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Examining Access to Engineering: Non-White Women's Experiences of an Undergraduate Engineering Admissions Process (Full Research Paper)

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Introduction

While engineering degree attainment for women has increased to 25% as of 2023, white women are disproportionately overrepresented, earning over half of those degrees. Only 11.4% of engineering bachelor's degrees were awarded to non-white, non-male students [1]. Current research on retention of underrepresented students in Engineering focuses on aspects like recruitment, pre-college preparation, sense of belonging, and similar factors [2-4]. Few consider the admissions process for Engineering majors. In a search of the literature, only one study was found that focused on the effect of an Engineering admissions process on retention [5].

There are many stages students must pass through to earn an engineering degree. Gayles and Ampaw refer to this as the "leaky pipeline," which symbolizes the STEM pathway from college to career [6]. To more accurately represent the non-linear and complex nature of journeys to engineer careers, Pawley and Hoegh recommend alternative analogies such as "journey" or "pathway" [7]. These metaphors represent the junctures, leaks, and roadblocks that complicate a student's engineering education and career. These challenges are more apparent for women and non-binary students who are racially underrepresented (Black, Hispanic, Native American) [8]-[9] than for their White and Asian male peers.

For most degree programs, incoming students are simultaneously admitted to both the institution and their major. In some cases, colleges or programs institute additional admissions processes at the major level, referred to here as Secondary Major Admissions (SMA) processes, as a method of managing enrollment. This creates an additional, invisible transition point that students must pass through, creating a potential roadblock in the engineering journey [5]. This project seeks to investigate this potential roadblock by exploring how students from underrepresented backgrounds experience a major admissions process in an undergraduate Engineering program in a large, public institution. Based on previous literature, underrepresented students in this study include students who do not identify as white or male [5]-[6], [8]-[13]. This IRB-approved study utilizes self-efficacy, the belief one has that they can accomplish a task, as a framework to address the following research question: How do non-white, non-male students experience a major admissions process in an undergraduate engineering program in a large, public institution?

Theoretical Framework

This study utilizes research on self-efficacy in STEM to explore student experiences of a secondary major admissions process. Developed by Albert Bandura, self-efficacy is the belief a person has that they can accomplish a task. It is influenced by individual and environmental factors that Bandura refers to as barriers and facilitators [14]. Self-efficacy is thought to be task specific; one's belief that they can do a task might vary from another task [15]. Relevant to this study, Academic self-efficacy is the belief one has that they can accomplish academic tasks [15]. Previous research has demonstrated that lower perceptions of academic self-efficacy can affect

STEM educational and career aspirations [4], [12], [16]. A 2011 study found that performance in early college math and science courses affected academic self-efficacy of underrepresented students, contributing to attrition in STEM majors like Engineering [16]. Another study suggests that negative interactions with faculty, especially in courses intentionally designed to "weed out" students, affect academic self-efficacy and can lead to attrition in STEM majors [4].

Methods

In order to describe how underrepresented students experience a secondary admissions process in an undergraduate Engineering program, the researcher utilized a phenomenological approach. The aim of the phenomenological research is to "gain a deeper understanding of the meaning of everyday ("obvious") phenomena" [17, p. 11]. In other words, it is a methodological approach in which the goal is to better uncover the experience of a particular phenomenon. A 2018 review of higher education research demonstrates that quantitative methods are limited in explaining underrepresentation in STEM [11]. Studies using quantitative methods risk homogenizing groups and missing important, distinct factors that might shed light on the problem. This suggests that a qualitative study, which is more suited for collecting and analyzing rich data, is more appropriate for describing how students experience SMA processes in Engineering. Because describing experience is the goal of the study, Interpretative Phenomenological Analysis (IPA) was the specific method used. This aim of IPA is to "focus on people's experiences and/or understandings of particular phenomena" [18, p. 41]. Researchers engaging in IPA intend to openly explore experiences and how individuals make sense of experiences. Because it is rooted in lived experience, this method will also allow for creation of meaningful policy suggestions to improve retention and student success.

Research Site and Participants

Data collection took place in the spring term of 2023 in the College of Engineering at a large, public 4-year institution. After the creation of the College, this program grew from 500 students to 2500 students over 5 years. The College implemented an SMA process to improve enrollment management by forecasting required resources, such as classroom space and teaching assignments. Previous employment relationships of the researcher facilitated access to the research site.

In order to capture experiences of underrepresented students, recruitment was limited to non-white, non-male students across the admissions process: students who had completed the process with different outcomes (accepted or rejected) and who had not yet completed the process. The intersectional nature of identity was acknowledged in the interview process through encouraging participants to explore how their gender, race, and the combination of the two shaped their experience.

Smith et al. recommend interviewing around 10 participants to balance the need for rich data with the time and rigor required in data collection and analysis [18]. Recruiting began with a recruiting email and eligibility survey distributed by academic advisors. This initial call for participants did not yield enough participants. Subsequently, the same recruiting materials were shared with student organization leaders. To ensure the correct population was sampled,

stratified purposive sampling, recruiting and selecting participants from specific subgroups, was used [19]. The recruiting process yielded 6 participants. The participants and demographic information are summarized in Table 1.

Table 1: Participants

Participant Pseudonym	Gender	Race	Year	Major	Application Status
Cam	Non-Binary	Asian	5	Electrical Engineering	Accepted on 1st Attempt
Judy	Female	Black	6	Mechanical Engineering	Accepted on 2nd Attempt
Emily	Female	Hispanic	4	Computer Systems Engineering	Accepted on 2nd Attempt
Mary	Female	Asian	4	Environmental Engineering	Accepted on 2nd Attempt
Sophia	Female	Hispanic	1	Intended Mechanical Engineering	Pre-Application
Ipshith	Female	Asian	2	Intended Computer Systems Engineering	Pre-Application

Interviews

Following IPA guidelines, semi-structured, in-depth interviews were used to allow participants to share detailed, personal accounts of their experiences. To allow adequate time for reflection and discussing their experience, interviews were scheduled for 60 minutes [18]. Despite an option for in-person interviews, all interviews were conducted and recorded via Zoom. The interview protocol (Appendix) consisted of open-ended questions designed with the theoretical framework and asked participants to reflect on and share about their experiences of aspects of the Engineering application process. At the beginning of each interview, participants self-selected pseudonyms.

Document Analysis

In addition to interviews, the researcher collected documents detailing the application process. These included two advisor emails about the process, a PowerPoint from an optional information session, a transfer student handbook, and departmental webpages that explain the processes. The advisor emails contain publicly available information, demonstrate how advisors communicate requirements to students, and illustrate a part of the application process experience. The information session PowerPoint, transfer student handbook, and program website documents provide important context in which to situate the data collected from interviews. Reviewing the documents allowed the researcher to contextualize the interview data and aided in the construction of the findings [18].

Data Analysis

The data collection process and analysis took place simultaneously. This iterative process allowed the researcher to immerse themself in each participant's data, which is necessary when making meaning of the data [19]. During interviews, the researcher took fieldnotes that included the participants body language, which may point to aspects of experience they do not verbally mention. The field notes also included personal reactions to responses, which aided reflexivity during analysis. In addition to fieldnotes, memos were written after each interview. The reflections included in fieldnotes and memos allowed for conceptualization of the data. This is an important step assisted in making meaning out of the raw data [20]. Interview transcription and cleaning was completed using Otter.ai. Each transcript was deidentified and sent to participants to check for accuracy.

Interview and document data were analyzed using MAXQDA, a software that facilitates making and writing notes in the data, as well as assigning codes that can be searched, categorized, ordered, etc. [19]. Coding, the process of assigning labels that apply meaning to information [21], took place in two cycles. The first cycle, used to initially describe and summarize concepts that arise in the data (2019), utilized inductive coding. Smith et al. recommend an inductive process, considering the data without predetermined codes [19], to describe participant experiences and their interpretations [18]. Exploratory noting was also used in this phase, as suggested when engaging in IPA, which is a process of reading transcripts and making notes on specific quotations with the goal of making meaning of an experience [18]. This facilitated centering student voices and focusing on experience. The exploratory notes were used to create codes to describe student experience. After inductive coding, deductive coding using concepts from the theoretical framework (self-efficacy) took place [19].

In the second cycle of coding, the researcher examined connections across codes by developing experiential statements. Smith et al. recommend creating experiential statements based on the exploratory notes. These are statements that relate directly to the participants' experiences or process of making meaning of the experiences [18]. This step marks a shift from identifying common themes to synthesizing them for the analysis. As suggested by Smith et al., searching for connections across experiential statements can help the researcher map interconnections [18]. Based on these recommendations, the researcher drew connections across the experiential statements and developed findings that center participant voices while exploring how they relate to previous literature.

Trustworthiness

Due to the nature of qualitative inquiry, establishing credibility and trustworthiness of results requires different methods than traditional cause-effect study designs [19]. To improve the rigor and trustworthiness of this study, the researcher engaged in the following procedures developed by Creswell and Miller [22] and Maxwell [23], to ensure rigor and trustworthiness: crystallization, engaging with participants, and reflexivity.

Crystallization is the process of collecting data from multiple sources or through multiple methods to ensure soundness of data [19]. This study engages in crystallization by using data

from semi-structured interviews, policy documents, and official communications regarding the major admissions process. Additionally, the researcher engaged with participants throughout the study through an IRB approved consent process, reminders that consent can change at any time, and member checks. At the beginning of the interview, the researcher disclosed previous employment as an academic advisor at the research site, to build trust and rapport with the participants. During member checks, participants were given the opportunity to review their transcript and provide clarification.

Findings

The data collection and subsequent analysis revealed two components of findings: SMA process context and SMA process experience of non-white, non-male students. The document analysis, supported by data collected in interviews, provided the context (timeline, requirements, evaluation, and resources) of this specific SMA process: the High Demand Major Application Process. This information is necessary for understanding how students experience the process. Taken as a whole, the details create the mechanism—the secondary major admissions process—that acts as a junction in the engineering pathway.

While considering the secondary major admissions process context, the data revealed three themes that shape underrepresented students' experiences of the secondary major admissions process: frustration and confusion, extra burden, and timing. These themes cannot wholly describe the experience, as only one interview for each of the six participants was conducted, but it is a starting point to consider how SMA processes may act as a mechanism in the Engineering Pipeline. The following section will explain the context of the secondary major admissions process being observed. Subsequently, it will describe the experiences of underrepresented students through emergent themes and experiential statements composed through the analysis.

Secondary Major Admissions Process Context

The impetus of this study is the researcher's experience with the SMA process as an Academic Advisor at the research site. Enrollment in the College of Engineering tripled between its founding in 2012 and 2016. At this point, the College created the High Demand Major High Demand Major Application Process (referred to colloquially by students and staff as the "HDM process") as a method of enrollment management [24]. The document analysis and interview data revealed that the context can be described by timeline and requirements, evaluation, and resources provided. The process is communicated similarly across the College of Engineering website, through advisor emails, in the Information Session PowerPoint, and the Transfer Student Handbook, with a few inconsistencies. At the point of data collection for this study (March 2023), the website lists different required courses for Electrical Engineering and Computer Systems Engineering than the Information Session PowerPoint and the Transfer Student Handbook. This indicates that the requirements have changed and not all documents have not been updated.

Timeline and Requirements

The HDM process requires interested students to declare "intended" engineering majors before matriculating to upper division coursework. Once students complete or in-progress with required courses they are eligible to apply to a first- and second-choice major [25]. Students must earn a C or better in each required course to be eligible. Admission is based on grades in General Education Coursework (English I, Calculus I, Calculus II, Physics I), Major Specific Coursework (three courses, specific to major), and a Personal Statement of Purpose (PSOP). Because of prerequisites to required courses, it takes 3-4 semesters for students to be eligible to apply. In the semester a student becomes eligible, they must complete the application form (online) and the Personal Statement of Purpose (at the UGA Testing Center).

Students have two attempts to be admitted to the College of Engineering and are allowed to withdraw their application before grades are published if they suspect they have not met the minimum grade in a course. The College website states, "Effective in the fall 2019 application cycle, a first-time HDM applicant is able to withdraw his/her application from being evaluated for acceptance" [25]. Beyond this, if a student is denied twice, they are no longer eligible to pursue an engineering degree. Once students are admitted to the College, major-specific courses are "unlocked," and students can continue in the curriculum towards degree completion.

Evaluation

Admission is evaluated by combining grades in required courses and the earned score on the Personal Statement of Purpose. Table 2 presents the weight of each requirement. According to the College of Engineering website, "The initial step in the application process is to complete the Personal Statement of Purpose. The PSOP must be written at the University's Testing Center" [25] According to student interviews, the PSOP is graded by graduate students in the English department. Once this is completed, students submit their grades in required courses through the online application form. The grades and PSOP score are reported to the College of Engineering Academic Manager, who creates a spreadsheet for the Dean. The Dean then evaluates applicants and, and the Academic Manager releases decisions a few months later.

Table 2: College of Engineering High Demand Major Application Requirements

Requirement	**Percent of Overall Score**
General Education Coursework	30%
Major Specific Coursework	40%
Personal Statement of Purpose	30%

Resources

Interview data and documents exhibit resources to assist students throughout this process. Advisor emails and the College of Engineering website reference an Information Session,

Personal Statement of Purpose Workshop, and Personal Statement of Purpose Review Day. The Information Session PowerPoint mentions these resources as well as the UGA Career Center, Writing Center, and external resources (such as YouTube videos, professors, friends, and family). Ipshith, Sophia, Cam, and Judy all referenced at least one of these resources and Sophia also mentioned tutoring that is available on campus for required courses.

Secondary Major Admissions Process Experience for Non-White, Non-Male Students

The synthesis of interview data through the lens of self-efficacy led to the following themes: frustration, extra burden, and timing. The themes were informed by experiential statements, developed using the IPA method, that center the student voice. The following sections describe the findings of each theme.

Frustration: Why Is This Necessary?

Experiential Statement: *When I learned about the application process, I was like "another one?" Don't the hard engineering courses weed us out anyway?*

When asked about their reactions to learning about the SMA process, the participants recalled feeling annoyed, confused, and frustrated. Ipshith, a second-year student who has not completed the process, remembered asking "what is an intended major?" but exhibited strong self-efficacy by saying she was not too concerned about being admitted. Judy recalled being annoyed and thinking "another application, really?" Beyond annoyance, participants reported not understanding why the process is needed when the acceptance rate is generally high. Emily was "surprised…that it's needed at all." Mary's reaction to learning about the application process demonstrates confusion as well:

> *"in [the College of Business], it made more sense because it was like a very competitive program. Everyone wanted to be a business major, so I understood it there. But for the College of Engineering, I didn't know there was like some sort of limitation to open and like seats or enrollments in certain majors. didn't really think that was going to be a problem since the program was so small. And the acceptance rate is pretty high. So it's like, well, wouldn't these classes already weed us out? Anyways?"*

Participants that have been through the application process exhibit more frustration than those who have not, especially about the Personal Statement of Purpose requirement. They question why it needs to be taken at the UGA Writing Center, where they cannot use any materials to remind them of what they want to say. Cam said the following:

> *"I don't know why you had to memorize your essay, and then just regurgitate it on the thing. That's kind of weird. That was one of the things that also bothered me a lot, because I was like, why would you do that? I would be really better if I like had time to actually like, sit there, write it and then submit it like that?"*

Each participant that reapplied to the College after either withdrawing their first attempt or being denied (Judy, Emily, and Mary) expressed frustration that they could not reuse their Personal Statement of Purpose. Emily found the application process "more frustrating" than her peers because she "had to, like, write two statements of purpose." This requirement is confirmed by College of Engineering website that states "student[s]…need to complete another PSOP during a future term he/she plans to apply." Participants wonder why "they can't just save it" (Judy) and were annoyed that they had to pay $30 for each attempt (Judy and Mary).

The PSOP challenged self-efficacy for two participants. Cam and Emily both described feeling anxious about the process; they felt they needed to exude some "grand purpose" in their statement for it to be good enough.

Extra Burden: It's Extra Work for Me

Experiential Statement: *When I walk into a classroom, I always take a quick inventory of who is there. When I am in a room with a lot of white guys, I have to be very careful and be very considerate, because otherwise, people might think I'm kind of annoying or aggressive and won't want to listen to what I have to say.*

Every participant noted that non-white, non-male students in engineering have additional challenges that their peers do not face. Students discuss that they must be mindful of interactions with male colleagues in classes, groupwork, and internships to avoid being referred to as stereotypes or being cast as "aggressive." Participants reported spending time and energy proving themselves and presenting themselves as valuable members of the learning environment. While Sophia said she had "a sense to prove [herself] worthy enough" she also resented that she was viewed as bossy by her white, male peers who call her "boss lady." Cam shared the following:

"I've also feel like, there's a lot of like, societal pressure to…not [assert] myself for the fear of like, being kinda called a bitch, or something like that, to be honest. And so I have to, like, write my emails and messages and everything, and be very careful and be very considerate, because otherwise, people might think I'm kind of annoying, or they might think that I'm being too aggressive. And the thing is, if people have a negative opinion of you, they might not really want to listen to what you have to say"

Mary echoed this sentiment:

"You have to be very careful of how you present yourself. And careful how you say things in case they make those quick judgments that they won't be able to wipe away, and you have to start rebuilding, you know, yourself, again, and establishing you are capable."

As shown with these quotes, non-white, non-male students experience extra burden in interactions in all engineering spaces. They fear that if they are viewed as "aggressive," it will hurt their ability to meaningfully participate in these experiences. This burden permeates the college experience, from entry level physics courses, to engineering groupwork, to working in

industry settings. The extra time and energy spent on these interactions took away from time they could spend on studying, using resources, or otherwise preparing for the admissions process.

In addition to the burden of carefully presenting themselves in white, male dominated spaces, participants expressed questioning their self-efficacy. Mary stated that her male peers "seem to be a little bit more intelligent and like capable" and "just walk with this confidence…that females don't." Judy shared that her male peers seem to be more prepared for aspects of the engineering curriculum, like fabrication. Sophia questioned her knowledge when male groupmates ignored her contributions.

Participants also noted challenges with interacting with faculty that added to their burden. Judy and Emily noted that professor assignment for required courses makes a difference in likelihood of being admitted to the major. Students who are assigned to "hard" professors are more likely to fail. Emily said, "I know, at least like two other people that…got their graduation delayed because…of the same Circuits class." Positive faculty interactions have positive impacts on self-efficacy. Ipshith noted that her current Asian female professor reminded her that she is not alone in the Engineering space and has improved her confidence.

Finally, students expressed that the need to find a welcoming community added to their burden. Several participants noted the importance of student organizations in helping them feel like they fit in the culture of the College of Engineering. Cam didn't feel like they belonged in engineering until their third year when they joined the Engineering Equity Council and found other students with similar experiences. They initially felt "isolated" and "considered quitting [their] major because of it." Judy said that despite not fitting in to her major, getting involved in College activities, like Society for Women Engineers, National Society of Black Engineers, and the Engineering Equity Council, had helped her to feel "very comfortable in the space" she is in.

Timing: Timing Matters

Experiential Statement: *Because I had to reapply, the major courses weren't open to me and I got stuck. Now it's harder because all I have left are engineering classes and no buffer classes. I feel like I was punished for struggling with one class. I'm worried about how I will pay for my last semester.*

Every participant that completed the application process discussed falling behind due to major courses being "locked" before admission to the College. Emily's self-efficacy faltered when she had to reapply because she did not initially pass a required course. She found this "limiting" because her friends, the community that supported her in classes, "left [her] behind." Cam , Emily, and Judy, who are nearing graduation, are taking heavy engineering course schedules this semester due to having no other requirements left. Judy described how being admitted late affected her: "I ran out of all those electives at the beginning…I am only taking engineering classes, only taking engineering electives, and my class schedule is stacked." Being admitted later results in difficult final semesters consisting mostly of difficult upper-level engineering courses. This adds to the burdens these students are already facing, and the additional challenge adds to self-efficacy doubts. The potential for a delayed graduation brought on by the admissions

process not only increases the cost of college but delays future income students will earn once they have graduated.

Discussion

The goal of this study is to describe how non-white, non-male students experience an SMA process through analyzing student interviews and program documents. The findings suggest that students wonder what the point of the process is. Simultaneously, they experience challenges that exacerbate the stress of the admissions process and affect academic self-efficacy. Because admissions requirements include grades in classes for a majority of the score, when students discuss their experience of the process, they necessarily discuss challenges that underrepresented students face in STEM programs generally.

These findings support previous literature about academic self-efficacy in STEM by echoing experiences that affect these concepts. This includes the extra mental effort they spend to fit into the classroom environment, challenges with faculty interaction, and concerns about timing of curriculum requirements [2]-[3], [5], [26]. Struggles with academic self-efficacy have been tied to negative interactions with faculty and weed out courses [4], which is also demonstrated in this study.

The findings from this study suggest that academic self-efficacy is tied to how students experience the secondary major admissions process. These experiences moderate the relationship between an SMA process and retention of underrepresented students. Students with positive experiences of the process, including a strong sense of academic self-efficacy, face less challenges and are more likely to be retained in the engineering pathway. The converse is also true. Underrepresented students often face additional challenges in their experience of the SMA process, which may lead to disruptions in the engineering pathway. These additional challenges are in part created by the chilly climate of engineering and STEM classes [26]-[29]. It is the role of the Institution and College, not the individual student, to create conditions for equitable experiences for all students. Specifically, it is the responsibility of the Institution and College to create learning environments that empower students, fostering self-efficacy, rather than (re)producing chilly climates that challenge self-efficacy. As such, the following sections provide policy suggestions to simplify the SMA process and create a more equitable engineering pathway for students regardless of background.

Policy Suggestions

Assessment

The components that make up an SMA process (i.e., the requirements, timeline, evaluation, etc.) necessarily affect student experience, which in turn may complicate the engineering pathway. Administrators should rigorously assess each component of their process to determine the necessity and effect on underrepresented students. Communication and transparency are especially important components that shape students' experience. The data in this study indicates that communication happens at the advisor-level and the college-level. Variation within and across these levels affect student understanding of the process. For example, Sophia expressed

not being concerned about being admitted because she just needs "to meet minimum grades, which shouldn't be too hard." The College of Engineering website (included in the document analysis) states "the above criteria are minimum application requirements and do not guarantee acceptance to any major in the College of Engineering." Sophia mistook that if she met the minimum grades, she would be guaranteed admission. This may be due to inconsistencies between advisor-level and college-level communications. An example explanatory email provided by an advisor did not address the minimum grade requirements but did link to the college website where the requirements are listed. Inconsistencies across college-level communications were also found. The website shows updated requirements for two majors while the Transfer Student Handbook and Information Session PowerPoint show outdated course requirements. Administrators should observe and assess how requirements are communicated to ensure consistency across and within all levels. Consistent wording provided to advisors that is consistent with college communications might alleviate confusion.

While considering how individual components of the process affect the experience of underrepresented students, the process should also be evaluated broadly. Administrators should determine if the benefit of the process (enrollment management) outweighs the effects on student experience and retention. Currently, the college assesses the process by summarizing admissions outcomes, providing outcomes based on demographics. Administrators should go beyond a simple summary of how many students are admitted or denied. They should consider how timing of the process affects retention and consider the following: at what point in the program of study are students admitted? Are students staying on the prescribed curriculum? Are they applying later than anticipated? Have they extended their graduation date in the process of meeting application requirements? Considering these questions, as well as evaluating the results with demographic breakdowns, will provide a more robust assessment of the process. Determining unintended outcomes of any SMA process, whether the outcomes present as additional burdens or lower retention rates of specific student groups, is essential to ensure no group is being disproportionately affected.

Transparency

All the students interviewed expressed frustration with the lack of transparency in the process. They wondered why the process is necessary if the acceptance rate is always so high. Administration should offer transparency to ease concerns and stress that may unnecessarily burden students. College communication about the process could include why it was implemented. Understanding the purpose may alleviate stress. Transparency about the rates of admission may also ease the experience of students. Currently, the college summarizes acceptance rates generally and based on demographics (including by major, gender, and race), but this is only shared internally. Sharing this information with students may calm their nerves about being accepted and allow them to prioritize how they spend their time and effort. Acceptance rates and student body demographic data should also be easily found on the College of Engineering website for potential students to consider in their college decision-making process.

Resources

Resources are essential in supporting students through transitions in higher education. Providing support for a secondary major admissions process is no different. Because underrepresented students experience additional challenges, resources should not only be provided, but carefully considered to ensure they support all students. The findings of this study reveal multiple types of resources, such as workshops, information sessions, videos, Career Consultants, and Advisors.

All but one of the participants in this study mentioned resources provided by the College of Engineering and the UGA community, but they expressed mixed feelings about the effectiveness. Sophia, a first-year student, acknowledged the available resources and has plans to "seek help" and talk to her advisor if she experiences challenges during the application process. Mary, a fourth-year student that was accepted on her second attempt, said she was "pretty proactive about finding resources and taking advantage of them" while some of her classmates that struggled more did not take advantage of resources. Cam and Emily expressed different opinions about available resources. Cam, a fifth-year who experienced anxiety completing the Personal Statement of Purpose, said they were too "worried like about…classwork" to take advantage of review days: "that was kind of a lot of like wasted time for me." Emily expressed concerns with transportation to the College of Engineering building. When help was offered after hours or when she was in different classes across campus, she found it difficult to attend: "I feel it's a little bit harder to do things as an engineering major with no car on campus."

These findings suggest that administrators should go beyond merely providing resources; they should evaluate the effectiveness and accessibility of resources. An evaluation of resources can aid administrators in making policy decisions about which resources to prioritize, what can be done to improve them, or if new ones are needed. For example, polling students about convenient times and locations for planned resources may increase opportunities for students that need support. Additionally, offering writing support earlier in the curriculum, as suggested by Cam, may be beneficial to some students who lack writing self-efficacy. Effective and accessible resources are essential in supporting students. They can ease the burden students face in the SMA process and create a more equitable journey on the engineering pathway.

Limitations

There are a few limitations to this study design. First, to truly get at an experience, temporal adjacency is preferable [18]. Some participants are a few semesters removed from the process, which may make it difficult for them to remember or accurately communicate their experience. Due to time and access constraints, this is not possible for this study. Smith et al. also suggest interviewing participants from multiple perspectives to develop a "more detailed and multi-faceted account of [the] phenomenon" [18, p. 47]. Secondly, this study is about a single institution. While it is a starting point to examine how students experience SMA processes in Engineering, it will only provide actionable insights for this institutional context. Finally, I was an academic advisor in this specific program for three years. Some of the participants knew me from that role. This may have affected rapport in the interviews and how much they were willing to share. I also have experience assisting students through this specific process, which may bias my interview process and analysis. To avoid this, I disclosed my experience as an advisor during interviews and took fieldnotes regarding my own feelings to avoid biasing analysis.

Future Research

After sharing the results of this research with administrators of the research site in 2023, the College engaged in an assessment of their SMA process through collaboration with the researcher. The results of this assessment led to a redesign of the SMA process, changing it from a selective admissions process (the HDM process) to an eligibility-based gateway process (the Entrance Requirement process). If students meet minimum grades in gateway classes, they are admitted to their chosen engineering major. Currently, the researcher is engaging in an embedded case study analysis that compares the former HDM process and the new Entrance Requirement process. This case study includes interviews with a total of 30 participants (advising staff, administrators, and students), observations, and document analysis.

The current study lays the foundation for future research to examine how SMA processes affect the engineering pathway of underrepresented students. Future research should build on this work to determine if these processes disproportionally affect retention of any student groups through quantitative analysis. This should examine retention at different points in the curriculum to capture students that may self-select out of engineering majors due to fears about the process. More broadly, a comparison of SMA processes in different institutional contexts would provide data to help design SMA processes that balance enrollment management goals and equitable student experiences.

Conclusion

Despite increased access and representation in undergraduate programs generally, women and underrepresented racial groups remain underrepresented in undergraduate Engineering programs and degree earners [2]-[3], [5], [8]-[9]. The complex nature of engineering pathways creates many transition points at which students may experience delays or roadblocks in earning engineering degrees [5]-[6], [26]. This study finds that SMA processes are an added transition point that can compound the difficulties underrepresented students already face. Administrators should consider if the benefits of SMA processes outweigh the potential negative impacts on student pathways to engineering degrees and careers. Future research should evaluate the effects of such processes on retention, whether through students are denied admission or self-select out of the process.

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Appendix

Interview Protocol

1. Can you start by telling me about why you decided to attend UGA? (Probing questions: What's your major? What year are you in? When do you plan to graduate?)
2. Tell me about how you chose this major? (Probing questions: What do you like about it? Is there anyone in your life who influenced your choice? Why are you interested in engineering? Has this changed since you started at UGA?)
3. What was your orientation experience like? (Probing questions: what did you do? What information did you learn? What was the advising experience like? Who was involved in orienting you to your program?)
4. How was your first year at UGA? (If they are a first-year: how is your first year going?)
    a. Can you share one thing you've enjoyed so far?
    b. Can you share a challenge you have experienced in college? What about in your major?
5. Can you describe the culture of your major/the college of engineering?
6. How good of a fit is the college of engineering for you? Do you feel like you fit in the college/major culture?
7. Do you think your experience is different from students from backgrounds that are different from your own? (Probing questions: Why or why not?)
8. How are your classes going this year?
9. Can you tell me about your experiences with your advisor?
10. If they haven't already answered this: Have you ever thought about changing your major? Can you share about your thought process? Why did/didn't you?
11. Can you tell me about the process of how you get into your major? (Probing questions: what are the requirements?)
12. Can you share your reactions to learning about the application process?
13. What is the application process like? OR What was the application process like for you? (Probing questions: how did it go?)
14. Were you worried about getting into your major? (if yes, why? What is your second major choice? Probe about changing out of engineering)
15. What challenges did you experience in the process?
16. Do you think your experience is common among other students applying to this major?
17. If you could share advice with a first-year who has a similar background to you, what would you say?
18. Is there anything else you feel is important that you didn't get to share that you would like to talk about?