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"My Blood Is Boiling When I Think About Advising": The Role of Academic Advising in STEM Student Retention

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Abstract

Student attrition from STEM disciplines is one of the most pressing issues in higher education. To better understand the causes of this attrition, this study examines STEM students' college experiences and uncovers their perspectives on the existing support systems with a specific focus on the role of academic advising. Our research reveals that students from a particular STEM major identified academic advising as problematic, serving as one of the main factors pushing them out of the major, while the STEM major they transferred to did not have this issue. We examined whether this difference was also evident in the perspectives of the student affairs offices by interviewing academic counselors. This research emphasizes the responsibility of academic counselors in students' decisions to leave STEM majors and the importance of care in their work. The findings suggest a need for STEM departments to re-assess academic advising philosophies and practices while creating more supportive learning environments.

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Reducing attrition in Science, Technology, Engineering, and Mathematics (STEM) disciplines has become a central issue for U.S. higher education institutions with only 40% of students who enter a STEM undergraduate program earning a STEM degree (Seymour & Hunter, 2019). Furthermore, those who leave STEM majors are disproportionately from minoritized backgrounds, which contributes to the lack of diversity in STEM industries and research fields. At the campus in this study, for example, the highest enrollment STEM major loses over 40% of its incoming class within students' first two years of college, with this figure being 50% higher for minoritized students. Previous studies have demonstrated that students leave STEM majors for a number of reasons, ranging from losing interest in the discipline and having negative experiences within the major to lacking a sense of belonging in the given department or institution (Emekalam, 2019; Seymour & Hunter, 2019).

Higher education institutions consistently emphasize the importance of increasing student retention and promoting student academic success, especially in their first year of college; however, these goals are rarely prioritized or are being only partially addressed at research-intensive universities (Anderson et al., 2011; Cadez et al., 2017; Milem et al., 2000). Tinto (1999) points out that institutions frequently solve such issues through adopting an "add a course" policy, where a freshman seminar or a mentoring program is added as a band-aid solution for the retention problem rather than addressing retention as a more complex issue. To substantially improve students' learning experiences, it is important to acknowledge that one of the main goals of a university is not only to teach students content and skills, but also to create a supportive environment that enables students to be successful (Copeland & Levesque-Bristol, 2011; Paguyo et al., 2015; Tinto, 1999). This view highlights the significance of creating an inclusive and positive learning environment constructed by multiple stakeholders (Copeland & Levesque-Bristol, 2011). A comprehensive inclusive learning environment is built by faculty and others involved in the educational process, such as counselors, teaching assistants, and academic personnel supporting students throughout their educational experiences. Through this lens, universities can be compared to complex machines containing multiple intertwining parts that play a crucial role in supporting students. Together, all the individuals involved in the educational process have the capacity to change the very nature of the learning environments to more effectively promote student success and retention.

In this study, we examine STEM student success and retention in a large public research university setting through the ethic of care theoretical framework, which

argues that care should be at the heart of every education system and caring educators are essential for student academic success. The goal of this work is to better understand how certain aspects of the college experience help shape STEM students' decisions to stay in or leave their majors and to uncover their perspectives regarding the effectiveness of existing support systems. This study looks at two STEM programs: a traditional STEM discipline (e.g. Physics, Life Sciences, etc.), which we refer to as Major 1 and a non-traditional STEM discipline (e.g. Economics, Public Health, etc.), which we refer to as Major 2. Note that Major 2 falls under the National Science Foundation's broader definition of STEM (National Science Foundation, n.d.).

Review of Literature

Research shows that a significant number of college students leave STEM majors, which is a disproportionately common outcome for minoritized students (Eagan et al., 2011; Bettinger, 2010). This trend presents one of the major obstacles for achieving a number of national goals including reaching sufficiency in the STEM graduate population (Chen & Soldner, 2013) and graduating enough STEM majors for many projected STEM jobs (Olson & Riordan, 2012). Students leave their selected STEM majors for a number of reasons: lack of interest in a STEM discipline or developed interest in a non-STEM field, poor teaching, heavy course loads, insufficient high-school preparation, inadequate academic advising, and career choice limitations (Seymour & Hewitt, 1997). Poor academic performance in STEM courses compounded by the fast-paced learning environment have been identified as major push factors; however, contextual factors, such as unwelcoming institutional environments and unsupportive departmental cultures have also been recognized as influential (Emekalam, 2019; Seymour & Hunter, 2019). The importance of identifying such factors and finding ways to adequately address them, as well as developing better student support systems are critical steps in reducing STEM attrition.

Providing support for students is especially crucial in their first year of college, since during this time they form a foundation for their future academic success (Andrew et al., 2007; Pitkeithly & Prosser, 2001; Tinto, 1999). When talking about retention factors, it is important to shift the focus from students' attributes and supposed deficiencies to the institutional conditions that may affect their attrition. Tinto (1999) identifies four conditions that are important for student retention: learning, involvement, support, and information/advice. First, students need to see the value of their learning and education: the more value they see, the more likely they are to stay in their major or institution (Wigfield & Eccles, 2000). Additionally, the more students are able to identify with what they are learning, the more engaged they will stay with the learning process (Copeland & Levesque-Bristol, 2011).

Second, students need to not only receive education, but also consider themselves as valued members of the institution. Students frequently experience their education in isolation, especially during the transition from high school to college. At this time, the

social relationships and the ties with the new institution are still weak and the likelihood of attrition is higher. Therefore, fostering inclusive environments and cultivating a sense of belonging should be among the primary tasks for educators. This can be accomplished by engaging STEM undergraduate students in research, as well as helping them to establish meaningful relationships with faculty, improving problem-solving and technical skills, and clarifying career goals (Carter, 2002; Hurtado et al., 2008).

Student support is another important factor contributing to retention. Multiple studies have demonstrated that supportive educational environments positively influence student persistence and retention in STEM disciplines (Cole & Espinoza, 2008; Fries-Britt et al., 2010; Hurtado et al., 2007). Tinto (1999) emphasizes that academic and social forms of support that are tailored to students' learning experiences and are contextualized to their lives become increasingly more effective. Academic support can include supplemental courses, tutoring, study groups and various support programs that are of particular value to students who appear to be insufficiently prepared for the rigors of college. Social support can be provided in the form of mentoring, counseling and engaging in student organizations, which is useful for all students who are navigating the new learning environment, and especially for those who might find themselves in a setting where they are a distinct minority (Tinto, 1999).

Another condition that is closely related to promoting retention is information and advice. Students thrive and persist when the expectations for success in college are consistent and the roadmap to degree completion is clear (Tinto, 1999). This is particularly relevant to the domain of academic counseling and advising. Previous studies have emphasized the importance of advising for ensuring students' positive college experiences and improving retention. King and Kerr (2005), for example, note that advising is a key factor in helping students to achieve their educational goals and increase their sense of belonging. Zegarra (2019) further states that students are more likely to persist while having more positive college experiences if they have access to academic advising. According to Noel-Levitz (2011), students' dissatisfaction with advising negatively influences their ability to integrate into campus life and develop effective mentoring relationships and a sense of belonging within their institution. Other studies further demonstrate that students who build effective relationships with academic counselors have more successful college experiences and feel better about their institution (Nadler & Nadler, 1999). With the importance of academic advising being widely recognized, good advising remains "one of the most underestimated characteristics of a successful college experience" (Light, 2001, p.81). A large-scale study that included 87 public colleges and universities revealed that students rate advising the highest among other campus-related features (Noel-Levitz, 2011) while another national survey discovered that advising is one of the aspects rated lowest in student satisfaction (Allen & Smith, 2008). While the literature has previously noted the importance of academic advising in student success, there is a scarcity of research on student satisfaction with advising and the role that it plays in students' decisions to change majors as well as in student retention

within STEM disciplines. This study aims to take a closer look at students' perceptions of academic advising and to contribute to closing this gap in the literature.

The research questions that guided this work include:

1. In the case of one public research university, what are STEM students' perceptions of the learning environment and support services, and how do these perceptions differ for current and former (those who transferred out of the major) students?
2. How does academic advising between the two selected major programs influence student attrition and retention?
3. How do the philosophies and practices of these student affairs offices compare and contrast to each other and to the student perspectives?

Theoretical Framework

This research was guided by the ethic of care theory, an innately feminist framework, that highlights the differences between the traditional male dominated view of rules and abstract thinking, and the more feminine approach that emphasizes the value of relationships, connections, and interdependence in decision-making (Owens & Ennis, 2005). Building on this theory, Nel Noddings, an educational researcher and philosopher, laid the foundation for use of this framework in the context of education (Noddings, 1984). According to Noddings (1984, 2002), care should be fundamental in any educational system and caring relationships should be instrumental in supporting student achievement.

Gordon et al. (1996, p. xiii) define caring as a "set of relational practices that foster mutual recognition and realization, growth, development, protection, empowerment, human community, culture, and possibility." In the ethic of care framework, educators, who are here defined as individuals involved in students' learning process, view themselves as responsible for empowering students. According to Noddings (2002), a caring relationship requires that the 'caregiver' (e.g. an instructor, an administrator) understands the 'cared-for' (a student) from their perspective. Educators should approach student needs from the perspective of *I must do something* rather than *something must be done*. This is in contrast to the common practice, particularly in STEM fields, of removing personal responsibility on the part of the instructor while blaming other factors negatively affecting student academic performance, (e.g. poor high school preparation) (Ferrare & Miller, 2020).

Although, as Noddings (1992) explains, care evolves from natural sympathy that human beings innately feel towards each other, the following characteristics of both the 'one caring' educator and the 'cared for' student need to be present in order to establish the ethic of care relationship: engrossment in students (focusing on students' needs, being sympathetic to their circumstances), commitment to students (practicing inclusion of students' ideas, acknowledging their experiences), and a motivational shift from a focus on the educator self to a focus on the student other (Owens & Ennis, 2005). Throughout a caring relationship, the caregiver minimizes their needs

in order to advance the needs of a student. The relationship between the 'one caring' and the 'cared for' should be reciprocal and, therefore, students must be receptive and responsive to the educators' efforts. Students are most receptive when they feel included and when they know that their experiences are both valued and accepted. A 'caring' educator should view students' worlds through two sets of eyes – those of students and their own. Scholars refer to this process as 'inclusion', which occurs when an educator assumes a dual perspective and combines both their own view and that of a 'cared for' student (Owens & Ennis, 2005).

Educators who employ the ethic of care model recognize that some students have been historically underserved by the educational system; therefore, they aim to equip students with academic and social skills that are necessary to succeed in college (Lane, 2016). The ethic of care can be exercised through such activities as: modeling, dialogue, practice, and confirmation (Owens & Ennis, 2005). With modeling, educators can demonstrate how to care through their own relations with students. Dialogue implies talking, listening, and responding with the goal of a common search for understanding, empathy, and appreciation; thus, allowing both sides of the dialogue to arrive together at sound decisions. Practice provides opportunities for students to develop certain ways of thinking or viewing the world to enhance their capacity to care. Finally, educators use confirmation to establish trust with students, as well as to encourage the best in them (Buber, 1965). Through developing a trustful relationship, educators learn more about their students in order to recognize their potential and aspirations. Noddings (1992) believes that even in the most difficult circumstances, a 'one caring' educator is capable of visualizing students' potential and helping them achieve their goals while becoming more successful.

Methods

To address our research questions, we used qualitative methods: focus groups with students and interviews with academic counselors. Using data collected at one large public research university, we explored STEM students' support structures within their majors and students' perceptions of academic advising services. The site for this study was selected for the following reasons: it is a research-intensive university, classified as an R1 according to the Carnegie Classification of Institutions of Higher Education, which are known for cultures that prioritize research over teaching (Alpay & Verschoor, 2014; Cadez et al., 2017). The site is unique in that it is also a minority-serving institution and a home to a significant number of traditionally minoritized students (which we define as Latinx and Black students), a subpopulation of STEM majors who are more likely to leave STEM fields (Olson & Riordan, 2012). While this institution has a reputation for fostering academic success, with a six-year graduation rate of nearly 85%, there are also significant departures from STEM programs with less than 50% of students who enter the university with a desire to pursue a STEM degree completing that degree. This highlights that while there is a perception of success within the institution, there are also likely similar

issues that are plaguing other STEM programs across the nation that we aim to investigate through this work.

To answer our research questions, six focus groups with students and individual interviews with academic advising counselors were conducted. Focus groups being described as "a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment" (Krueger & Casey, 2009, p.2), allowed us to explore a wide range of students' experiences in their major(s). Given that we were targeting a specific student population, we used a purposive sampling strategy – we recruited participants who would provide in-depth information about the studied phenomenon. Upper division current and former (those who had transferred out of the major) Major 1 students were interviewed in order to get an in-depth understanding of their learning experiences and perspectives on their interactions with academic counselors. A total of 28 students participated in the focus groups. Students were recruited from large enrollment STEM courses as well as from non-STEM or non-traditional STEM courses offered by the programs to which students switched more frequently. The majority of the study participants (80%) were female (which corresponds to the student population of the given major). 40% of the participants belonged to underrepresented minority groups; 55% of interviewees identified as first-generation college students and 45% were considered to be low-income based on their Pell Grant eligibility.

Focus group sessions lasted about 60 min and took place on campus in a building that does not house any of the studied programs. Participation was voluntary and participants received gift cards for their time. Students were assigned to focus groups based on whether they left or remained in Major 1. The semi-structured focus group protocol included a number of questions about students' expectations of the initially chosen major, their learning experiences within the major(s), as well as their opinions about student support services. Additionally, those who switched to a different major, the majority of whom switched to Major 2, were asked about the main reasons for doing so and their transition to a new program. We specifically wanted to talk to both students who left and stayed in the major to get a more complete understanding of their experiences in the academic program.

Based on the data from the focus groups, we recognized the need for and interviewed four academic counselors, two from Major 1 and two from Major 2, in order to get their perspectives on the existing student support structures. The interviews lasted up to 60 min; participation was voluntary, and interviewees received gift cards for their time. During both focus groups and interviews, detailed notes were taken, which guided regular discussions with the research team. The focus group and interview data were audio recorded, transcribed verbatim by a professional transcription service, and checked for accuracy by the research team.

The data were organized and coded using Atlas.ti software. The codebook development process was both concept and data driven: while using a hybrid coding approach, some codes were identified in the literature and others emerged from the data (Kvale & Brinkmann, 2009). As we continued coding, some codes were revised and/or

combined. The codebook underwent multiple rounds of revisions before being applied to all the transcripts. To ensure inter-rater reliability, we used consensus coding with some of the transcripts coded by two researchers, and any discrepancies discussed and reconciled among the coders (Richards & Hemphill, 2018). We further performed a thematic analysis which included searching for patterns across interviews and identifying recurring themes and their relations to one another. In the second round of analysis, we compared the findings from the focus groups and interviews aiming to identify similarities and discrepancies between students' experiences and counselors' perceptions. Throughout both coding and analysis phases, analytic memos were generated documenting emerging themes and ideas, which were further incorporated into the analysis.

Results

The results of the study are organized in two sections: the first section presents findings from the student focus groups and the second section presents findings from the interviews with academic counselors.

Student Focus Groups

Themes that emerged from the focus groups with both former and current Major 1 students include the following: (A) the impact of students' negative experiences with academic advising within Major 1 on student retention, (B) the importance of care and compassion for students in their decisions to switch majors, and (C) the students' positive and negative perceptions of peer academic advisors.

Impact of students' negative experiences with academic advising on student retention. One of the most prominent findings from the student focus groups was that the majority of participants were highly unsatisfied with the academic advising services within Major 1 and that in many cases this dissatisfaction drastically affected their decision to leave the major. The Major 1 counselors appeared to be one of the first points of contact for struggling students. A common experience for these students, however, was that rather than exploring ways to improve their current situation, counselors would suggest switching to another major, frequently a non-STEM or non-traditional STEM major. One of the participants described their interactions with counselors after failing an exam in an introductory course:

> I would go in so many times to speak to the counselors and they were just so mean to me. They would turn me down and then be like, "Oh, look at your social science grades. You got an A and a B. Why don't you go to social sciences?" I am not here for you to tell me to switch my major. I am here for you to help me stay in the major! … And at the end of the day, what did I do? I got out of my major.

An important takeaway from the above quote echoed by other focus group participants is that the student did not visit a counselor intending to switch to another major; however, they were encouraged to do so. In this case, academic advising became a push factor for a STEM student who was struggling academically. Another participant's experience aligned with this finding:

> So instead, [the academic counselor] spent 15 min telling me other options I have instead of continuing to stay in my major. And she told me to switch to an English major, which I've never had an interest in.

Interestingly, the suggestion to switch majors also came up in conversations with current students, even those who were academically thriving. According to those students, the question of switching was raised even during routine appointments; for example, when they tried to obtain a signature for an unrelated form. Below is a situation described by a high performing student who met with a Major 1 counselor:

> Not to be rude, but I think the counselors don't make it very belonging. They don't want you to be in the major. I went in to get my study abroad form signed, right? She looks at my GPA. It's a double major cumulative GPA. And she's like, "Oh, you should consider dropping [Major 1]." I was like, "Why, my [Major 1] GPA is 3.8, my double major is a little lower." And she said, "No, you should drop it." I'm like, "I am here to do study abroad for the summer and just get my form signed." And she said, "No, I just want to give you advice." I'm like, "I don't need this advice."… This happens to all my friends. They walk in to get advice about something else, and they're always told to drop the major.

It appears that lower grades serve as a signal for counselors to immediately suggest switching to another major, which makes these interactions frustrating for students and leaves them feeling unwelcome. When asked for their opinions as to why counselors were frequently suggesting switching majors, students said that it was likely due to Major 1's high enrollment and a corresponding desire to weed out weaker students as early as possible. Excluding weaker students results in a major population with a higher GPA and an improved time to degree, which, in the words of one focus group participant, "makes the school shine". Encouraging low performing students to leave the major may come with a price. With participants referring to counseling appointments as "frustrating", "discouraging" and "condescending", students frequently choose not to seek advice from counselors. One study participant noted that interacting with Major 1 counselors might be especially damaging for a student who is considering switching majors:

> If you have one thought, one doubt… like I'm sure we've all had one thought of "Am I even in the right major?" I always give them advice, "Don't go to the counselors, they will make you want to drop this major, and you are probably smart enough to be here. If you

made it to [this campus], you're smart enough to be in this major. It's just that counselors are not there to support you. They will break you down and make you leave."

When conducting focus groups, we anticipated that the current Major 1 students would have more positive views on the support services. To our surprise, while their overall outlook on their learning experiences was quite positive, their opinions about academic advising were frequently negative, and, sometimes, even emotionally colored. For example, when answering a question about the counselors, one student became heated and responded: "I get so mad every time someone talks about them [counselors]… I always hear about it. My blood is boiling when I think about advising!"

It is important to mention that we are presenting individual experiences from students who self-selected to participate in the focus groups and these opinions may not necessarily reflect the views of all the students in the major. However, both students who left the major and those who remained expressed similar opinions. The consistent negative descriptions of advising indicate that regardless of their academic performance, all participants struggled with similar issues related to their counselors and many, consequently, left their major.

Importance of care and compassion for students in their decisions to switch majors. Most participants emphasized the importance of feeling that they are being cared for and valued in their major. For many, the lack of care and empathy turned out to be a decisive factor in switching majors. When referring to the Major 1 student affairs office, students compared their experiences to being on a conveyor belt, where everyone is treated the same regardless of their circumstances. The study participants consistently stressed the need for counselors to be more caring, empathetic and more invested in their academic success. One student lamented:

> It was after a year and a quarter, I went through academic advising. She was very condescending, where it was to the point where I said, "I don't really know what I want to do with my degree". And they were like, "Well, you don't have good grades. You are barely passing, so I don't know if this is for you. You can still do it, but you're probably not going to succeed." And for me it was like, "If you don't care, why should I be here?"

This quote highlights the importance of care and empathy for students in their decisions to switch out of their chosen majors. In addition, the study participants mentioned that it was not only *what* the counselors were saying but also *how* they were saying it, such as the example below from another student:

> They are supposed to help you thrive and they don't. You go in there, and they tell you that you are not good enough, that you are not going to make it. I wish counselors and faculty were a little more empathetic and had a passion for helping students. I feel like not having support from them was a huge point for me and why I ended up switching.

An excerpt from a focus group with the current students who stayed in Major 1 adds to the point of students' expectations and need for additional support from the major:

Focus group (FG) participant 1:	But the one thing that you really expect is that you can get support from your department, from your counselors, but really here, especially for [Major 1], it's so hard to get any support from them.
FG participant 2:	The opposite of support. What's the opposite of support? That's what you get from the major.

As we intentionally recruited some students who had switched majors to participate in our focus groups, some participants were able to compare their experiences seeking advice from both the Major 1 and Major 2 counselors. Based on these conversations, it appears that Major 2 counselors were much more welcoming and exhibited increased care from the start:

> So I go to see that [Major 2] counselor, and it was just a walk-in appointment. But they take me in immediately, and then I asked if I could make a plan for the future, and the counselor told me that she could absolutely do that, she gave me alternative options. I asked her if this major would be good for what I am looking for in a career, and she told me yes, that I could work with them, and that I could ask for any advice I'll need in the future. And she gave me her phone number at the end to call her if I had any questions, and I think that's when I decided that I'm switching [to Major 2] the second I can.

An important distinction with this conversation relative to the previously presented Major 1 counselor conversations is the way the counselor approached this dialogue and dealt with the student's concerns. This difference in approach helped the student to finalize their decision to switch out of Major 1 and transition to Major 2. Another student provided an example, comparing their experiences within Major 1 to those from their peer in another STEM major:

> I think what I also have seen is that it's only counselors in our major, because my roommate is in [another traditional STEM Major] right now, he's been on academic probation for so many quarters, but every time he goes into his counselors' office, they try to work with him to keep him in the major. They've even gotten the Dean to be involved. Whereas I feel like if I came in with "oh, I have academic probation", they'd literally just say, "I don't think you're cut out for this. You should leave."

These two excerpts highlight the personalized nature of these more exemplary experiences, one in which the counselor provided their phone number to the student in case of additional questions and the other in which the Dean of the program participated to ensure that the student was able to remain in the major.

Participants also noted that they would understand reasonable arguments for unsolicited advice from counselors, if these arguments were made while exercising care and compassion. Below is an excerpt from a conversation about students' suggestions for improvement of the Major 1 student affairs office:

FG participant 3: I would like to see a proper attitude when counselors are dealing with students. They also treat us like we're inferior.

FG participant 4: They don't have compassion.

FG participant 5: We're adults.

FG participant 4: So maybe more empathetic …

FG participant 3: They need to treat us like adults who understand reason. If you have a valid reason why I shouldn't be in this major, not just because you don't want me here, then that's how you should say it. You don't say, "You can't do this, just drop it." But, "You may not be able to graduate in five years. Are you sure you want to continue this?"

As we can see from this quote, the students intuitively describe the ethic of care framework as an effective way for counselors to engage with students.

Students' perceptions of peer academic advisors. While there was a negative perception of the academic counselors, the focus group participants noted that they were much more likely to turn to their peers for assistance. Students in almost all focus groups mentioned peer academic advisors (PAAs) as a valuable resource that they frequently utilized. PAAs are undergraduate students employed by student affairs offices to provide general advice regarding courses and other major-related issues; they hold walk-in office hours and are available through email and online chats. The PAAs offer an opportunity for students to talk to someone who has gone through similar struggles and "made it", providing additional support while decreasing anxiety and insecurity often associated with their major.

Most students, both former and current, described reaching out to PAAs frequently and found them to be really helpful. For example, this is how one of the students described their interaction with a PAA:

Oh yeah, peer advisors! They are really helpful, and they would actually sit down with you and walk you through the courses that you would need to take. I was telling them, "Oh if I didn't do well in these classes, how can I make up the credit?" and they would go over my options and tell me that it wouldn't be difficult since I was already in the program. So, they were pretty supportive in that aspect.

The focus group participants particularly highlighted the care and support provided by PAAs and the personalized nature of their feedback. The fact that they would take the time to help students figure out their study plans, as well as listen to their concerns

while relating them to their own experiences in the same major, appeared to leave a very positive impression on the study participants. One student commented: "I feel that PAAs are a good middle ground because they work at the school, but they are also undergrad students, so they get it. So that's why I actually seek them a lot." It appears that students were more comfortable seeking help from peer advisors, especially when they began struggling with classes. They viewed their peers as more amicable and caring than counselors: "PAAs are super approachable because they are also undergrads just like you. So, no one has a superiority complex."

Perceptions of the PAAs were not unanimously positive though. For example, one student described an instance when they reached out to a PAA to look over their study plan that went beyond 4 years due to the struggles with anxiety and mental health issues. In this case, the peer advisor appeared to be dismissive of their situation, having insisted that the student should be capable of graduating within four years regardless of any personal issues. This experience mirrored the previously explored lack of care exhibited by the Major 1 counselors.

Interviews with Academic Counselors

To provide a more balanced perspective of the academic advising at the study campus, we interviewed Major 1 and Major 2 academic counselors. Our goal was not to confirm positive or negative practices highlighted by the focus group participants, but rather to explore potential differences in the philosophies and approaches to working with students between the two majors. Throughout these interviews, we identified both similarities and differences in how counselors from these two offices dealt with struggling students in particular. Counselors from both programs noted the importance of treating each student as an individual with their unique problems and challenges and appeared to be equally concerned about student academic success and overall well-being. A counselor from Major 1 stated that their job is two-fold:

> I think a good counselor is someone who one, knows the resources at their disposal and two, who really does have the students' best interest at heart and wants to see them succeed, whether it's in their major or somewhere else. Someone who wants to invest in the student and help them get connected with whatever they need to on campus to be successful. They have to be competent, and they have to be compassionate.

Similarly, a Major 2 counselor stressed the importance of caring and supporting students:

> So, a good academic counselor absolutely needs to be empathetic, being able to put themselves in the students' shoes. To really understand what's going on and to be able to support the student. They need to be able to listen to the student and really listen. I'm talking active listening here, right? Like I'm truly listening to you, I'm truly hearing

you. I do think there needs to be an understanding of different student needs and knowing that every student's going to come in with something different.

Furthermore, the counselors revealed differences in the way their offices view their mission. While Major 2 counselors were committed to maximally supporting their students through their time to degree in their program, Major 1 counselors aimed to help students graduate with any degree, not restricting it to their program. Additionally, Major 1 counselors strongly encouraged students to graduate within four to five years, which is not a goal in Major 2. Moreover, Major 2 counselors stressed the importance of proactively addressing potential issues that students may face as opposed to reacting to existing problems. Next is how a Major 2 counselor defined their office's mission:

> I feel like we spend a lot of time talking about prevention. So, I actually see us as a place where students should be coming kind of early with their concerns. I think the reality of it is that some students do that. They'll stop by ahead of time, before a problem occurs.

The difference in the timing of students seeking advice from counselors may potentially be reflected in the mission of the Major 1 student affairs office: since the counselors mostly deal with the aftermath of the problems that students face throughout their college experiences, they try to ensure that students graduate with any degree, even if it is not their initial choice. For example, below is how a Major 1 counselor viewed the mission of their office:

> The overall mission of our office is to support our undergraduates and help enrich their academic, research and personal experiences on campus, and to make sure that they are able to attain a degree by the time they leave the university. Our aim is to assist students in achieving the goal of earning a bachelor's degree, even if it's not within our school.

Acting with their best intentions in mind, counselors from Major 1 did mention that they would initiate conversations with students about switching majors quite frequently; however, only in the situation when those students fell into the 'poorly performing' category. In the following example, a Major 1 counselor describes a typical "switching situation":

> I'd say it happens with a fair amount of frequency just whenever we're seeing students who are doing poorly in the science courses…We try to show students where their strengths are, whether it's they continue to pursue [Major 1] or we encourage them to pursue another major or maybe require them to pursue another major because they're not making good progress in the sciences. We try to highlight that: "So you made it to this university, which means that you do belong here. Based on your grades though, it seems like your strength is not in sciences. At the same time, you're earning As in

humanities and in social science courses, so perhaps that's something that you want to look into."

This quote aligns with the students' description of similar situations; however, there is a misalignment in how the conversation is perceived by each party. While counselors believe that they are helping students to find a better fit, students feel that they do not belong in their major. The Major 2 counselors also mentioned that switching majors comes up in conversations with students; however, only if students initiate it:

> So, it makes sense for some students to switch and get the major that they actually want. But I'm never trying to convince somebody that this is what they should do. I want them to make that decision for themselves. So sometimes students will come to me and say, "I'm thinking about switching." Or, "What are my career prospects?" And so I'll just talk about that. I also try to maybe connect them to somebody or tell them about different groups of students who they can talk to about their plans. We have some active student organizations within our school, so those are good outlets to point unsure students to.

Not surprisingly, students noted that in comparison to Major 1, Major 2 counselors appeared to be more positive and generally focused on providing support structures to succeed in the major. However, from speaking to the counselors themselves, there is not a clear difference in the degree to which Major 1 counselors care about their students relative to Major 2 counselors.

Before providing any recommendations, it is important to acknowledge the context in which counselors work with their students. A Major 2 counselor admitted that dealing with large numbers of students on a daily basis is challenging and requires developing a certain skill set:

> There's a list of problems that students always need help with. And I think there's a certain amount of skill for just resetting and saying "Even though I heard this 50 times today…" And I think this mindset is really helpful, and it is something that you need special training on. View every single person as if you'd never heard their issues before and make sure that everyone you see is a fresh slate. And that's hard.

Adding to that, a Major 1 counselor commented on the struggles in their professional role:

> We definitely care about our students but that's where it's hard too. So, something that our staff kind of struggled with when we moved to allowing students to stay five years and relaxing some of the requirements that we had was that because so many of our students wanted to pursue this major and were set on their career goals, a lot of the staff really struggled with that idea of letting students meet their aspirational goals. If it meant grad-uating from the major with barely a 2.0 GPA, we had to be realistic with them about their future if we were allowing them to do that while still setting them up to success.

Working with one of the most impacted majors at the university, Major 1 counselors admitted that when dealing with students they need to make sure that these students are realistic with their expectations while simultaneously trying not to discourage them.

Discussion and Implications

In conducting this research, we sought to uncover factors affecting STEM student attrition and retention, specifically focusing on academic advising services within two selected majors. Both former and current Major 1 students identified advising as problematic, serving as a critical push factor for many students in their decisions to switch majors. This study also included academic counselors' perspectives regarding their offices' philosophy and practices.

The analysis of student focus group discussions yielded three major themes. First, the study revealed a strong impact of students' negative experiences with academic advising within Major 1 on student retention. Having reflected on their previous interactions with counselors, students frequently found those experiences unhelpful and discouraging. Second, they emphasized the importance of feeling cared for and treated as individuals with unique issues and concerns. It is important to note that for many former Major 1 students who switched to a different program, the lack of a personalized approach along with the decreased sense of belonging in the major contributed to their departure. Finally, students identified peer academic advisors (PAAs) as a valuable support resource. In contrast to counselors, PAAs were described as more relatable, approachable, and caring than academic counselors.

These findings align with the ethic of care theory as well as with existing literature that highlights the importance of building supportive learning environments and the impacts of academic advising in student retention (King & Kerr, 2005; Light, 2001). The ethic of care emphasizes the responsibility of educators in student academic success. We argue that educators in this context should include all individuals that facilitate student success in the university setting, including academic counselors. According to Nutt (2003), academic advising, being at the very core of institutional retention efforts and being vital to student success, should be viewed as the 'hub of the wheel' rather than an isolated service provided to students.

The data from our study highlight that counselors should not function reactively, with a primary role of removing students from the major, but assume a proactive role in contributing to their academic success and retention. In accordance with one of the major principles of the ethic of care, counselors should take an *I must do something to help this student* approach rather than a more passive *something must be done about it* attitude. Students in our study felt they would particularly benefit from being approached as individuals with unique problems that require personalized attention and acknowledgement. This individual attention directly corresponds to the 'inclusion' process highlighted by the ethic of care theory, which implies that an educator should focus on students' needs while being receptive and sympathetic to their unique problems and circumstances.

It is important to note that the results of this research do not reflect a difference in care from the perspective of Major 1 and Major 2 counselors, but instead uncover a difference in students' perceptions of how this care is manifested by the counselors. Interviews with counselors revealed that they are all invested in student success but approach students differently, especially in the context of switching majors. Major 2 counselors try to help students to graduate with a Major 2 degree, while Major 1 counselors aim to ensure that students graduate with any degree from this university in a timely manner. There appear to be legitimate reasons for these differing approaches. Compared to Major 2, Major 1 is a larger and more established academic program, and, therefore, it is likely that the counselors have less pressure to grow the major and possibly even an incentive to shrink its student population in the context of recent increases in the undergraduate population across campus. One of the means to accomplish this would be by eliminating students who are struggling in their introductory major courses. Because it is a newer program, Major 2, on the other hand, may possess a stronger incentive to not only retain its students but also to recruit from other majors. Furthermore, having accumulated years of experience in this particular context, Major 1 counselors may be shaping their recommendations based on the historical knowledge of student outcomes, realizing that consistently poor performance in certain classes often signals that the major is not an appropriate fit for a student and likely leads to future removal from the major. The desire to push students out of the major, if it appears that a four-year graduation is not possible in their program, may be informed by an understanding of the real-world implications of additional time to degree (e.g. costs that students will incur if they decide to stay in the major for additional years) or by institutional data that highlight decreased likelihood of degree attainment for each additional year spent as an undergraduate. On the other hand, having that historical knowledge can make it more difficult for Major 1 counselors to see students as unique and in need of individualized attention. Finally, while Major 1 enrolls a considerably larger number of students, both student affairs offices have a very high student-to-counselor ratio, nearly 400 to one. This inevitably affects the amount of time and attention that counselors can dedicate to each student.

While acknowledging these issues and to, at least, partially address them, both majors leverage peer academic advisors (PAAs) to provide additional support for their students. PAAs have been shown in numerous studies to be valuable sources of support for struggling students (Griffin et al., 2015; Hutchinson, 2017). Interactions with PAAs help students realize that they share much in common with previous generations of students who had gone through the same struggles and succeeded. However, peer advising is most successful in terms of retention when it is formally implemented with peer advisors being assigned to specific students (Ellis & Gershenson, 2020); this may be something these programs can consider in the future.

While the importance of academic advising in student college experiences has been previously noted by multiple scholars, there is lack of research on its significance in major-switching decisions. This study is particularly important in the context of STEM student retention, since it sheds more light on the factors affecting students'

decisions to switch out of STEM, which may be overlooked or unnoticed, as they are less related to the classroom experience and role of faculty, common targets for improving STEM education (National Academies of Sciences, Engineering, & Medicine, 2016; Olson & Riordan, 2012). Negative experiences within the major, including interactions with counselors, make students feel unsupported and unwelcomed, negatively affecting their sense of belonging within the major (Seymour & Hunter, 2019). This, in its turn, may lead to switching out of a chosen major and, frequently, out of STEM completely.

This study has implications for policy, practice, and research. Our findings suggest a need for STEM departments to reassess their goals and philosophies, and correspondingly the academic advising services and practices provided to students that help them to achieve these goals. While both interviewed student affairs offices had clearly delineated policies, it was obvious that particularly for Major 1, there was a lack of understanding of how the student/counselor relationship was manifested in practice from the student perspective. Thus, we recommend that student affairs offices consider developing assessments to regularly capture student satisfaction with their services, which may serve as opportunities for students to communicate their frustrations in an anonymous fashion. Incorporating students' feedback may help institutional support units to deconstruct these somewhat intimidating and unwelcoming environments and make them more inclusive. Additionally, by having their concerns addressed, students may feel a greater sense of belonging within the program.

In the context of our focus group participants, we would encourage counselors and educators more broadly, to consider exercising more empathy and care. As students noted, it is not only about *what* is being said to them in regard to their academic performance, but also *how* it is being said. There may be cases when switching majors is the only viable option for students who are otherwise setting themselves up for failure. However, such a recommendation should be provided with strong rationale so that students do not feel as if they are being forced to leave their chosen major but rather provided with an alternative college pathway that may be more beneficial for their professional success in the long run. It is important to recognize that during such conversations, students may likely be in a vulnerable state and may not be able to rationally hear the counselor's message unless it is delivered with empathy and care. As the ethic of care suggests, dialogue is one of the means by which educators and students can reach a better understanding and appreciate each other's views. When students are offered choices rather than ultimatums and feel more encouraged rather than pressured, they start feeling more competent and motivated to succeed while taking responsibility for their own learning (Copeland & Levesque-Bristol, 2011).

Finally, the analysis of the interview data suggests that it might be beneficial for counselors to focus on implementing preventive practices that may help to preclude potential problems that students face. Major 2 counselors identified this aspect of their work as important and mentioned that they encouraged students to seek help early. Leveraging institutional data may also enable student affairs offices to

identify the struggling students early before switching majors becomes more of a necessity.

Limitations and Future Research

Although focus groups can stimulate a richer dialogue, some student voices in our study may have been more dominant than others. To account for this issue, future studies could further explore STEM students' experiences through the use of individual interviews. Additionally, exploring academic counselors' views and perspectives in more detail can serve as another direction for potential future research. Furthermore, as this study is qualitative in nature and was conducted at one particular university, future research will be beneficial for presenting a more generalizable picture of the role of academic advising on student retention. Given the identified importance of care in the educational context, further studies can also explore faculty perspectives on advising and student support, especially during the first year of college. Finally, similar research can be conducted in the context of other STEM or non-STEM majors to see how different majors and disciplinary environments shape student academic experiences.

Conclusion

Increasing retention in STEM disciplines is a critical goal of colleges and universities nationwide. This issue requires attention and collaboration across multiple stakeholders within these institutions. This article has discussed one aspect of students' educational experiences, academic advising, and provided recommendations for institutional practice and future research. Institutional leaders, faculty, and student affairs practitioners may find these recommendations useful in supporting and promoting student success and retention within STEM disciplines. It is important for higher education institutions to understand the role that care plays in positive and productive student learning experiences. If various stakeholders within these institutions work together to create more inclusive learning environments which make every student feel welcomed and appreciated, environments in which students can perceive themselves as successful and worthy, STEM student attrition can eventually become an obsolete concern.

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References

Allen, J. M., & Smith, C. L. (2008). Importance of, responsibility for, and satisfaction with academic advising: A faculty perspective. *Journal of College Student Development*, *49*(5), 397–411. https://doi.org/10.1353/csd.0.0033

Alpay, E., & Verschoor, R. (2014). The teaching researcher: Faculty attitudes towards the teaching and research roles. *European Journal of Engineering Education*, *39*(4), 365–376. https://doi.org/10.1080/03043797.2014.895702

Anderson, W. A., Banerjee, U., Drennan, C. L., Elgin, S. C. R., Epstein, I. R., Handelsman, J., Hatfull, G. F., Losick, R., O'Dowd, D. K., Olivera, B. M., Strobel, S. A., Walker, G. C., & Warner, I. M. (2011). Science education. Changing the culture of science education. *Science (New York, N.Y.)*, *331*(6014), 152–153. https://doi.org/10.1126/science.1198280

Andrew, N., McGuinness, C., Reid, G., & Corcoran, T. (2007). Supporting students in the first year of an undergraduate nursing programme: The enhance project. *Practice and Evidence of the Scholarship of Teaching and Learning in Higher Education*, *2*(2), 128–150.

Bettinger, E. (2010). To be or not to be: Major choices in budding scientists. In C. T. Clotfelter (Ed.), *American Universities in a global market* (pp. 69–100). University of Chicago Press.

Buber, M. (1965). Education. In M. Buber (Ed.), *Between man and man* (pp. 83–103). Macmillan.

Cadez, S., Dimovski, V., & Groff, M. Z. (2017). Research, teaching and performance evaluation in academia: The salience of quality. *Studies in Higher Education*, *42*(8), 1455–1473. https://doi.org/10.1080/03075079.2015.1104659

Carter, D. F. (2002). College students' degree aspirations: A theoretical model and literature review with a focus on African American and Latino students. In J. C. Smart (Ed.), *Higher education: A handbook of theory and research* (pp. 129–171). Agathon Press.

Chen, X., & Soldner, M. (2013). *STEM Attrition: college students' paths into and out of STEM fields*. National Center for Education Statistics. https://nces.ed.gov/pubs2014/2014001rev.pdf.

Cole, D., & Espinoza, A. (2008). Examining the academic success of latino students in science, technology, engineering and mathematics (STEM) majors. *Journal of College Student Development*, *49*(4), 285–300. https://doi.org/10.1353/csd.0.0018

Copeland, K. J., & Levesque-Bristol, C. (2011). The retention dilemma: Effectively reaching the first-year university student. *Journal of College Student Retention: Research, Theory & Practice*, *12*(4), 485–515. https://doi.org/10.2190/CS.12.4.f

Eagan, K., Herrera, F. A., Sharkness, J., Hurtado, S., & Chang, M. (2011). *Crashing the gate: Identifying alternative measures of student learning in introductory science, technology, engineering, and mathematics courses*. Higher Education Research Institute.

Ellis, J. R., & Gershenson, S. (2020). Gender, peer advising, and college success. *Labour Economics*, *62*, 101775. https://doi.org/10.1016/j.labeco.2019.101775

Emekalam, A. (2019). Reducing attrition from STEM disciplines: Understanding the student athlete's perspective. *Peer Review*, *21*(1-2), 34-38.

Ferrare, J. J., & Miller, J. M. (2020). Making sense of persistence in scientific purgatory: A multi-institutional analysis of instructors in introductory science, technology, engineering,

and mathematics (STEM) courses. *The Journal of Higher Education*, *91*(1), 113–138. https:// doi.org/10.1080/00221546.2019.1602392

Fries-Britt, S., Younger, T., & Hall, W. (2010). Underrepresented minorities in physics: How perceptions of race and campus climate affect student outcomes. In T. E. Dancy (Ed.), *Managing diversity: (Re)visioning equity on college campuses* (pp. 181–198). Peter Lang.

Gordon, S., Benner, P., & Noddings, N. (Eds.). (1996). *Caregiving: Readings in knowledge, practice, ethics, and politics*. University of Pennsylvania Press.

Griffin, M., DiFulvio, G. T., & Gerber, D. S. (2015). Developing leaders: Implementation of a peer advising program for a public health sciences undergraduate program. *Frontiers in Public Health*, *2*, 288. https://doi.org/10.3389/fpubh.2014.00288

Hurtado, S., Eagan, K. M., Cabrera, N. L., Lin, M. H., Park, J., & Lopez, M. (2008). Training future scientists: predicting first-year minority student participation in health science research. *Research in Higher Education*, *49*(2), 126–152. https://doi.org/10.1007/ s11162-007-9068-1

Hurtado, S., Han, J. C., Sáenz, V. B., Cabrera, N. L., & Cerna, O. S. (2007). Predicting transition and adjusting to college: Biomedical and behavioral science aspirants' and minority students' first year of college. *Research in Higher Education*, *48*(7), 481–887. https://doi.org/10.1007/ s11162-007-9051-x

Hutchinson, A. L. (2017). *Experiential learning: perspectives from undergraduate peer-advisors pursuing careers in higher education* [Doctoral dissertation, Arizona State University]. ProQuest Dissertations Publishing.

King, M. C., & Kerr, T. J. (2005). Academic advising. In M. L. Upcraft, J. N. Gardner, & B. O. Barefoot, & Associates (Eds.), *Challenging and supporting the first-year student: A handbook for improving the first year of college* (pp. 320–339). Jossey-Bass.

Krueger, R. A., & Casey, M. A. (2009). *Focus groups: A practical guide for applied research* (4th ed). Sage.

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage.

Lane, T. B. (2016). Beyond academic and social integration: Understanding the impact of a STEM enrichment program on the retention and degree attainment of underrepresented students. *CBE-Life Sciences Education*, *15*(3), ar39.

Light, R. J. (2001). *Making the most of college: Students speak their minds*. Harvard University Press.

Milem, J. F., Berger, J. B., & Dey, E. L. (2000). Faculty time allocation: A study of change over twenty years. *The Journal of Higher Education*, *71*(4), 454–475. https://doi.org/10.1080/ 00221546.2000.11778845

Nadler, L. B., & Nadler, M. K. (1999). Faculty and student expectations/perceptions of the adviser-advisee relationship. *Journal of the Association for Communication Administration*, *28*(2), 47–59.

National Academies of Sciences, Engineering, and Medicine (2016). *Barriers and opportunities for 2-year and 4-year STEM degrees: Systemic change to support students' diverse pathways*. National Academies Press.

National Science Foundation (n.d.). *Classification of fields of study*. https://www.nsf.gov/ statistics/nsf13327/pdf/tabb1.pdf.

Noddings, N. (1984). *Caring: A feminine approach to ethics & moral education*. University of California Press.

Noddings, N. (1992). *The challenge to care in schools: An alternative approach to education*. Teachers College Press.

Noddings, N. (2002). *Starting at home: Caring and social policy*. University of California Press.

Noel-Levitz. (2011). National student satisfaction and priorities report. https://www.stetson.edu/law/conferences/highered/archive/media/Student%20Satisfaction.pdf.

Nutt, C. L. (2003). *Academic advising and student retention and persistence*. NACADA Clearinghouse of Academic Advising Resources. https://www.nacada.ksu.edu/Resources/Clearinghouse/View-Articles/Advising-and-Student-Retention-article.aspx.

Olson, S., & Riordan, D. G. (2012). *Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Executive Office of the President.

Owens, L. M., & Ennis, C. D. (2005). The ethic of care in teaching: An overview of supportive literature. *Quest (Grand Rapids, Mich)*, *57*(4), 392–425. https://doi.org/10.1080/00336297.2005.10491864

Paguyo, C. H., Atadero, R. A., Rambo-Hernandez, K. E., & Francis, J. (2015, June, 14). Creating inclusive environments in first-year engineering classes to support student retention and learning [Conference session]. ASEE Annual Conference & Exposition, Seattle, WA, United States.

Pitkeithly, A., & Prosser, M. (2001). The first-year experience project: A model for university-wide change. *Higher Education Research and Development*, *20*(2), 185–198. https://doi.org/10.1080/758483470

Richards, K. A. R., & Hemphill, M. A. (2018). A practical guide to collaborative qualitative data analysis. *Journal of Teaching in Physical Education*, *37*(2), 225–231. https://doi.org/10.1123/jtpe.2017-0084

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Westview Press.

Seymour, E., & Hunter, A. B. (Eds.). (2019). *Talking about leaving revisited. Persistence, relocation, and loss in undergraduate STEM education*. Springer International Publishing.

Tinto, V. (1999). Taking retention seriously: rethinking the first year of college. *NACADA Journal*, *19*(2), 5–9. https://doi.org/10.12930/0271-9517-19.2.5

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Zegarra, M. (2019, April 30). *The importance of academic advising*. Florida National University. https://www.fnu.edu/importance-academic-advising/.

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