al. [39] analyzed the mentoring narrative of women of color in faculty engineering positions at U.S. institutions through in-depth interviews. The participants in the study regarded the culture of mentoring with varying levels of suspicion, ambiguity, vulnerability, and dis/enchantment. The mentoring assisted participants in understanding how to complete things correctly, achieve career goals, experience meaningfulness in their work, and learn how to complete academic work in more productive and personally satisfying ways.

Mentoring has been recognized to have many positive attributes for greater success in graduate school, but this needs to be considered in relation to students' personal characteristics as well. Several groups of students (e.g., underserved racial groups and first-generation students) encounter different barriers in higher education and therefore may need other types of support.

1.2.2. Underserved Racial and Ethnic Groups

Historically, graduate school was composed of White males from higher socioeconomic backgrounds. This trend remains evident in many fields of study, such as STEM [7]. Current research often examines the role of mentors with underserved students to gain insight into the possible reasons these trends persist. Okahana et al. [40] completed a multivariate logit regression model to understand the factors affecting STEM doctoral completion rates of underrepresented minority (URM) students. This study utilized student-level data on completion and attrition for enrollment records of Black, Latino/a, and other URM students who began their STEM doctoral studies between 1992 and 2012 from 21 research universities in the U.S. The analysis revealed that Black students completed STEM doctoral degrees at lower rates than other underrepresented groups. Black students were also 1.8 times less likely to have earned their doctorate in the life sciences than Latino students. Furthermore, female URM doctoral students in the physical and mathematical sciences took longer to complete their doctorates than other students. The lack of representation of females from underserved racial or ethnic groups is a prominent concern in the physical and mathematical sciences.

Some fields in STEM are more welcoming to females, such as life science, whereas others have historically been dominated by White males, including mathematics [19]. Understanding why females have higher rates of participation in certain areas of STEM can provide insight into the necessary supports for underrepresented students. Borum and Walker [41] investigated the experiences of twelve Black women with doctoral degrees in mathematics through in-depth interviews and historical documents. The seven women who attended HBCUs reported positive experiences and perceived support from faculty and students who encouraged them to pursue a doctorate in mathematics. Students who attended non-HBCUs described feelings of isolation and being targeted for their race or gender. Mentorship and peer support were identified as beneficial aspects of some women's graduate experience, whereas other women cited discrimination and a lack of support as inhibitory factors. Two participants sought doctorate degrees at other institutions due to negative experiences during their master's work, which they recounted as traumatic and damaging to their self-esteem. The variance in support from different types of institutions may provide insight into understanding how to best support underserved groups.

The underrepresentation of URM females in STEM programs and careers is considered a leading cause of the loss of valuable perspectives that could contribute to research and practice [42,43]. To gain insight into this issue, Guy and Boards [44] used a group participatory methodology to investigate the experiences of URM females completing STEM degrees. Seven of the eight participants were graduate students, two identified as Latina, and six identified as African American. Four themes related to the experiences of URM females in STEM were uncovered: mentoring, research, opportunities, and academia. Mentors were identified as a critical component to STEM success for URM females; however, there was a lack of mentors who understood the unique experiences of being a minority in STEM. Participants recounted that not seeing other females of color in STEM fields was discouraging, and many had experienced professors discouraging them from pursuing academic careers. The participants also noted there was an expectation for students who identify as a minority to focus their research on minorities. The study's participants maintained a passion and drive for academia and research that moved them forward in STEM.

1.2.3. First-Generation College Students

Another group facing additional barriers in graduate school is first-generation college students, comprising 29.8% of doctoral recipients in the United States [7]. These are

individuals whose parents did not earn a bachelor's degree [10]. First-generation students often experience an intersectionality of underserved groups, as more than half of first-generation college students identify as an underrepresented racial or ethnic group (54%) and over a quarter of first-generation college students come from lower socioeconomic households (27%) [45]. Continuing-generation college students are individuals whose parents earned a bachelor's degree. They have the opportunity to use their family's collective history and knowledge as a cognitive map as a source of guidance during graduate school [33,45,46]. Gardner and Gopaul [47] posited that first-generation college students may experience additional difficulties in persisting in graduate programs without the scaffolding knowledge from family members. Furthermore, differences in feelings of belonging, academic performance, and persistence [48] may account for the cultural mismatch that many first-generation students experience during college [16,49]. Gaining insight into the barriers first-generation students face can provide insight into the support they may need to be successful (e.g., mentor support, peer support, and opportunities to conduct research).

Students can also identify as first-generation graduate students, a subgroup of students whose parents earned a bachelor's degree but not a graduate degree. These individuals have a potential source of guidance during the completion of their undergraduate studies, but the familial knowledge declines during graduate school. Hutson et al. [50] completed a mixed-methods study of first-generation graduate students through surveys collected from students and faculty at a private university in the U.S. The study included 60 graduate faculty and 247 graduate students. The findings identified the motivations for attending graduate school as: advancement in current position, pursuing a different career path, and personal satisfaction or interest. First-generation students indicated personal satisfaction or interest at a greater rate (60%) than the whole group (17%). Eighty-seven of the participants felt very supported or somewhat supported by their families. However, 74% of those participants who felt a lack of support from their families were first-generation students. Forty-four percent of participants indicated that time management was a significant challenge during their graduate experience, whereas only 20% indicated that family responsibilities were a considerable challenge. Of those who selected family responsibilities, 65% were first-generation. Only 23% of the study participants reported taking a break during their graduate studies; first-generation students comprised 63% of those who responded that they had taken a break during their graduate studies. These findings support prior research with first-generation undergraduate students, indicating the need for additional support for this sub-population (e.g., [9,33,51,52]).

1.2.4. Psychological Barriers for Graduate Students

Students from underserved groups often encounter additional barriers during graduate school. Their lower representation as professionals in the field and professors at institutions may result in fewer mentors who reflect the experiences of underrepresented graduate students and understand their personal journeys. This disparity can lead to concerns about a lower sense of belonging or a lack of resilience. Similarly, individuals who lack representation at a university (e.g., underserved racial groups at PWI) or within a program (e.g., females in STEM) may face additional challenges with impostor phenomenon or microaggressions.

Microaggressions are subtle or passive-aggressive behaviors that may initially be overlooked due to their simplicity but imply negative stereotypes based on race or gender [26]. They can be carried out through comments, behaviors, or environmental circumstances. Microaggressions toward race have been associated with lower self-esteem in undergraduate students [53]. In contrast, microaffirmations are words and behaviors to support racial

identities and social justice [26]. Prior research has correlated the relationship between lower retention rates for females in STEM fields and the lack of encouragement from faculty, as well as the competitive nature of STEM programs [54].

An additional psychological barrier faced by many graduate students is imposter phenomenon, also known as imposter syndrome. This phenomenon is the belief that one has achieved success due to luck or circumstances, not to personal attributes [27,55]. Individuals who are characterized by this phenomenon often achieve greater than average success in school or in their career but maintain a fear that they will fail at the next major challenge. These individuals struggle to believe they hold the necessary skills to be successful and worry that others will realize they do not belong to the group. Prior research has found that approximately 95% of females in higher education experienced moderate to intense levels of imposter phenomenon [56]. However, a positive relationship between racial identity and self-esteem in URM undergraduate students has been linked to lower perceptions of imposter phenomenon among URM in STEM [57,58].

As imposter phenomenon highlights concerns of not belonging, the socioemotional aspects of graduate school often relate to how students perceive their place in the academic community. Sense of belonging is the degree to which an individual believes they belong to a group or community, a contributing factor to graduate student success [59]. Advisors and faculty contribute to students' sense of belonging, as they are often the individuals with whom students primarily interact during graduate programs [60,61]. Just as academic support is critical to student success, individuals who can provide socioemotional support can be beneficial as well.

Many of the prior psychological aspects can impact students' sense of resilience toward completing graduate school [32]. This concept reflects students' ability to adapt to challenging situations, maintain motivation, and persist to graduate [62]. High levels of stress and anxiety have been documented to be a common occurrence in graduate students [63,64]. These factors can have a negative impact on students' mental health, undermining their sense of resilience and contributing to high attrition rates in graduate programs. Gaining insight into the complexity of the psychological barriers many students face can provide guidance on how to better support students.

1.3. Theoretical Framework

1.3.1. Social Identity Theory

Social identity theory (SIT) examines how individuals construct their identities in relation to social groups, thereby protecting their self-identity [65]. Social identity is an individual's sense of self in relation to a group [65]. Tajfel and Turner proposed that group identity serves as a source of pride and self-esteem, helping individuals develop a social identity and a greater sense of belonging. For individuals to maintain a positive self-identity, they must establish a positive value for their group compared to other groups [65].

The group to which an individual belongs is the in-group, whereas those individuals they perceive as different are classified as the out-group. Students may belong to various groups to which they identify, referred to as dual identities, and alternate between these identities in different environments [66]. In graduate school, individuals may identify with their university, program area, or research group. Away from the university, students may identify with their racial or ethnic group, religious beliefs, or cultural background. Tajfel and Turner [65] explained that in-group membership produces a positive bias toward the shared characteristics of group members, along with the creation of a collective, depersonalized identity within the group. The group characteristics can lead to the distinction of in-group features and exaggeration of differences for the out-group [65,67,68].

Emotionally laden, positive in-group bias can be viewed as a comparison of self to others concerning a threat [69]. Negative out-group characteristics can result when the out-group poses a threat and the in-group has an increased need for identification, as with protection or self-enhancement [70]. In graduate school, students may gain emotional strength and motivation from the success of their classmates, whom they view as their in-group. For example, individuals may be more motivated to submit a proposal to a conference knowing that other individuals in their research group (in-group) were accepted to the same conference. Students may share the idea that individuals in their research group (in-group) are strong researchers with valuable information to present to the research community (positive in-group bias). In-group members may focus on previous failed attempts or instances in which the research was flawed (negative biases) from other research groups (out-group) to diminish the perceived threat of the out-group, while simultaneously reinforcing the positive attributes of the in-group. As group members observe positive behaviors from the in-group and negative behaviors from the out-group, the biases are reinforced, and the groups' identifying characteristics become more solidified [71].

Through intergroup comparison, Cooper and Fazio [72] established that negative out-group characterization can lead to the notion that two groups are competing for the same resource. If there is negative out-group characterization between graduate programs, students may view students in other programs as competitors for resources, such as fellowship or assistantship funding that supports them financially. Students may perceive a positive gain for their group if a member of their research team obtains a reward, such as winning a poster competition held for all graduate programs and collectively share the praise (supporting positive in-group biases). Similarly, if a group member fails to receive the reward, such as not obtaining a postdoctoral position or graduate assistantship, the group may view this as a loss for the entire group, a factor that can potentially tarnish their shared reputation.

As shown in Figure 1, SIT offers crucial insights into the social identity biases that contribute to discrimination, prejudice, and intergroup conflict, stemming from group-based categorization and self-enhancement motives [70]. As individuals classify themselves into in-groups and out-groups, they gain value by assigning positive attributes to the in-group, which creates a satisfied social identity. Likewise, individuals view out-group members as a threat, and positive events or attributes that are favorable to the out-group create dissatisfaction with the in-group's social identity. Table 1 reviews terms for SIT along with exemplar statements.

Table 1. Social identity theory definitions and exemplar statements.

Definition	Exemplar Statements
Social Identity: Individuals define their identities with regard to social groups, which protect and improve their self-identity [65].	When I think of myself, I see myself as a female scientist. As a first-generation student, I have been a pioneer in education for my family.
In-group: The group to which an individual belongs or identifies based on shared characteristics [65,67,68].	As a graduate student, I see myself positively contributing to the field of education through my research.
Out-group: The group to which an individual perceives as different [65,67,68].	As a part-time graduate student, I often miss out on opportunities to complete research like full-time students. I view myself as a first-generation college student and struggle to see myself as part of the academy.
In-group bias: Instances of favoritism that are unfair or unjustifiable in that they go beyond the requirements for the situation [73].	Male students have more opportunities to complete research than female students. As a Black student, I am often called on to share about Black culture, as the expert for my predominantly White class.

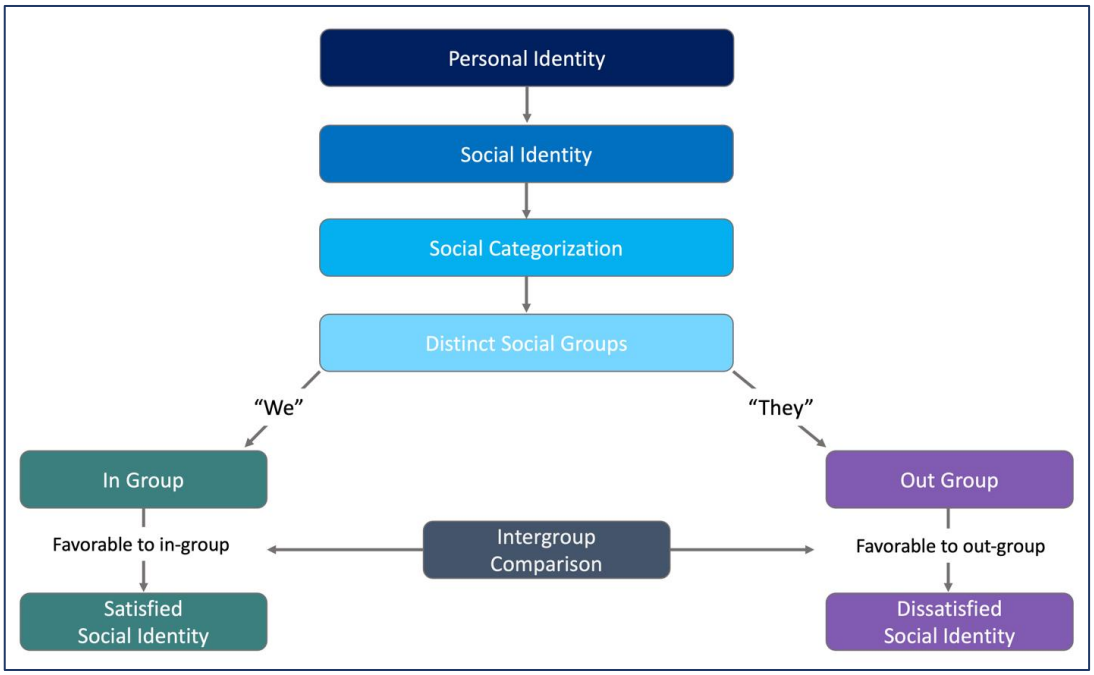

Figure 1. Social Identity Theory (Modified from Tajfel & Turner [65]).

1.3.2. Linking the Graduate Student Success Survey+ to Social Identity Theory

Graduate students arrive at the university with unique circumstances, traversing facets of race, socioeconomic status (SES), and gender. The culmination of these diverse identity characteristics can contribute to an arduous journey through graduate school. To assist graduate students, university faculty, advisors, and administrators need to better understand the barriers faced by graduate students and facilitate structures and supports to reduce the attrition rate and improve their academic success. Scaffolding the educational growth of these students will ultimately create a more inclusive graduate school climate while positively contributing to the diversity of the STEM workforce.

The GSSS+ is composed of 7 latent constructs (Table 2), which have the capacity to contribute to graduate students' social identity. Mentor support and peer support can foster in-group beliefs and reinforce the positive attributes of the individual. Mentors and peers can provide guidance on completing program requirements and navigating nuanced aspects of their institution. This support can help confirm that students are members of the in-group, which can lead to positive reinforcement of their social identity. In contrast, microaggressions can act as a form of bias from other students, potentially reinforcing the notion that the graduate student is a member of the out-group. The effects of imposter phenomenon are similar to those of microaggressions in that they reinforce biases that students believe they are a member of the out-group. However, the source of imposter phenomenon comes from the students' personal beliefs regarding their own competency.

Table 2. Latent constructs of Graduate Student Success Survey+.

Latent Constructs of GSSS+	Definitions
Imposter Phenomenon	The experience of high-achieving, successful individuals who attribute their accomplishments to luck and fear of being exposed as a fraud [27,55].
Microaggressions	Words and actions that stereotype or invalidate racially minoritized individuals [26]. Behaviors can also be directed toward gender.
Mentor Support	Academic, psychological, or social support in progressing through graduate school from one's advisor, committee members, or faculty at the university. Support can be related to program design and communication about completing milestones.

Table 2. *Cont.*

Latent Constructs of GSSS+	Definitions
Peer Support	Academic, psychological, or social support in progressing through graduate school from classmates.
Resilience	Positive mindset about completing graduate school, especially in reference to academic success and mental well-being.
Access & Opportunity	Opportunity to participate in research, academic writing, or presentations (conference) regarding facets of one's graduate school studies.
Financial Support	Support to help offset the cost of tuition, books, fees, or other costs (e.g., technology, conference fees) associated with graduate school.

Financial support is an additional factor impacting student success in graduate school. The cost of graduate school can create a burden for many individuals, requiring them to attend school part-time or take breaks from class to provide opportunities to earn income. The acquisition of scholarships, fellowships, and assistantships can provide students with valuable financial support, enabling them to devote more time and energy to their studies. Similarly, loans can provide students with the necessary funds to continue their education if their current financial situation cannot support their studies. Gaining financial support, especially when provided by the institution, can create a sense of belonging to the institution, thereby reinforcing the in-group identity.

The last two constructs of the survey provide a final confirmation that the identity is correct. Access and opportunity is a construct that measures students' opportunities to participate in research, write papers for publication, or present at conferences. These aspects of graduate school are often not part of the degree requirements but are critical skills as graduate students develop into independent scholars. Similarly, resilience is a construct that reflects students' confidence in their progression through the graduate program. A student's sense of resilience demonstrates their level of motivation, capacity to handle stress and anxiety related to their program, and ability to maintain focus on essential tasks. These two components ultimately verify that they are members of the in-group, reflecting the culmination of their academic journey to become scholars.

2. Materials and Methods

2.1. Research Design

The purpose of this study is to explore the experiences of graduate students through the distribution of the Graduate Student Success Survey+ (GSSS+), a previously validated survey [18], to students attending an R2 institution [17] in the southeastern U.S. The survey consists of 5-point Likert-scaled items and an open-response question. The study's objective is to identify areas where graduate students receive adequate support and regions in which additional support is needed. A second objective is to compare how support needs vary between groups (e.g., racial/ethnic groups, gender, first-generation status, program type), providing insight for universities to better support their students. This study builds on substantial pilot work [12,18,74], and the research questions guiding this study are as follows:

1. What are the differences in graduate students' perceptions of success factors, based on:
    a. Demographic characteristics?
    b. Enrollment in STEM programs?
    c. Program type (e.g., research-based master's, PhD programs, and professional programs)?
    d. Intersectionality of identifying with multiple categories of underrepresented groups (e.g., racial/ethnic groups in STEM, females in STEM)?

2. What survey constructs, if any, relate to students' resilience?
3. What survey constructs, if any, relate to students' access and opportunities to become independent scholars (e.g., complete research, write academic papers, and attend conferences)?

2.2. Data Collection

2.2.1. Survey Instrument

The Graduate Student Success Survey (GSSS) was developed to gain a holistic understanding of graduate student experiences [12]. Much of the prior research focused only on one scale, and therefore lacked the complexity of the graduate school experience (e.g., [13,55,75–77]). The GSSS sought to gain insight into the complex experiences associated with graduate school, including mentoring, imposter phenomenon, microaggression, sense of belonging, and microaffirmations. The GSSS was first distributed at an R1 institution during Fall 2020 (N = 696). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to test the survey's validity and reliability, producing a 28-item, 7-factor survey. The subscales included: microaffirmations, sense of belonging, mentor relationships, financial, access and opportunity (for research, writing, and presentations), imposter phenomenon, and microaggressions.

A second iteration of the survey was developed to incorporate constructs of mental well-being [18]. The GSSS+ also included reworded items from the first survey. These items were previously negatively worded and modified to be positively worded. These changes were implemented to reduce confusion associated with negative items, as well as to improve the statistical fit with validity and reliability testing. The second iteration also included items that had been previously eliminated in the previous version by rewording the items. The GSSS+ was distributed across the southeastern portion of the U.S. and in several states with larger populations (e.g., Texas and New York). Participants (N = 648) attended 23 different universities, predominantly PWI and R1 institutions. EFA and CFA were repeated with the second iteration and produced a 40-item, 7-factor model. The latent constructs include: mentor support, imposter phenomenon, financial support, microaggressions, access and opportunity, resilience, and peer support. This iteration only included responses from students who were in research-based master's or PhD programs. Students who were in programs that were not research-focused, such as an EdD or MAT, or in a profession track, were not included.

The current study sought to redistribute the GSSS+ to gain insight from students across various fields of study, including professional students and those in programs with a lesser research focus (e.g., MAT or EdD). The survey was also distributed at an R2 institution, which was less represented in prior iterations. The version of the GSSS+ distributed in the second iteration was repeated in the current study with the addition of a few demographic questions. The GSSS+ used in the current study is composed of 40 survey items and 12 demographic questions. Institutional IRB approval (#2250182-6) was obtained for the study prior to the distribution, and the students' consent was solicited as part of the online survey through Qualtrics. All survey items were evaluated with a 5-point Likert scale, with 1 representing strongly disagree, 3 representing neither disagree or agree, and 5 representing strongly agree. Statements were blocked together by construct.

2.2.2. Participant Recruitment

Participants were graduate and professional students at an R2 institution in the southeastern U.S. The first author worked with the administrative offices of the graduate school to create a database of graduate students. This list included all students who attended graduate or professional programs at the university within the 2024–2025 school year (N = 4586).

The survey was distributed to all graduate students via their university email addresses, and it remained open for three weeks. Students were sent several reminder emails encouraging their participation. Of the 346 surveys begun, 242 completed a minimum of 95% of the items, resulting in a survey completion rate of 69.9%. Though 4586 emails were sent to students, it is impossible to know how many students disregarded the email without either opening or reading its contents. Therefore, the survey completion rate is calculated based on the number of individuals who began the survey (69.9%) rather than a reflection of those who received emails (5.2%). A total of 12 data points were missing from the usable data (N = 242), accounting for 0.12% of missing data. Listwise deletion was implemented for item analysis, where a case is excluded from the analysis if it contains a missing variable.

2.2.3. Survey Validation

The GSSS+ was previously tested for validity and reliability through EFA and CFA, respectively [12,18]. However, this iteration only employed EFA to verify the structure, as the response rate was too small to accommodate both testing mechanisms. The first author selected to complete EFA, as opposed to CFA, to verify the survey structure with the new population. This was especially pertinent in that the population was smaller than the previous sample, included students only from an R2 institution, and included students in professional and non-research-based programs. The first author also chose to complete an EFA to compare how survey items parsed out in this iteration compared to the two prior iterations [12,18]. This was of particular interest as the first version had a sense of belonging subscale. Transitioning to the GSSS+, negatively worded items were reworded positively when possible, and additional items were added to assess student well-being. The well-being items generally became part of the resilience subscale. However, the sense of belonging subscale disappeared, and most of these items moved to the mentor support subscale, while others created the peer support subscale (e.g., Peer1, Mentor 3, and Mentor5). The first author repeated the EFA process in the current study to determine if these items would cluster as mentor and peer support or if they would rejoin under a sense of belonging subscale.

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (0.0841) and Bartlett's Test of Sphericity ($p \leq 0.001$) were used to verify the suitability of factor analysis [78,79]. Statistical Package for the Social Sciences version 30 (2024) was utilized to complete EFA to identify latent constructs and the variables that represent them in the instrument. The Shapiro–Wilk normality test determined that the data were not normally distributed. Therefore, principal axis factoring was selected as the method of factor extraction (PAF) [80,81]. Human behaviors often fail to function independently; consequently, Oblimin rotation was selected as it provides a more accurate representation of the constructs [80,81]. The Oblimin Rotation with Kaiser Normalization was selected because it yields a simple structure by minimizing the cross-products of the factor loadings [82].

The eigenvalues revealed a 7-factor model. Heuristics were used to determine which items to evaluate for possible removal, including factor loadings (>0.33), communities (>0.200), and cross-loading values (<0.32). However, all items remained in the survey [79,80]. EFA determined a 7-factor, 40-item model for the GSSS+ with the following subscales: mentor support, financial support, microaggressions (race and gender), imposter phenomenon, access and opportunity (for research, academic writing, and presentations), peer support, and resilience (toward completing their graduate program). The eigenvalues for the 7-factor model ranged from 9.877 to 1.00 and explained 57.73% of the variance in the data (Table 3).

Table 3. Cronbach's alpha for the 7-factor model.

Factor	Number of Items	Eigenvalues	Explained Variance (%)	Cumulative Explained Variance (%)	Cronbach's Alpha
Mentor Support	10	8.677	21.69	21.69	0.917
Financial Support	6	4.098	10.24	31.94	0.909
Microaggressions	6	2.892	7.23	39.17	0.839
Imposter Phenomenon	4	2.598	6.50	45.66	0.882
Access & Opportunity	6	2.219	5.55	51.21	0.821
Peer Support	3	1.473	3.68	54.90	0.884
Resilience	5	1.133	2.83	57.73	0.881
All Items	40	—	57.73	57.73	0.889

The previously validated structure was maintained, except for one item that moved constructs. Item Acc&Opp5, I believe I will finish writing my thesis/dissertation, transitioned subscales. Based on the factor loadings produced for the EFA, this item was placed on the access and opportunity subscale. In contrast, it had been part of the resilience subscale in the previous model [18]. From a theoretical perspective, it is a logical switch in that the item can be seen as a component of resilience, in that the student will have a greater sense of resilience if they also believe they will finish their thesis or dissertation. Similarly, the item can be considered a component of the access and opportunity subscale in that it relates to written products that will likely be published in journals.

Reliability testing yielded alpha values ranging from 0.92 to 0.82 for the seven subscales and an overall alpha of 0.89 for the complete survey, supporting the validity of the survey (Table 3) [83]. The highest correlation was between financial support and resilience (−0.347). Other factor correlations ranged from −0.342 to 0.191 (Table 4). The factor loadings ranged between 0.871 and 0.440 (Table A2 in Appendix B).

Table 4. Factor correlation matrix.

	Mentor	Financial Support	Micro-Aggressions	Imposter Phenomenon	Access & Opportunity	Peer Support
Financial	0.160					
Microaggressions	0.144	0.141				
Imposter Phenomenon	−0.019	0.100	0.125			
Access & Opportunity	0.312	0.072	0.021	−0.001		
Peer	−0.342	−0.13	−0.067	0.020	−0.290	
Resilience	−0.281	−0.347	−0.010	−0.233	−0.138	0.191

Note: Principal Axis Factoring; Oblimin with Kaiser Normalization.

2.2.4. Descriptive Statistics

Table 5 presents the parental population of students who received survey invitations (N = 4586) and those who completed the survey (N = 242). Approximately 5% of those invited completed the survey. Most students who participated were female (75%), White (56%), and first-generation graduate students (67%). Most of the students self-identified as in-state for residency (85%) and attended graduate school full-time (70%).

As shown in Table 6, slightly more than half of the students were enrolled in non-STEM programs (52%), with a relatively even distribution across the stages of their programs, ranging from 32% to 36%. Most students reported being in another graduate program, specifically regarding program type (51%), with roughly equal numbers in research-focused doctoral programs (22%) and professional track programs (23%). Thirty-seven percent of the survey participants were enrolled in education programs, whereas 13% were students attending medical school. The remaining participation spanned across nine programs, ranging from 7% to 1%. Due to the nature of self-reported data, anomalies exist in Table 6. For example, the parent population specified only five students in other graduate programs; however, 16 students reported attending other programs during the survey. It is likely

that several survey participants fell into more specific categories but responded in a more general manner.

Table 5. Self-reported demographic statistics.

		Parent Population (N = 4586)		Survey Participants (N = 242)	
		N	%	N	%
Gender	Male	1401	30.6	56	23.1
	Female	3185	69.5	181	74.8
	Nonbinary	—	—	3	1.2
	Prefer Not to Say	—	—	2	0.8
Race/ Ethnicity	American Indian/ Alaska Native	4	0.1	0	0
	Asian	602	13.1	14	5.8
	Black/African American	955	20.8	60	24.8
	Latino/a	314	6.9	12	5
	Native Hawaiian or Other Pacific Islander	4	0.1	1	0.4
	South Asian/Indian	0	0.0	3	1.2
	White/Caucasian	2452	53.5	135	55.8
	Two or More Races	128	2.8	9	3.7
	Other	127	2.8	2	0.8
	Prefer Not to Say	—	—	6	2.5
URM	Non-URM	3054	66.6	149	61.6
	URM	1405	30.6	85	35.1
	Other/Prefer Not to Say	127	2.8	8	3.3
First-generation	College Student	—	—	103	42.6
	Graduate Student	—	—	161	66.5
SES Background	Poor	—	—	26	10.7
	Working Class	—	—	155	64
	Professional Class	—	—	57	23.6
	Wealthy	—	—	4	1.7
Citizenship	Domestic in-state	—	—	206	85.1
	Domestic out-of-state	—	—	20	8.3
	International	—	—	15	6.2
Student Type	Full-time	—	—	169	69.8
	Part-time	—	—	73	30.2

Note: Categories with a "—" represent areas for which data were not available.

Table 6. Self-reported program and university characteristics.

		Parent Population		Survey Participants	
		N = 4586	%	N = 242	%
Graduate Programs	Allied Health Science	346	7.54	11	4.55
	Art, Humanity, Social Science	155	3.38	15	6.20
	Computer Science	168	3.66	12	4.96
	Education	1500	32.71	90	37.19
	Other Graduate Programs	5	0.11	16	6.61
	Business	75	1.64	6	2.48
	Post-Graduate Certificate	4	0.09	0	0.00
	Nursing	472	10.29	16	6.61
	Public Health	214	4.67	18	7.44
	Science and Math	19	0.41	3	1.24
	Dental School	387	8.44	9	3.72
	Medical School	1241	27.06	32	13.22
Program Type	All Professional Programs	1628	35.50	41	16.94
	All Graduate Programs	2958	64.50	187	77.27
	Unknown	—	—	14	5.79
	Research-focused doctoral program	—	—	53	21.9
	Thesis-based master's program	—	—	11	4.5
	Professional track program	—	—	55	22.7
	Another graduate program	—	—	123	50.8
Program Status	Early (beginning of course work)	—	—	79	32.6
	Mid (finishing course work)	—	—	86	35.5
	Late (thesis/dissertation)	—	—	76	31.4
STEM	STEM	—	—	101	41.7
	Non-STEM	—	—	126	52.1

Note: Categories with a "—"represent areas for which data were not available.

Graduate students identified employment or personal savings as the most common form of financial support, as reported by 41% of survey participants (Table 7). This was followed by spouse, partner, parents, or other family members, with 35% of survey participants. Only 20% of participants reported support from graduate assistantships, and 17% stated that they received support from scholarships or fellowships. Loans were identified by 19% of participants as a source of financial support for graduate school. Many students identified multiple sources of financial support.

Table 7. Financial support for graduate students.

Financial Support	*n*	%
Employment or Personal Savings	99	40.91
Spouse, Partner, Parents, or Other Family Members	84	34.71
Graduate Assistantship	50	20.66
Loans	45	18.60
Scholarships or Fellowships	41	16.94
Other	31	12.81
Emergency relief funds (e.g., COVID relief)	19	7.85

Note: Percentages do not add up to 100% because students were able to identify multiple categories for financial support.

2.2.5. Quantitative Analysis Procedures

A composite score was calculated for each latent construct (i.e., mentor support, peer support, financial support, access and opportunity, imposter phenomenon, microaggressions, and resilience) by averaging the scores of the items on each subscale. These composite scores were then used to determine if significant differences ($p < 0.05$) existed in survey responses between different subgroups, such as gender, racial or ethnic identity, or program type. Before analysis, the survey items underwent normality testing with the Shapiro–Wilk and Kolmogorov–Smirnov tests; all items failed to show normality. As a result, a one-way, nonparametric ANOVA, the Kruskal–Wallis test, was employed to identify significant relationships between survey responses and subgroups based on composite scores. If no differences were found using composite scores, further analysis was performed on individual item responses within those subgroups. Additionally, the composite scores were used in regression analyses to explore potential relationships between the latent constructs (i.e., mentor support, peer support, financial support, imposter phenomenon, microaggressions, resilience, and access and opportunity). See the Results section for the findings.

2.2.6. Qualitative Analysis Procedures

At the end of the survey, students were provided with an open response item stating, Please share any additional information you would like about your graduate school experience. Students offered additional insight into their experiences through 71 comments. After reading through the comments several times, the decision was made to use the latent constructs of the survey (i.e., mentor support, financial support, peer support, resilience, access and opportunity, microaggressions, and imposter phenomenon) as an a priori coding mechanism for initial evaluation. Academic support was added as an additional code to reflect aspects relating to grading, course design, and material delivery. The statements were also coded as either a barrier or a support to clarify their impact on the graduate school experience. Table 8 provides exemplar statements of the codes used in the analysis.

Table 8. Codes used in thematic analysis.

Codes	Exemplar Statements
Imposter Phenomenon	Constantly battling imposter syndrome. (Barrier)—Thesis-based, domestic student, unknown race and gender
Microaggressions	I am 1 of 3 Black people in my program which has the most significant impact on my experience. (Barrier)—Professional Track, Black Female
Mentor Support	I believe that my experiences as a graduate student has been positive due to the efforts of [Dr. X & Dr. Y]. (Support)—Professional Track, Multiracial Female I have an amazing support system from faculty members in my department. Leadership are interested in my academic journey and my post graduate school pursuits. (Support)—Research-focused Doctorate, Black Male
Peer Support	The cohort model of my program is unique and I believe it ultimately led to my success in this program. We lifted each other up, created an online community through GroupMe, and frequently reached out to each other when we had questions. (Support)—Research-focused, White Female
Resilience	Graduate school is overwhelming. There is always so much to do and with a little distraction, you fall down a steep hill which is mostly difficult to come back from. (Barrier)—Research-focused Doctorate, Black Male Having the opportunity to work towards a graduate degree has increased my feelings of self-confidence and the ability to work diligently towards something meaningful. (Support)—Another Graduate Program, White Female
Access & Opportunity	As an online student, I would like more opportunities for research. (Barrier)—Another Graduate Program, White Female I wish we, as graduate students, had more opportunities to present orally....I rarely have practice orally presenting, as my lab does not have regular data presentation meetings. (Barrier)—Research-focused, White Female
Financial Support	Grant funds are only allocated semesterly, causing much grief among students in our program due to fears about losing funds; those that lose funds are told at most a month before they run out. (Barrier)—Research-focused, Multiracial Male
Academic Support	I feel that the amount of material that some instructors expect us to read and then submit a paper or well thought out discussion post is realistically just not attainable. (Barrier) Another Graduate Program, White Female I wish the online programs were more hybrid driven allowing for classroom time. Having one on one in classrooms settings are more personable and creates a better learning environment. (Barrier)—Another Graduate Program, White Male

Coding was completed in an Excel Worksheet. The first author read through the statements several times and broke statements into discrete units for different coding segments, a process referred to as unitization [84]. If the statement included multiple sentences or lines pertaining to the same concept, e.g., concerns over grading, those lines were grouped as one unit. If the response included multiple ideas, the statement was broken into separate units based on the different concepts. Units were differentiated by using different colors of text in the document. The first author read through the responses and assigned initial codes to each statement. Those codes were then hidden in the document by blacking them out to eliminate the potential for creating biases. The second author then reviewed the statements and assigned codes to each one. The first author checked the degree of agreement between the two coders, with an initial agreement of 77%. The units that received different codes from the authors were then discussed, and a decision was made regarding which code to assign. This process was completed until 100% agreement was reached for all statements.

Imposter phenomenon was used to identify statements describing barriers stemming from personal insecurities of not belonging to a group and being perceived as a fake. Microaggressions was a code used to highlight responses reflecting experiences with negative actions or statements belittling one's abilities due to race or gender from individuals at the university. Mentor support and peer support were used to designate the socioemotional or holistic academic support that students receive from faculty and peers, respectively.

Financial support was utilized to address concerns or support related to the financial costs of graduate school. Access and opportunity was used in the open response statements referring to the opportunities students have regarding academic writing, publication,

research, or presenting at conferences. The code resilience involved comments referencing students' mindsets toward completing their program, including their mental health, stress levels, and potential for academic success.

A code that emerged in the open-response items was academic support. These statements encapsulate the learning experiences of a student, encompassing grading, classroom environment, and interactions with professors during class. This code differs from mentor support in that it is not involved in the overarching goals of programs and associated milestones; instead, it focuses more on the academic environment, including assignments, feedback, and grading. Refer to the Results sections for details regarding the analysis.

3. Results

3.1. Composite Scores for Latent Constructs of Graduate Student Success Survey+

The composite scores from the participants (Table 9) reflected the strongest supporting factors in their experiences with mentor support (4.06) and peer support (3.89), resulting in the highest composite scores. These constructs were followed by financial support (3.68) and access and opportunity (3.65), which were also considered additional supportive aspects of students' experiences. The whole group composite score for resilience (3.62) fell between a neutral response (3) and an agree response (4), indicating that students have a generally positive perspective toward completing their program.

Table 9. Composite scores for the Graduate Student Success Survey+ subscales.

	Mean	Std. Deviation
Mentor Support	4.06	0.75
Financial Support	3.68	0.92
Microaggressions	2.65	0.90
Imposter Phenomenon	2.96	1.09
Access & Opportunity	3.65	0.74
Peer Support	3.89	0.89
Resilience	3.62	0.85

The imposter phenomenon subscale was initially reverse-coded due to the presence of negatively worded items; after testing for validity, the subscale was recoded to facilitate interpretation. After recording, low scores (1–2) indicate that students perceived fewer feelings relating to imposter phenomenon, whereas higher scores (4–5) represent more feelings related to the construct. The composite mean for imposter phenomenon (2.96) was between a disagree (2) and a neutral response (3), reflecting a lower perception of feelings related to imposter phenomenon. Microaggressions was also a subscale composed only of negatively worded items and was recoded to aid in interpretation. The microaggressions composite mean reflected fewer perceived feelings related to this construct for the entire participant group (2.65). However, higher scores reflecting areas of concern were isolated in subgroups through item analysis.

3.2. Differences in Graduate Students' Perceptions of Success Factors

Item analysis was conducted for composite scores of the latent constructs in the GSSS+ to compare differences in survey responses across various subgroups. The following section displays tables of composite means organized by subgroup populations. Mean scores highlighted in red font represent groups who reported scores statistically lower than their comparison group ($p < 0.05$). The lower scores indicate areas in which subgroups of students perceive less support or a greater barrier for that respective construct (e.g., mentor support or financial support) compared to other groups.

Though these scores do not reflect measured supports, they reflect how students perceive these constructs during their graduate school experience. For example, some

subgroups may report receiving less financial support, despite receiving the same assistantships. The survey does not reflect the quality of support provided, but rather the quantity needed, which is influenced by the students' backgrounds (e.g., first-generation status, female in STEM, or lower socioeconomic status background). The results of the survey are valuable in that they highlight the additional supports needed by some groups and the barriers that other groups may face, such as imposter phenomenon.

3.2.1. Race, Ethnicity, and Gender

Analysis of composite scores for racial and ethnic groups determined one significant relationship (Table 10). Students who identified as Black or African American reported higher scores for perceived microaggressions for race and gender than those students who identified as White. A higher score for this construct indicates that students who identify as Black or African American perceived more incidents that can be described as microaggressions than White students, a potential barrier for graduate student success. No other significant differences were identified for racial and ethnic groups in those latent constructs.

Table 10. Racial and ethnic group composite means.

	Asian (*n* = 14) *M* (*SD*)	**Black (*n* = 60) *M* (*SD*)**	**Latino/a (*n* = 12) *M* (*SD*)**	**S. Asian/ Indian (*n* = 3) *M* (*SD*)**	**White (*n* = 135) *M* (*SD*)**	**Two or More Races (*n* = 9) *M* (*SD*)**	**Other (*n* = 2) *M* (*SD*)**	**Prefer Not to Say (*n* = 6) *M* (*SD*)**
Micro-aggressions	2.62 (0.91)	2.99 (1.02)	2.85 (0.65)	3.33 (1.20)	2.50 (0.80)	3.06 (0.72)	1.42 (0.59)	2.31 (1.02)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

To gain a better understanding of the impact that success factors may have on racial and ethnic groups, additional analyses were conducted. Based on common constructs used in the literature, the term URM was employed to identify these individuals. This group comprises all racial groups represented in the survey, except those who identified as White or Asian [85,86]. Those who initially selected 'other' or 'prefer not to say' were combined in a secondary 'other' category. Item analysis revealed lower scores for URM students than non-URM students for financial support, indicating that URM students perceived less support. Similarly, URM students reported higher mean scores for microaggressions than non-URM students and those who identified as other. This suggests that URM students reported more perceived incidents of microaggressions related to race and gender than other students, which may be a potential barrier to graduate student success (Table 11).

Table 11. URM students' composite means.

	URM (*n* = 85)	**Non-URM (*n* = 149)**	**Other (*n* = 8)**
	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**
Financial Support	3.46 (1.02)	3.79 (0.84)	3.96 (0.78)
Microaggressions	2.96 (0.96)	2.51 (0.81)	2.08 (0.98)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

No significant differences were identified for gender with the composite scores. However, significant differences were isolated for one item on the microaggressions scale, Microagg4, and one item for imposter phenomenon, ImpPhen3 (Table 12). For both items identified, female students reported scores indicating a greater perceived barrier with microaggressions and imposter phenomenon than male students. Both of these responses reflect potential barriers to graduate student success.

Table 12. Gender item means.

	Male (*n* = 53)	Female (*n* = 181)	Nonbinary (*n* = 3)	Prefer Not to Say (*n* = 2)
	M (SD)	**M (SD)**	**M (SD)**	**M (SD)**
ImpPhen3	2.54 (1.35)	3.23 (1.42)	2.00 (1.00)	5.00 (0.00)
Microagg4	1.98 (0.86)	2.50 (1.16)	2.33 (0.58)	1.50 (0.71)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

3.2.2. Program Characteristics

Based on the programs the students identified in the survey, they were placed in either a STEM group or a non-STEM group. The STEM classification included groups such as the medical school, biomedical science, and computer science. The non-STEM group included students studying areas such as business, humanities, and social sciences. A significant difference in composite means was discovered for access and opportunity (for research, writing, and publication) between STEM and non-STEM students. Non-STEM students indicated less access to these opportunities with a lower composite score than STEM students. This suggests that non-STEM students reported fewer opportunities to participate in scholarly activities (e.g., writing for publication, research, and presentations), which may be a potential barrier to their graduate school experience (Table 13).

Table 13. STEM composite means.

	STEM (*n* = 101)	Non-STEM (*n* = 126)
	***M* (*SD*)**	***M* (*SD*)**
Access & Opportunity	3.87 (0.64)	3.47 (0.77)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups.

Item analysis also identified barriers that students experience based on their program type (Table 14). Students in another graduate program reported significantly lower scores than those in research-based doctorate programs for the mentor support composite scores. The lower score represents less support from mentors for students in another graduate program, indicating a potential barrier. Students in research-focused doctoral programs reported significantly lower scores for financial support compared to those in thesis-based master's programs. A lower score for financial support suggests that research-focused students have less access to scholarships, fellowships, and assistantships to support their graduate studies. With reduced financial support from the university, this can lead to an additional financial burden, potentially becoming a barrier to graduate student success.

Table 14. The program type composite means.

	Research-Focused Doctorate (*n* = 53)	Thesis-Based Master's (*n* = 11)	Professional Track (*n* = 55)	Another Graduate Program (*n* = 123)
	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**
Mentor Support	4.27 (0.77)	4.29 (1.06)	4.00 (0.71)	3.97 (0.72)
Financial Support	3.41 (0.97)	4.20 (1.26)	3.77 (0.92)	3.71 (0.83)
Access & Opportunity	4.18 (0.56)	4.06 (0.58)	3.63 (0.73)	3.40 (0.69)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

For access and opportunity, three significant differences were identified in mean composite scores, highlighting potential barriers. Students in another graduate program reported lower scores for access and opportunity than research-focused doctoral students and thesis-based master's students. In contrast, professional track students reported a

lower score for access and opportunity than research-focused doctoral students (Table 14). Lower scores for access and opportunity indicate these students reported having fewer opportunities to participate in scholarship (e.g., writing for publication, conducting research, or presenting at a conference). Though these components may not directly contribute to degree completion, they are linked to developing into an independent scholar.

Data analysis did not reveal significant differences in composite means between the stages of the program (e.g., early, middle, or late) for students. Additional analyses were conducted using individual items, which identified significant differences in four specific survey items (Table 15). Students in the middle stage of their program reported lower scores for mentor support compared to students in the late stage (Mentor10). Lower scores for this item indicate that students perceived less mentor support, which can act as a potential barrier. Students in the early stage of their program reported lower scores for two items on the access and opportunity subscale (Acc&Opp3 and Acc&Opp1) compared to students in the late stages. Students in the middle stage reported lower scores for access and opportunity compared to those in the early stage (Acc&Opp6). Lower scores for access and opportunity reflect fewer opportunities to participate in research, publications, or presentations. Lacking these aspects during graduate school or experiencing them to a lesser degree can be viewed as a potential barrier, as students have fewer opportunities to develop into independent scholars.

Table 15. The stage of the program item means.

	Early (*n* = 79)	**Middle (*n* = 86)**	**Late (*n* = 76)**
	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**
Mentor10	4.00 (1.09)	3.77 (1.21)	4.30 (0.94)
Acc&Opp3	3.58 (1.06)	3.73 (1.05)	3.97 (1.05)
Acc&Opp1	3.90 (0.87)	3.94 (0.83)	4.21 (0.83)
Acc&Opp6	3.11 (0.95)	2.73 (1.06)	3.11 (1.27)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

3.2.3. Student Characteristics

Analysis for student type revealed several significant differences in the students' perceived supports. Full-time students reported higher scores for perceived microaggressions related to race and gender. Higher scores for these constructs indicate that full-time students perceived a more frequent occurrence of microaggressions than part-time students, which may be a potential barrier. In contrast, part-time students reported lower scores for access and opportunity and lower scores for peer support than full-time students. The lower scores reveal that part-time students had fewer opportunities to participate in research, writing, and publications (access and opportunity), as well as less peer support, underscoring additional barriers for this subgroup (Table 16).

Table 16. Enrollment composite means.

	Full-Time (*n* = 169)	**Part-Time (*n* =73)**
	***M* (*SD*)**	***M* (*SD*)**
Microaggressions	2.75 (0.92)	2.44 (0.82)
Access & Opportunity	3.72 (0.75)	3.51 (0.68)
Peer Support	3.98 (0.84)	3.67 (0.96)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups.

Significant differences for composite means were identified between international students and in-state students. In-state students perceived less mentor support and fewer opportunities to participate in research, writing, and publications (access and opportunity)

than international students, with lower scores for both of these constructs. These results indicate potential barriers for in-state students (Table 17).

Table 17. Residency composite means.

	In-State (n = 206)	Out-of-State (n = 20)	International (n = 15)
	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**
Mentor Support	3.99 (0.76)	4.33 (0.66)	4.59 (0.40)
Access & Opportunity	3.60 (0.74)	3.90 (0.68)	4.12 (0.52)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

A significant difference in the financial support composite means was seen in subgroups based on socioeconomic backgrounds. Students from working class backgrounds reported lower scores for financial support than those from professional class backgrounds. These scores do not reflect the quantity of support received, but more so the fulfillment of the need for financial support. These findings can be used to identify groups of students with a greater need (Table 18).

Table 18. SES background composite means.

	Poor (n = 26)	Working Class (n = 155)	Professional Class (n = 57)	Wealthy (n = 4)
	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**	***M* (*SD*)**
Financial Support	3.59 (1.15)	3.57 (0.90)	3.95 (0.80)	4.5 (0.58)

Note: *M* represents composite mean. *SD* symbolizes standard deviation. Items in red represent groups reporting a score representing a barrier compared to other groups. Comparison groups are specified in the text.

No significant differences in composite mean scores between programs were identified; however, two survey items were found to have significant differences between groups. Students attending another graduate program reported a significantly lower score (n = 15; M (SD) = 2.67 (1.23)) on financial support (Financial3) compared to students enrolled in medical school (n = 32; M (SD) = 4.13 (0.94)). As shared in the previous section, this finding does not reflect the quantity of support received but the fulfillment of support needed. However, these findings identify groups with unmet needs, i.e., students in another graduate program, which can act as a potential barrier. Students in the education programs (n = 89; M (SD) = 3.20 (1.18)) reported a lower score for an access and opportunity item (Acc&Opp2) than students attending a nursing program (n = 16; M (SD) = 4.13 (0.60)). This finding highlights the presence of fewer opportunities for research and writing within the education program, accentuating a potential barrier. No significant differences were discovered between first-generation college students and first-generation graduate students in composite mean or individual item means.

3.2.4. Interaction Terms

Interaction terms were created for various student characteristics (e.g., STEM-female, STEM-URM) to investigate potential relationships between the survey constructs and subgroups of students. As previously conducted, a one-way, nonparametric ANOVA, specifically the Kruskal–Wallis test, was used to identify significant relationships between survey responses and subgroups based on interaction terms.

STEM-females reported significantly higher scores for access and opportunity (n = 69; M (SD) = 3.85 (0.68)) than other students (n = 164; M (SD) = 3.58 (0.76)), indicating more opportunities to participate in writing, research, and presentations. This is a supportive aspect of their graduate experience. In contrast, STEM-URM-females perceived significantly higher rates of microaggression (n = 27; M (SD) = 3.42 (0.99)) than other students

(n = 242; M (SD) = 2.56 (0.84)). Similarly, STEM-URM students reported significantly higher scores for microaggressions (n = 42; M (SD) = 3.18 (0.92)) than other students (n = 195; M (SD) = 2.57 (0.85)). Higher scores for microaggressions for both of these groups highlight a potential barrier to student success, as these students are reporting a great perception of hostile behavior related to their race or gender.

Students who identified as first-generation graduate students in STEM majors reported significantly higher scores for mentor support (n = 59; M (SD) = 4.29 (0.73)) than other students (n = 176; M (SD) = 4.00 (0.73)). Higher scores for mentor support can be interpreted as an area of support for students. First-generation graduate students in STEM also reported higher scores for access and opportunity (n = 59; M (SD) = 4.01 (0.63)) than other students (n = 176; M (SD) = 3.53 (0.74)). The higher score for access and opportunity indicates that the students perceived more opportunities for scholarship-related activities, a positive aspect of their graduate school experience. However, they may also represent differences in expectations for support between groups of students.

For the last set of interaction terms, a category for lower socioeconomic background was created by combining students who disclosed they were raised in either a poor or working-class environment. This term, low SES background, was combined with STEM and first-generation status to identify potential differences in the data. Students in STEM from lower SES backgrounds reported significantly higher scores for imposter phenomenon (n = 71; M (SD) = 3.24 (1.11)) than other students (n = 159; M (SD) = 2.85 (1.06)), a potential barrier. However, students from lower SES backgrounds in STEM reported support with higher scores for mentor support (n = 71; M (SD) = 4.24 (0.72)) than other students (n = 159; M (SD) = 4.01 (0.71)) and increased access and opportunity for research writing, and publication (n = 71; M (SD) = 3.95 (0.58)) than other students (n = 159; M (SD) = 3.52 (0.77)). Students who identified as first-generation graduate students from lower SES backgrounds reported significantly less financial support (n = 142; M (SD) = 3.60 (0.90)) than other students (n = 100; M (SD) = 3.80 (0.93)), highlighting a potential need for additional support.

3.3. Regression Analysis

The composite scores were used in regression analyses to determine the potential relationships of the latent constructs (i.e., mentor support, peer support, financial support, imposter phenomenon, microaggressions, and access and opportunity) with students' sense of resilience (Table 19). For the given model, the following factors had p-values greater than 0.05 and, therefore, were not considered significant: microaggressions and access and opportunity. Significant relationships were identified with mentor support, peer support, financial support, and imposter phenomenon. Based on the coefficients, mentor support, peer support, and financial support are positively related to students' resilience. In contrast, the coefficients for imposter phenomenon indicated a negative relationship with resilience.

Table 19. Regression of latent constructs on resilience.

Predictor	Coefficient	*SE*	*p*	95% CI	
(Intercept)	1.19	0.36	0.001 *	0.47	1.91
Mentor Support	0.24	0.07	<0.001 *	0.11	0.38
Financial Support	0.33	0.05	<0.001 *	0.23	0.43
Microaggressions	0.063	0.05	0.214	−0.04	0.16
Imposter Phenomenon	−0.20	0.04	<0.001 *	−0.28	−0.12
Access & Opportunity	0.01	0.07	0.944	−0.13	0.14
Peer Support	0.16	0.06	0.006 *	0.05	0.28

Note: * denotes a significant factor in the regression model ($p < 0.05$).

For each point increase in the composite score for mentor support, there was a 0.24 point increase in the composite score for resilience. A one-point increase in the composite score for financial support and peer support resulted in a 0.33 point and a 0.16 point

increase in the composite score for resiliance, respectively. For each one-point increase in the composite score for imposter phenomenon, there was a 0.20 point decrease in the score for resilience. This implies that students who struggled more with feelings related to imposter phenomenon reported lower scores for resilience. In contrast, students who received more mentor support, peer support, and financial support reported a greater sense of resilience toward completing their program. These relationships represent correlations in data trends and not causative factors. Caution should be exercised when extrapolating potential effects; however, the data analysis does provide evidence of relationships between constructs.

Additional analyses were conducted to investigate the potential relationships of the latent constructs with students' sense of access and opportunity (Table 20). For the access and opportunity model, the following factors had p-values greater than 0.05 and, therefore, were not considered significant: financial support, microaggressions, imposter phenomenon, and resilience. Significant relationships were identified between mentor support and peer support. A one-point increase in the composite score for mentor support translated into a 0.25 point increase in students' composite score for access and opportunity. Similarly, a one-point increase in the composite score for peer support resulted in a 0.25 point increase in the composite score for access and opportunity. The relationships identified in the model indicate that students scoring higher in peer and mentor supports perceived more opportunities to complete research, write academic papers, and publish findings (Access and Opportunity). However, these relationships are correlations found in the data, not causative factors.

Table 20. Regression of latent constructs on access & opportunity.

Predictor	Coefficient	*SE*	*p*	95% CI	
(Intercept)	1.27	0.34	<0.001 *	0.61	1.94
Mentor Support	0.25	0.06	<0.001 *	0.13	0.38
Financial Support	0.06	0.05	0.207	−0.04	0.17
Microaggressions	0.08	0.05	0.106	−0.02	0.17
Imposter Phenomenon	−0.03	0.04	0.519	−0.11	0.05
Resilience	0.004	0.06	0.944	−0.12	0.12
Peer Support	0.25	0.05	<0.001 *	0.15	0.36

Note: * denotes a significant factor in the regression model ($p < 0.05$).

Further analyses were conducted to investigate the potential relationships of the latent constructs with students' perception of mentor support, as this factor explained the most variance in the survey responses (Table 21). For the given model, the following factors had p-values greater than 0.05 and, therefore, were not considered significant: financial support, microaggressions, and imposter phenomenon. Significant relationships were identified between access and opportunity, peer support, and resilience, indicating that students scoring higher in these constructs perceived more mentor support. For a one-point increase in the composite score for access and opportunity, mentor support increased by 0.25 points. For a one-point increase in peer support and resilience, mentor support increased by 0.20 points and 0.21 points, respectively.

Table 21. Regression of latent constructs on mentor support.

Predictor	Coefficient	*SE*	*p*	95% CI	
(Intercept)	1.54	0.33	<0.001 *	0.89	2.20
Financial Support	0.02	0.05	0.665	−0.08	0.12
Access and Opportunity	0.25	0.06	<0.001 *	0.13	0.37
Peer Support	0.20	0.05	<0.001 *	0.10	0.31
Resilience	0.21	0.06	<0.001 *	0.10	0.33
Microaggressions	−0.07	0.05	0.151	−0.16	0.03
Imposter Phenomenon	0.05	0.04	0.078	−0.03	0.13

Note: * denotes a significant factor in the regression model ($p < 0.05$).

Finally, regression models were also constructed in relation to several latent constructs of the survey and various interaction terms used in the analyses. Table 22 displays the relationships between the interaction terms and mentor support. The only significant relationship identified was with graduate students who were in STEM and came from lower SES backgrounds. The coefficient indicates that individuals who identified with this group had a mentor support score that was 0.37 points higher than that of other students. Similarly, this was the only group of students who reported significant scores in the regression model with access and opportunity (Table 23). Students who were in STEM programs and came from lower SES backgrounds had access and opportunity composite scores 0.42 points higher than other students. As previously mentioned, the findings of regression analyses are to be interpreted as correlations, not causations, simply identifying similar patterns in findings but not specifying causative factors. A more in-depth investigation is required to determine if these are only correlated factors or if they are causative factors.

Table 22. Regression of interaction terms on mentor support.

Predictor	Coefficient	*SE*	*p*	95% CI	
(Intercept)	4.04	0.07	<0.001 *	3.89	4.18
1st Gen. Graduate-Low SES	0.00	0.10	0.997	−0.20	0.29
STEM-Female	−0.26	0.16	0.100	−0.57	0.05
STEM-Female-URM	−0.11	0.27	0.683	−0.66	0.43
STEM-URM	0.12	0.21	0.571	−0.30	0.54
STEM-Low SES	0.37	0.14	0.01 *	0.09	0.64

Note: * denotes a significant factor in the regression model ($p < 0.05$).

Table 23. Regression of interaction terms on access and opportunity.

Predictor	Coefficient	*SE*	*p*	95% CI	
(Intercept)	3.55	0.07	<0.001 *	3.40	3.69
1st Gen. Graduate-Low SES	−0.11	0.10	0.263	−0.31	0.09
STEM-Female	0.07	0.16	0.669	−0.24	0.38
STEM-Female-URM	−0.17	0.27	0.553	−0.72	0.38
STEM-URM	0.09	0.21	0.673	−0.33	0.51
STEM-Low SES	0.42	0.14	0.003 *	0.14	0.69

Note: * denotes a significant factor in the regression model ($p < 0.05$).

3.4. Qualitative Analysis of Open Response Item

A total of 159 units were identified from the open response statements from 71 students. The majority of the comments were coded as resilience (34.6%) and mentor support (27.7%), followed by academic support (16.4%). The least used code was imposter phenomenon (0.6%). The statements were also coded as supports and barriers. Collectively, most of the students' comments were about barriers (66%). Three categories only addressed issues as barriers, including financial support, microaggressions, and imposter phenomenon. Other codes had a higher frequency of barriers than supports, including mentor support, academic support, and access and opportunity. Codes for peer support and resilience were distributed relatively evenly, serving both as supports and barriers. The distribution of codes is shown in Table 24.

Table 24. Frequency of codes in open response statements.

Code	Frequency	Percentage	Support	Barrier
Resilience	55	34.6%	47%	53%
Mentor Support	44	27.7%	34%	66%
Academic Support	26	16.4%	16%	84%
Peer Support	13	8.2%	54%	46%
Financial Support	9	5.5%	0%	100%
Microaggressions	7	4.4%	0%	100%
Access & Opportunity	4	2.5%	40%	60%
Imposter Phenomenon	1	0.6%	0%	100%
All Items	159	—	34%	66%

Resilience was assessed through statements reflecting students' perspectives on their program and outlook for completing program milestones. Many of these comments reflected students' mental health. Many students used emotional language, as in, "The first semester of my program has been stressful" (White female, education program), or "I feel very lost in starting this process" (White female, medical-based program). The emotional words expressed in the statements coded as resilience were identified and used to create a Word Cloud (Figure 2), exemplifying the complexity of graduate school experiences. The frequency of the words is not accounted for in the graphic.

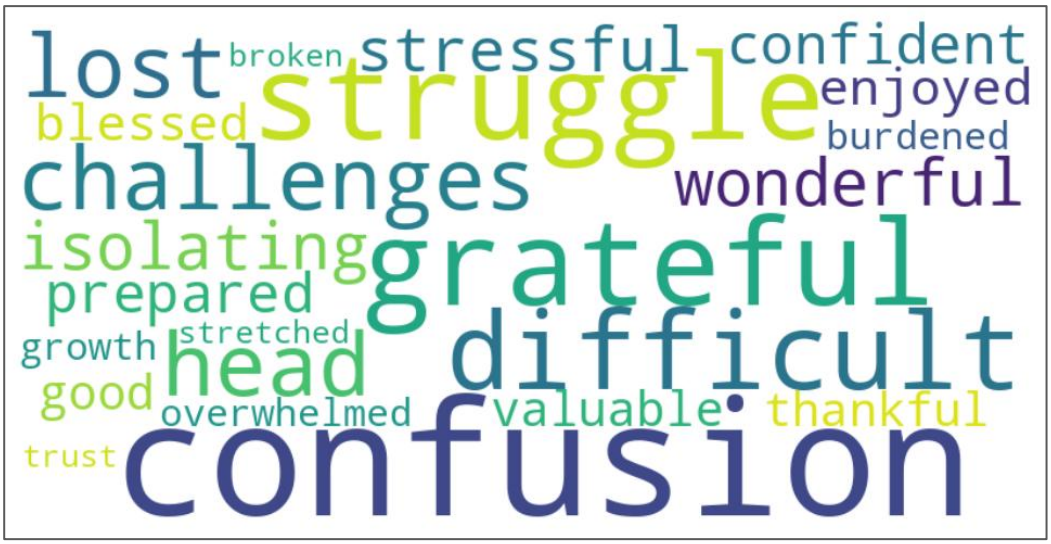

Figure 2. Emotional words from resilience codes.

4. Discussion

Graduate school has the potential to increase career opportunities, provide academic gains, and offer a sense of personal fulfillment [1,50]. However, many students struggle to navigate the nuances of graduate school, especially those from underrepresented groups, such as females in STEM, underserved racial and ethnic groups, or first-generation students (e.g., [41,50,87]). These students may struggle with a lower sense of belonging and encounter psychological barriers, such as microaggressions or imposter phenomenon [26,75,88]. However, peer support and mentor support have been documented to help students overcome these barriers (e.g., [31,35,36,89]).

Understanding the nuances between programs and how they vary between different subgroups of students is vital in understanding why students may not complete their program. Professional track programs often employ a cohort model in which students complete classes as a collective group and complete milestones around the same time. The similarities in program progression may scaffold a support network for students within the same program. In contrast, students in research-based programs have more autonomy to

oversee their capstone project, which may contribute to ambiguity in program completion. The lack of similarity between students' journeys could contribute to higher attrition rates in research-based programs. Identifying the barriers students encounter, as well as the supports that can be provided, can offer insight into how universities can better support their students. In doing so, graduate school becomes more accessible to all students, creating a more inclusive academic community.

4.1. Graduate Student Success Survey+

The GSSS+ was developed as a measure to evaluate success factors in graduate student success. The survey has previously been distributed across the southeastern U.S., primarily at R1 institutions, which are the highest level of research [18]. The current iteration aimed to gain insight from an R2 institution and to incorporate responses from students in both professional programs and non-research-focused programs. This was especially insightful as professional students historically have more structured programs than research-based PhD programs, are more likely to progress through graduate school in a cohort-style model, and have lower attrition rates than research-based programs. This iteration of the study also included qualitative analysis from open response items, which had not been included in the previous analysis. The findings from the current project provide additional insight into the supports and barriers present during graduate school, how they vary between students based on demographic characteristics, and the types of programs.

Exploratory factor analysis was used to validate the GSSS+ survey (N = 242). A 7-factor, 40-item model with the following subscales: mentor support, imposter phenomenon, financial support, microaggressions (race and gender), access and opportunity, resilience, and peer support. The survey also had an open-response item, providing an opportunity for students to share additional insight into their graduate school experience. Seventy-one comments were coded from this open-response item. The qualitative analysis provided additional insight into students' experiences and supported the findings of the Likert-scaled survey items.

A concern with the survey was the low response rate from the invited participants (5%). A project by the American Institutes for Research (AIR) conducted an interview-based study to better understand why individuals elect not to respond to surveys [90]. The researchers identified several reasons surveys are not completed, including (1) privacy concerns, (2) anti-government sentiment, (3) lack of time or energy, (4) survey length or difficulty, (5) lack of interest, and (6) lack of civic/community engagement. AIR suggested several strategies to improve response rates, including confirming legitimacy, revising messaging, redesigning the survey, enhancing visual appeal, and adding a sense of urgency. Future iterations of the GSSS+ survey distribution will consider these aspects to increase response rates.

4.2. Survey Constructs Mapped onto Social Identity Theory

Based on the findings of the survey, the latent constructs of the survey are mapped onto the SIT framework (Figure 3). As seen in the current study, students' perceptions of supports and barriers can be differentiated by their social categorizations. A Graduate or Professional Student is listed under social identity, as it is the primary identity focused on for this project. As a subset of this identity, social categorizations outside of the university include race/ethnicity, gender, SES, and first-generation status. These constructs affect how students view themselves in relation to their student identity. Aspects relating to their student status are included as part of their distinct social group, including full/part-time, domestic status, degree type, STEM, and program characteristics. These aspects contribute to how students view their identity inside the university and where their in-group resides.

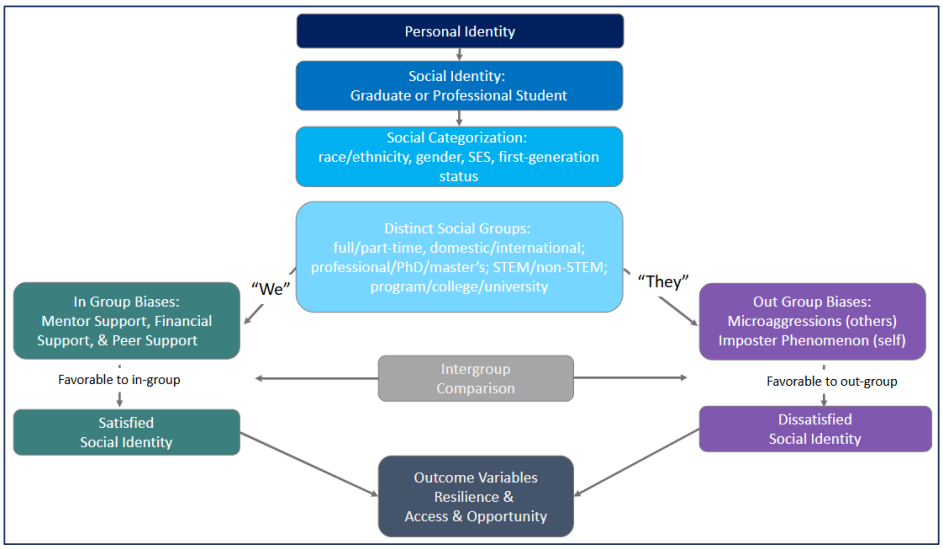

Figure 3. Latent variables of the Graduate Student Success Survey+ and Social Identity Theory (Modified from Tajfel & Turner [65]).

Regarding biases, in-group identity can be supported through mentorship, peer support, and financial assistance. If these areas are lacking, the feelings associated with being a member of the in-group, such as being part of a research group, graduate program, or university, are potentially reduced. In contrast, out-group bias may be affected by feelings related to impostor phenomenon or microaggressions. These components either support a satisfied social identity or move individuals toward a dissatisfied social identity. The implications of the identity formation are reflected in the outcome variables of sense of resilience and access and opportunity for scholarly opportunities.

Previous research has identified similar facets in the experiences of graduate students. Based on a survey of graduate students in educational leadership and counseling, Bain and colleagues [91] found that student and faculty connections were fundamental to graduate students' success, especially when faculty facilitated the students' belief in their own success (resilience). Their study also indicated that more support was needed for financial aid and affordable tuition (financial support). Bain et al. emphasized the importance of students' feelings related to connectedness, which relates positively to the current survey's constructs of peer support and mentor support, and inversely to imposter phenomenon and microaggressions. In contrast, Tompkins et al. [89] determined that doctoral students received more academic socioemotional support from friends, family, and peers than from faculty members. Walsh et al. investigated the role of family supports for first-generation and historically marginalized doctoral students [92]. The researchers found that families provided support to doctoral students through emotional support, instrumental support, communicative support, and mental health support. The prior study suggested that graduate schools can hold orientations for family members to provide insight into the expectations of the graduate students as they progress through the program. Walsh et al. also suggested extending counseling services to family members to alleviate stressful situations and providing workshops focused on communication to help graduate students discuss their graduate school experiences with their families.

4.3. Differences in Perceived Support and Barriers Between Subgroups

The findings of the current study revealed that underrepresented graduate students in their programs perceived less support and more barriers (e.g., Black students, part-time students, and those from low SES backgrounds). In contrast, other groups encountered fewer barriers than hypothesized (e.g., female and first-generation students). When in-

terpreting these results, it is essential to consider that a lower score may not indicate that a particular subgroup receives less support in specific areas but rather that the groups may require additional support to overcome the unique barriers faced by their population. For example, students from lower SES backgrounds had significantly lower scores with financial support, indicating a barrier. This does not necessarily imply that these individuals received less financial support. It is possible that this group needs additional support compared to students from higher SES backgrounds. Similarly, first-generation students perceived higher scores for mentor support. This finding may reflect lower expectations for faculty support rather than increased support from faculty. Prior research has established that first-generation students often remain on the periphery of peer groups and are less likely to seek out faculty support (e.g., [32,52]), possibly due to lower expectations. Without additional information, the findings can only be interpreted as perceived supports and barriers, not allocated support. However, these findings can highlight areas of need in various student groups.

4.3.1. Holistic Findings from Survey Population

Composite scores for the whole survey population were the highest for mentor support and peer support, indicating areas where students perceived the most support during graduate school. However, resilience's composite score was the lowest of all the latent constructs that were considered supports. Lower scores for resilience may indicate a greater need for psychological support to help students maintain a growth mindset and a positive mental perspective, as supported in recent studies (e.g., [93,94]). The scores for imposter phenomenon and microaggression were lower than resilience, but these constructs reflect potential barriers. Therefore, lower scores in these two areas are advantageous.

4.3.2. Differences in Supports Between Subgroups

Despite the outline of the same program milestones, graduate students' experiences can vary based on a variety of social identities (e.g., race, gender, socioeconomic status), necessitating scaffolded supports for subgroups. Findings from the item analysis identified several areas where students need additional support through significant differences in composite means and survey items between subgroups (Figure 4).

Based on the survey results, microaggressions were perceived as a greater barrier for several subgroups, including Black, URM, female, STEM-URM-female, and full-time students. The findings of the current study are reiterated by Johnson-Bailey and colleagues [70], who examined four decades of responses from 586 Black graduate students. The investigators recognized that Black graduate students experienced isolation, exclusion, and a sense of survival during graduate school. In contrast, the White students encountered a more amiable campus with a more positive classroom environment. The researchers determined that the primary support for Black graduate students originated from Black professors and Black peers. The significance of microaggressions is further demonstrated by Boyle et al., who found higher rates of depression and anxiety connected to experiencing more microaggressions in minoritized graduate and law students [95].

In the current study, only females and STEM students from lower SES backgrounds reported more feelings related to imposter phenomenon. Prior research illustrated differences in experiences based on gender through a study of females' experiences in male-dominated doctoral programs [96]. In the prior work, females described lower academic self-concept, a deficit in support for family issues within their department, and lower career commitment. Similarly, Abshire et al. [97] conducted a study on gender-based perspectives and academic outcomes for students in an accelerated nursing program. Abshire et al. revealed that females were more likely to be dissatisfied with their peer support. The prior study also re-

ported that both male and female students who were unhappy with their peer support were less likely to graduate, reinforcing the importance of peer support during graduate school.

Figure 4. Identified barriers by subscale and group for the Graduate Student Success Survey+. Groups listed for each subscale have item(s) or composite mean(s) indicating perceived barriers compared to other subgroups ($p < 0.05$).

Financial support was a reported concern in the current study for those in research-based programs, from working-class backgrounds, in another graduate program, and first-generation graduate students from lower SES backgrounds. The differences in graduate school experiences are further reinforced by Wildey et al. [98], who explored mental health problems, service utilization, and support among subgroups of 734 graduate students attending a Midwestern university in the U.S. The researchers reported that females experienced more mental health problems, whereas students of color encountered greater financial strain than other students.

Composite means and item analysis revealed less mentor support for students who identified as students in another graduate program, in the middle stage of their program, and in-state students. In contrast, students from lower SES backgrounds in STEM and first-generation students in STEM reported more mentor support and greater access and opportunities to complete research. Prior research has shown that access to support and encouragement from mentors and peers was associated with decreased mental health symptoms. Perves et al. discovered doctoral students were at greater risk than the general population for experiencing depression, anxiety, and impostor phenomenon [99]. The study also identified a negative relationship between social support from supervisors (mentors) and friends (peers) and mental health symptoms. These findings highlight the critical role that peers and mentors play in the mental health of graduate students.

Access to research and writing opportunities was a concern for students during both the early and middle stages of their program, as well as for in-state students and those in education programs. As a potential support mechanism, O'Clair [100] explored a for-credit course in information research that scaffolded graduate students' access to research and writing; these experiences increased students' perceived levels of confidence and

preparedness. In a similar vein, participation in apprentice-style research groups that function as communities of practice and epistemic communities has been shown to enhance methodological and intellectual proficiencies in graduate students [101].

4.4. Relationship with Support Factors and Latent Constructs of the GSSS+

Regression analyses were conducted using the latent constructs of resilience. These variables reflect a positive mindset toward completing the program. The findings revealed that mentor support, peer support, and financial support were positively related to students' composite scores for resilience, whereas imposter phenomenon was negatively correlated with this construct. Through this data, it is evident that there is a relationship between these support structures and the creation of confidence, likely leading to a sense of belonging to the in-group as one moves closer to completing the program. The impact of imposter phenomenon reinforces biases one may hold toward being a member of an out-group, negatively relating to graduate school progression, as seen in the relationship with students' composite scores for resilience. The regression models provide evidence that the latent constructs of the current study are interconnected in influencing the graduate student journey.

Charles and colleagues [102] investigated factors affecting graduate students' mental health and reported on relationships similar to those identified in the current study's regression analysis. The prior study analyzed questionnaires regarding depressive symptoms from 3600 graduate students attending universities in California, U.S. Charles et al. identified financial concerns, poor mentorship, and perceived institutional discrimination as negative factors affecting students' health. In contrast, social support, departmental social climate, and optimism about their career were found to be positive factors.

Similarly, Hyun et al. [103] reported that 44% of international graduate students experienced stress-related problems that significantly impacted their well-being and academic performance. In the prior study, students with more functional mentor relationships were less likely to report stress-related problems, and those with fewer financial concerns were less likely to utilize counseling services. Hyun and colleagues determined that graduate students' sense of resilience is influenced by various aspects of graduate school, including mentor support, financial support, and peer support.

Additional regression analyses were completed with access and opportunity. These analyses revealed that mentor support and peer support are positively correlated with students' access to and opportunities for completing research, academic writing, and presenting at conferences. Regression analysis for mentor support revealed a positive relationship with access and opportunity, peer support, and resilience. Supporting the findings of the current study, Click [104] asserted that the support international graduate students acquired through specialized library assistance facilitated their research-based skill set. Contrary to the current study, Cullen and Vose determined that graduate students need to have initiative for their professional development to become independent scholars [105].

4.5. Relationship with Support Factors and Demographic Factors

Regression analyses were also conducted with demographic factors. In two separate models, graduate students from lower SES backgrounds in STEM had positive relationships with mentor support and access and opportunity. However, caution is advised in generalizing these findings toward the larger group. These models identified relationships, which can only be interpreted as correlations, not causations. In addition, the nature of self-reported data reveals perceived supports. Students coming from lower SES backgrounds may not perceive a need for additional mentor support or the necessity to complete scholarship-related activities (e.g., write papers for publication or present at conferences).

There is little literature on graduate students from lower socioeconomic backgrounds, but these findings may be related to patterns seen in studies on first-generation college students. Prior research has indicated that first-generation undergraduate students are more reluctant to interact with faculty and need more assistance acclimating to the social culture of higher education [106,107].

4.6. Students' Thoughts on Needed Supports

At the end of the survey, participants were asked to share additional thoughts about their graduate school experience. The open-response item was worded to limit the influence of the question. The survey items likely influenced what students shared; however, their concerns and praises aligned with the latent constructs of the GSSS+. A new concept of academic support emerged during this analysis, highlighting another area of potential concern for students. These statements focused on the quality of classroom instruction students experienced and the classroom support students received from professors. This area of interest may be an additional topic to investigate, especially in consideration that many graduate programs are moving to online platforms in an asynchronous format to accommodate working adults.

The most common codes used were resilience (35%), mentor support (28%), and academic support (16%). The majority of the statements expressed concerns about students' experiences as graduate students (66% barriers), reiterating the necessity of structural support and programs to facilitate students' success. Of the coded categories, the majority of the codes were shared as barriers, especially for microaggressions, impostor phenomenon, and academic support. Other codes were shared roughly as supports and barriers, including peer support and resilience.

As one mechanism of support, Cuthbert and Spark [108] identified that graduate writing groups had a positive impact on graduate students in Australia. The writing program was structured with pedagogic concepts, providing guided exercises, peer review, and support. The use of writing groups could provide additional assistance for students as they complete program milestones. If the students' departments scaffolded these groups, this could provide additional support. Similarly, the use of cohort-style programs could be beneficial to students. West et al. [29] established that students in cohorts had greater success than non-cohort students during graduate school. Prior work has shown that cohorts can provide both academic and motivational support for students in graduate school (e.g., [32,109]).

Similarly, the support of mentors can be invaluable to graduate students. In a qualitative study, Cain and colleagues [110] explored the experiences of graduate students in online programs. The study found that students expected their instructors to be knowledgeable about academic and administrative services, underscoring the importance of quality mentor support. Mentors can be especially valuable in bridging gaps for students who feel less engaged (e.g., underserved racial groups at PWI, females in physical science programs, or first-generation college students) [111–113]. Kelly and Schweitzer found a positive relationship between graduate student outcomes and mentor relationships, and that this relationship was more crucial for non-Caucasian students [114].

4.7. Limitations

Survey responses were limited to one university during one semester. There was a small response rate from the parent population, at 5%, indicating the need to exercise caution when extending the results to the entire graduate population. Similarly, the survey sample may not be representative of the parent population, as well. Moreover, these findings can be considered a snapshot of some students' experiences during graduate

school, and they may represent unique experiences not generalizable to larger groups of graduate students. It is believed that a larger sample set might have influenced the students' composite scores for resilience and access and opportunity. In the current study, microaggressions did not have a significant effect in any of the regression models. However, microaggressions were identified as a barrier for females, URM, and Black students through item analysis. Regression analysis that accounts for other variables, such as race and gender, could identify relationships not identified in the current study.

Lastly, the responses must be considered in relation to survey response bias. Without additional insight, the data gathered from the survey should be interpreted as perceived supports and barriers, rather than direct measures of support. Additionally, it is possible that respondents provided socially desirable answers, responding with the answers they believed would be most favorable to others. It is also possible that the responses may have included instances of extreme response bias, where the most extreme answer option was selected for specific items, especially if it was a prominent concern for those individuals. In the data cleaning process, individuals who exhibited this tendency across the entire survey would have been removed. However, if it only pertained to particular constructs, these responses were not excluded, as they may have represented their perceived experiences. These are common concerns with any survey distribution, and caution is advised in interpreting results as direct measures of support. The findings for the current study should not be extrapolated to larger populations.

5. Conclusions and Implications

The GSSS+ was distributed as an R2 university in the southeastern U.S. EFA determined a 7-factor, 40-item survey, including mentor support, peer support, financial support, access and opportunity, resilience, microaggressions (race and gender), and imposter phenomenon. Findings from the GSSS+ highlight areas where students require additional support and differences in needs based on demographic characteristics (e.g., race, socioeconomic status, and residency) and program type (e.g., master's/Ph.D., part-time/full-time, STEM/non-STEM).

5.1. Practical Recommendations

As supported by the findings of this current study and prior research, graduate students need more than academic support to be successful in graduate school. Based on these findings, recommendations are provided to enhance graduate students' experiences and foster a more inclusive campus climate (Figure 5).

As graduate students work toward completing their program requirements, scholarship components must be an integral part of their work. This includes completing research, presenting at conferences, and engaging in academic writing. Support for scholarly components ought to be incorporated into graduate programs to provide students with opportunities to gain these experiences. Prior research has indicated the use of specialized library programs [104], courses on research [100], and apprenticeship-style research groups [101] to be beneficial for graduate students. These supports can scaffold students' efforts to assist them in completing milestones and completing their programs.

Figure 5. Recommendations for university programs.

Social support from fellow students (peer support) and faculty (mentor support) can help students navigate the nuances of graduate school [32]. In prior work, mentors were described in three roles: allies, ambassadors, and master teachers. As allies, mentors were supportive on an interpersonal level [115]. Mentors also utilized a master-apprentice relationship with students to help graduate students develop into expert researchers. As ambassadors, mentors helped students create a sense of professional responsibility while introducing them to the academic culture. Comparably, the use of a cohort-style model for graduate programs facilitates the integration of peer support into these programs. Cohorts have the capacity to provide academic, social, and emotional support for students [32].

Similarly, universities need to provide professional development opportunities for faculty on mentorship. Despite the positive success of mentor programs, Mullen [116] indicated that potential successful mentors may not elect to become doctoral mentors due to a lack of institutional support. Prior work by Lindén et al. [117] discovered that faculty members reverted to the role of supervisor when they lacked mentor training, focusing on tasks rather than learning. Universities can offer professional development opportunities to hone faculty members' mentoring skills.

Lastly, support for graduate students' mental and financial well-being is also critical for their persistence in higher education [103,118]. Access to counseling in both areas will benefit students by reducing extraneous stressors and, consequently, allowing them to have more time and energy to focus on their academic paths (e.g., [95,99,119]).

5.2. Implications

The qualitative and quantitative findings of the current study highlight the need for scaffolded supports for graduate students, particularly for underserved groups. The findings of the current study lean toward a particular focus on mentorship. Gaining insight into the differences in students' experiences during graduate school and how they can be better supported provides universities with the knowledge needed to support their students more effectively. Through greater mentor support and scaffold peer support, students will have more insight into the strategies required to complete program milestones and navigate the nuances of graduate schools. These supports are essential for students who have a lower sense of belonging or feel distant from the university culture. These supports may also lessen the impact of barriers, such as microaggressions and imposter phenomenon. Similarly, support for financial and mental well-being will translate into a greater sense of resilience in students. These supports will provide students with more opportunities to

develop the skills necessary to complete their programs and become independent scholars. Increasing students' success will lower attrition rates and increase the creativity of ideas, as more students can complete graduate programs.

5.3. Future Research

Subsequent iterations of this research will involve distributing it across additional universities to gain a more comprehensive understanding of graduate students' experiences. Future research aims to investigate the experiences of students attending Historically Black Colleges and Universities (HBCUs) and Minority-Serving Institutions (MSIs), as well as private universities and institutions that have historically had all-male or all-female student bodies. To further support this research, an investigation into the impact of specific types of mentor support would be beneficial. The use of this survey instrument can provide universities with insight into the perceived supports and barriers that their graduate student population encounters. Identifying areas lacking support (e.g., mentorship support or financial support) or perceived as barriers (e.g., imposter phenomenon or microaggressions) can enable universities to support their students through strategic interventions, thereby creating a more inclusive climate.

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Abbreviations

The following abbreviations are used in this manuscript:

GSSS+	Graduate Student Success Survey+
STEM	Science, Technology, Engineering, and Mathematics
URM	Underrepresented Minority
HBCUs	Historically Black Colleges and Universities
MSI	Minority Serving Institutions
R2	Research Level 2 Institution, Carnegie Classification
U.S.	United States
UFGLI	Underrepresented First-generation, Low-income
SIT	Social Identity Theory
SES	Socioeconomic Status

Appendix A

Table A1. Graduate Student Success Survey+ [18].

Scale	Item	Question
Mentor Support	Mentor1	My academic progress is supported by faculty in my program.
	Mentor2	I am satisfied with the quality of the time I spend with my advisor.
	Mentor3	I have received academic support from faculty members in my program.
	Mentor4	I receive helpful feedback on my research from the faculty in my program.
	Mentor5	I feel my advisor cares about my well-being.
	Mentor6	I am treated with respect in my program.
	Mentor7	My contributions are valued by faculty members in my program.
	Mentor8	My own goals and research interests are incorporated into my master's/doctoral research.
	Mentor9	I am encouraged to complete my degree.
	Mentor10	I feel well-informed about the process of degree completion.
Imposter Phenomenon	ImpPhen1 *	I'm worried people may find out that I'm not as capable as they think I am.
	ImpPhen2 *	I'm afraid that I may fail at a new assignment or undertaking even though I generally do well at what I attempt.
	ImpPhen3 *	I compare myself to those around me and think they may be more intelligent than I am.
	ImpPhen4 *	I think I gained my present success because I happened to be in the right place at the right time.
Financial Support	Financial1	I receive sufficient financial resources to maintain steady progress toward my degree.
	Financial2	I am confident I can handle the cost of graduate school.
	Financial3	I receive enough financial resources to maintain an acceptable standard of living.
	Financial4	I am confident that I will have financial resources for next year.
	Financial5	I am confident that I will have financial resources during the summer.
	Financial6	I am able to afford the technology I need to support my graduate work.
Micro-aggression	Microagg1 *	I think people make assumptions about my abilities because of my race/ethnicity.
	Microagg2 *	I believe my opinions are overlooked in group discussions because of my race/ethnicity.
	Microagg3 *	I think other people make assumptions about my abilities because of my gender.
	Microagg4 *	I believe my opinions are overlooked in group discussions because of my gender.
	Microagg5 *	I think others suggest that people of my race/ethnicity get unfair benefits.
	Microagg6 *	I think others suggest that people of my gender get unfair benefits.
Access & Opportunity	Acc&Opp1	I have opportunities to participate in research.
	Acc&Opp2	I have opportunities to write academic papers for publication.
	Acc&Opp3	I have opportunities to participate in conferences.
	Acc&Opp4	I have opportunities to engage in outreach/extension activities beyond my program.
	Acc&Opp5	I believe I will finish writing my thesis/dissertation.
	Acc&Opp6	I have opportunities to help write grant proposals.
Resilience	Resilience1	I feel capable of handling the stress I encounter.
	Resilience2	I am able to handle my graduate student responsibilities without overwhelming anxiety.
	Resilience3	I can maintain focus on important things.
	Resilience4	I am motivated to start my day in the morning.
	Resilience5	I am satisfied with my life.
Peer Support	Peer1	I have received academic support from graduate students in my program.
	Peer2	I feel that graduate students in my program care about my well-being.
	Peer3	Graduate students in my program value my ideas.

Note: * denotes items that were reverse-coded.

Appendix B

Table A2. Graduate Student Success Survey+ item mean scores and factor loading.

Scale	Item	*N*	Mean	Std. Deviation	Factor Loading
Mentor Support	Mentor1	242	4.26	0.83	0.841
	Mentor2	241	3.62	1.26	0.726
	Mentor3	242	4.08	0.94	0.725
	Mentor4	241	3.85	1.02	0.616
	Mentor5	242	3.92	1.13	0.815
	Mentor6	242	4.30	0.85	0.774
	Mentor7	242	4.12	0.91	0.852
	Mentor8	240	3.97	0.97	0.566
	Mentor9	241	4.45	0.86	0.708
	Mentor10	242	4.00	1.12	0.652
Imposter Phenomenon	ImpPhen1	241	2.96	1.30	0.871
	ImpPhen2	242	3.15	1.29	0.801
	ImpPhen3	242	3.07	1.43	0.838
	ImpPhen4	242	2.67	1.31	0.483

Table A2. *Cont.*

Scale	Item	*N*	Mean	Std. Deviation	Factor Loading
Financial Support	Financial1	241	3.65	1.17	0.733
	Financial2	242	3.57	1.16	0.778
	Financial3	242	3.65	1.06	0.816
	Financial4	242	3.65	1.08	0.825
	Financial5	242	3.66	1.12	0.842
	Financial6	241	3.88	1.02	0.758
Microaggressions	Microagg1	242	2.77	1.23	0.670
	Microagg2	242	2.19	1.08	0.736
	Microagg3	242	2.78	1.28	0.752
	Microagg4	242	2.37	1.109	0.745
	Microagg5	241	3.05	1.32	0.545
	Microagg6	242	2.77	1.25	0.628
Access & Opportunity	Acc&Opp1	242	4.01	0.86	0.665
	Acc&Opp2	242	3.67	1.12	0.790
	Acc&Opp3	242	3.76	1.06	0.705
	Acc&Opp4	242	3.76	0.99	0.647
	Acc&Opp5	241	3.75	0.89	0.440
	Acc&Opp6	242	2.98	1.10	0.667
Resilience	Resilience1	242	3.66	0.93	−0.761
	Resilience2	242	3.27	1.18	−0.791
	Resilience3	242	3.77	0.89	−0.800
	Resilience4	241	3.56	1.13	−0.741
	Resilience5	241	3.84	1.01	−0.704
Peer Support	Peer1	242	3.76	1.12	−0.824
	Peer2	242	3.89	0.97	−0.888
	Peer3	242	4.01	0.86	−0.791

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