*Research Article*

# Exploring Rural Engineering Students' College Choice Process at Two Land-Grant Universities

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*This qualitative case study examines the college choice decisions of rural students enrolled in engineering majors to understand what conditions and experiences led rural students to pursue engineering at their institution. We found four themes that help illuminate rural engineering students' college choice journeys (1) The Inextricable Nature of College, Major, and Career Choice (2) "The Smart Person Thing to Do:" The Power of Prestige, (3) "Are You Sure You Don't Want to Change your Major?" Dissonance Between Aspirations and Expectations, and (4) School and Community as Crucial Resources in College and Major Exploration. These findings have implications for those working with rural high school students seeking engineering degrees and admissions processes at four-year colleges and universities.*

The career development of young people in science, technology, engineering, and math (STEM) fields has been a focus of national conversation since the launch of Sputnik I in 1957. In the United States, the availability of STEM jobs has grown three times faster than in non-STEM fields; however, enrollment in STEM majors is low, and persistence is even lower (Peterson et al., 2015). Lack of representation is particularly severe for Students of Color, women, and low-income students who are less likely to enter and persist in STEM fields of study, especially engineering (National Academy of Engineering and National Research Council, 2009; National Center for Education Statistics [NCES], 2010; Rozek et al., 2019; Yoon & Strobel, 2017). As such, there are a lack of underserved students entering the STEM workforce, which has implications for social mobility and the reproduction of inequality. STEM graduates not only enjoy job stability provided by the growing demand for STEM-trained workers but are also privy to higher occupational earnings than those in other fields. In many ways, a STEM degree could help low-income students break cycles of intergenerational poverty and ensure a stable financial future for themselves and their families (Fayer et al., 2017).

Given the potential for a STEM degree to increase social mobility, it is not surprising that a great deal of research has focused on underserved students' movement through STEM pathways—with special attention on first-generation, low-income students, and Students of Color (e.g., Rozek et al., 2019; Schultz et al., 2011; Yoon & Strobel, 2017). Alongside these populations, rural students may also be vulnerable to stopping out of the STEM pipeline. While there is some research exploring rural students' involvement in STEM (e.g., Assouline et al., 2017; Carrico et al., 2017), this population is often absent in the conversation about underserved students in STEM. Adjacent literature exploring rural students' postsecondary matriculation indicates that this population faces several unique barriers that may impact their ability to successfully enter college, persist, and pursue STEM careers. Geographic isolation prevents exposure to colleges (Hillman, 2016; Peterson et al., 2015), insufficient bandwidth provides barriers to online coursework and educational technology (Spencer, 2017), and inadequate school funding limits access to advanced STEM coursework options (National Science Board, 2014). Together, these factors may limit the ability of rural students to participate in the learning opportunities that are crucial in helping them develop STEM aspirations (Assouline et al., 2017).

In addition to neglecting rural students in the STEM pipeline, the literature exploring students' transition from high school to college often fails to consider college choice a crucial element of matriculation into STEM programs (Wang, 2013). College choice is an important topic to consider in examining students' persistence in STEM, as research on postsecondary transitions notes that factors of institutional fit that students consider during the college choice process also have a bearing on persistence and degree completion (Hausmann et al., 2007; Welbeck et al., 2014). Given the importance of institutional fit in helping students progress from matriculation to graduation, college choice should be considered in the conversation about the STEM pipeline (Morgan, 2005).

The purpose of this study is to explore the college choice processes of rural students enrolled in engineering undergraduate programs. By exploring this topic, our study seeks to strengthen the body of literature on rural students in STEM and underscore the importance of conversations about college choice in the broader STEM pathway literature. In doing so, this study will contribute to the larger conversation on persistence in STEM for underserved students. We narrow our focus to students in engineering majors rather than STEM majors broadly because bachelor's degrees in engineering often allow access to high-paying jobs without graduate education (Fayer et al., 2017). In this way, a successful journey to and through engineering undergraduate programs offers rural students, many of whom are low-income (Hussar et al., 2020), greater future earning potential for themselves and their families. Further, scholars have called for disaggregating STEM majors in research, as these majors are not a monolith (Sax & Newhouse, 2018). Treating all STEM majors the same increases the chances of overlooking important nuances and contextual factors that matter to advancing persistence and degree completion for underrepresented students.

**Purpose of Study and Research Questions**

Framed by Perna's (2006) Proposed Conceptual Model of Student College Choice as well as Lobao and colleagues' (2007) framework of spatial inequality, the purpose of this study is to understand the college choice process of students from rural counties who choose to enroll in college and major in engineering. Two research questions guide our study:

1. How do engineering students from rural areas make decisions about college choice?
2. How does rurality shape the college choice process of engineering students from rural areas?

The findings from this study will assist school counselors, student affairs professionals, and colleges in supporting the aspirations and transitions of rural students into engineering.

**Conceptual Framework**

Our research study is framed by Perna's (2006) Conceptual Model of Student College Choice and Lobao et al.'s (2007) framework of spatial inequality. Perna's model explains a wide range of factors that influence whether and where students attend college. These factors are organized into four layers: (1) individual *habitus*; (2) school and community context; (3) the higher education context; and (4) the broader social, economic, and policy context.

At the core of Perna's (2006) conceptual model is Becker's (1993) human capital theory, which assumes that students make college choice decisions by weighing the expected benefits (monetary and non-monetary) with the expected costs (costs of attendance and foregone earnings) of attending college. The innermost layer of the model, the *habitus*, includes students' demographic characteristics, social capital, and cultural capital (Perna, 2006). Rural youth often have less accumulated college-related social and cultural capital, but also possess a high amount of community social resources compared to their nonrural peers (Byun et al., 2012b). Layer two of Perna's (2006) model draws on McDonough's (1997) concept of "organizational *habitus*," which explains how the school and community context influences a student's college choice decision. Specifically, school social capital (Lin, 2001) includes the social networks within schools, such as counselors, teachers, and peers, that provide information to students about college. As this study is focused on rural students, it is important to understand the influence of the local community on students' college choice behaviors. This study on rural students' college choice leans heavily on the first two layers of Perna's (2006) conceptual model, as we seek to understand how the social, economic, and financial characteristics unique to rural environments have shaped their college-going process.

To better situate our study within the context of rural communities we have also chosen to utilize the theoretical framework of spatial inequality (Lobao et al., 2007). Drawn from sociology, spatial inequality examines how social institutions, like schools, create, alleviate, and reproduce social stratification across geographies. This theory posits that social institutions are made to allocate resources across geographic space and stratification occurs when resources are not distributed evenly (Lobao et al., 2007). In this study, we utilize spatial inequality to conceptualize how unequal resource distribution in rural communities could affect rural engineering students' college-going processes. We believe that our use of spatial inequality helps better align our conceptual frameworks with our population of interest.

### Literature Review

This review of the literature extends the discussion on college choice presented in our theoretical framework by exploring the research on college-going experiences of both engineering students and rural students. While this study focuses on rural students in engineering, the literature on this topic is limited. Our study seeks to connect these two bodies of literature with the intent of including rural students in conversations about underserved students' experiences in engineering.

### Engineering Students and College-Going Experiences

A large portion of the literature on the educational experiences of engineering students focuses on persistence and completion in engineering fields once a student is enrolled in college (French et al., 2005; Wang, 2013). While some of these studies have examined pre-college factors that predict persistence (Anderson & Kim, 2006; French et al., 2005; Tyson, 2011), this body of literature does not often examine the connection between pre-college experiences and entrance into postsecondary education (Wang, 2013). The literature that exists on engineering-promising students' entry into postsecondary education focuses primarily on factors that predict a students' choice to pursue an engineering degree. Studies have found that factors such as math and science achievement in secondary school (Crisp et al., 2009; Martinez & Guzman, 2013), mentorship and encouragement (Venville et al., 2013), exposure to advanced math and science courses (Trusty, 2002), and enrollment in pre-college engineering coursework (Miller et al., 2020; Phelps et al., 2018) are positively related to the likelihood that a student will choose an engineering degree program.

Although there is limited research on rural student entry into engineering programs, we know that not all students have equal access to the resources and guidance necessary for nurturing engineering aspirations. In particular, rural students often lack access to the advanced high school courses in math and science and other enrichment opportunities that predict the choice to pursue an engineering major (Brown et al., 2016; NCES, 2010; Yoon & Strobel, 2017). While these studies do help build a better understanding of why students may be encouraged to enter into engineering majors, they do not address the factors that lead students to major in engineering at their particular institutions. By failing to discuss college choice within the context of the leaky STEM pipeline, the literature does not take into account other institutional fit factors, such as institutional resources (Hoxby, 2009; Light & Strayer, 2000) and net cost of attendance (Chen & DesJardins, 2008; Welbek et al., 2014), that have been shown to influence persistence to graduation. While persistence and college choice are often explored separately, Morgan (2005) argues that college choice should be considered in conversations on persistence and attainment, as it is a necessary prerequisite. In addition, by omitting college choice, the body of literature on the STEM pipeline and transitions to college fails to identify the unique barriers that some students in engineering may face as they navigate the college-going process.

### Rural Students and College-Going Experiences

Although there is little research addressing college choice behaviors for engineering students, there has been substantial recent scholarship on rural students' college-going processes. It is well documented in the literature that rural students face unique financial, academic, informational, and social barriers to college readiness and enrollment (e.g., Hlinka et al., 2015; Roscigno & Crowley, 2001; Roscigno et al., 2006). Compared to their nonrural peers, students from rural areas matriculate into postsecondary institutions at lower rates (Byun et al., 2012a; Koricich et al., 2018). Additionally, rural students often come from lower socioeconomic backgrounds than their nonrural peers (Byun et al., 2012b). This has implications not only for their ability to pay for college but also their academic college preparation. Due to the funding structure of many K-12 school systems, which is based on local property taxes, rural students often attend K-12 schools with fewer resources, which include less rigorous course offerings and fewer school counselors (Irvin et al., 2017; Johnson & Zoellner, 2016; Means et al., 2016)

Rural students also face unique social barriers to college. Notably, they are less likely to be encouraged to attend a four-year college, as a lower proportion of rural parents expect their children to earn a bachelor's degree (Demi et al., 2010). Those who are encouraged to attend college experience tension in deciding to leave their rural community for college and career opportunities (Hlinka et al., 2015; Means et al., 2016; Tieken, 2016). Consequently, rural students aspire to attend institutions closer to home (Means et al., 2016), are more likely to enroll in non-selective two-year colleges, and are less likely to enroll in selective, four-year colleges (Byun et al., 2015b; Koricich et al., 2018).

Despite these barriers, recent research has highlighted the unique supports rural students enjoy in their communities, which serve to support their educational aspirations (McNamee, 2019; Tieken, 2016). In particular, rural communities are often characterized as caring and tight knit with extensive, close social ties outside of the immediate family. This creates an environment where students can leverage relationships within their families, the community, and their schools to receive both emotional and technical support in the college application process (Nelson, 2016; Tieken, 2016). In addition, rural high schools are more likely to offer dual enrollment programs than their urban peers (Pretlow & Washington, 2013; Waits et al., 2005). The opportunity to take both academic and technical college courses while in high school has been associated with loftier educational aspirations (Smith, 2007), higher GPAs in the first year of college, better likelihood of persistence, and greater progress toward college degree completion (Karp et al., 2007).

The literature on the college-going journeys of rural students establishes that these students often face high barriers to postsecondary access. Additionally, the literature on matriculation into engineering majors reveals that rural students may not have access to the pre-college coursework and activities that help bolster engineering aspirations (Irvin et al., 2017). These bodies of literature indicate that rural students interested in pursuing engineering may face barriers to entry into these majors thereby potentially allowing them to exit the STEM pipeline.

## Research Methods

### Case Study Design

A case study approach was appropriate for this study, as we aimed to develop an in-depth understanding of a phenomenon, event, process, or activity within a bounded system (Yin, 2014). We employed a multi-site case study approach, which "investigates a defined, contemporary phenomenon that is common to two or more real-world or naturalistic settings" (Mills et al., 2010, p. 587): students from rural counties who have chosen to pursue majors in engineering at one of two public land-grant institutions.

### Setting

The participants in this study were from two land-grant institutions in the southern region of the United States. We chose to situate this study at land-grant institutions because of their strong focus on STEM, and the reputation for excellence their engineering programs typically maintain. Additionally, these institutions are within states that have a high proportion of rural residents (Fields et al., 2016) and low-income residents (Hussar et al., 2020) –thereby making the college-going patterns of its rural residents a priority for the health of the state economy. Both institutions are Carnegie doctoral universities with very high research activity and have over 25,000 undergraduates. Land-Grant State has "somewhat selective" admissions standards and admits around 75 percent of applications. Land-Grant Tech has "very selective" admissions standards and only admits about 50 percent of applicants (College Board, n.d.).

Students interested in an engineering major at Land-Grant State apply to the university and specify engineering as their intended major. The university admissions office reviews the applicants for admission and engineering majors do not have additional admissions requirements at this first application stage. Students who are admitted into the university and indicated engineering on their application are first enrolled in a separate first-year college at the institution. During the first year, students complete the required prerequisite courses for the college of engineering including an introductory course for the engineering major they are interested in. Once enrolled in Land-Grant State there is no formal application process to the college of engineering for students who declared engineering at the time of entry. Once students meet the engineering prerequisite requirements in the first-year college (coursework and GPA), they are automatically moved to the college of engineering. Students initially admitted to the university in a major outside of the college of engineering will have to meet the same prerequisite requirements and request an official change of major.

Table 1
*Participant Profiles*

| Pseudonym | Gender | Race | Major | Institution | Year in college | First-generation |
|---|---|---|---|---|---|---|
| Amari | Female | White | Computer Science | Land-Grant State | 3rd year | Yes |
| Daphne | Female | White | Civil Engineering | Land-Grant State | 3rd year | No |
| Ed | Male | Black | Computer Science | Land-Grant Tech | 2nd year | Yes |
| Elizabeth | Female | White | Computer Science | Land-Grant Tech | 1st year | No |
| Esther | Female | White | Chemical Engineering | Land-Grant State | 3rd year | No |
| Jenny | Female | White | Civil Engineering | Land-Grant State | 3rd year | Yes |
| Lewis | Male | White | Computer Science | Land-Grant Tech | 1st year | No |
| Margo | Female | White | Manufacturing Engineering | Land-Grant Tech | 1st year | No |
| Paige | Female | White | Chemical Engineering | Land-Grant Tech | 3rd year | Yes |
| Peter | Male | White | Electrical Engineering | Land-Grant State | 1st year | No |
| Sebastian | Male | White | Electrical Engineering | Land-Grant Tech | 1st year | No |
| Tomas | Male | White | Nuclear Engineering | Land-Grant Tech | 1st year | No |

College-bound students hoping to attend Land-Grant Tech are required to apply to the university with engineering as their intended major. They are then admitted into the university and the college of engineering, admitted to the university and their second-choice major, or denied admission. The students who are admitted to the college of engineering are then enrolled in an engineering first-year curriculum, which is a general engineering track. After students have taken the requisite introductory classes, they can apply to their specific majors. Admission into these majors is dependent on how well the student has done in introductory coursework and how popular the major is. Students who are not admitted to the engineering first year's program can apply to specific majors within the college of engineering once they have taken the pre-requisites; however, it is more difficult for them to gain admission.

**Participant Selection**

During participant recruitment, we attempted to seek out participants who represented multiple perspectives and had differing experiences as suggested by Creswell and Poth (2018). Subjects were recruited through an email sent using existing listservs within each university's college of engineering. At Land-Grant Tech, the authors sent the recruitment email to students enrolled in STEM or engineering-based living-learning communities. At Land-Grant State, an upper-level administrator sent the recruitment email to all engineering students at the institution. Students who participated in this study a) were enrolled in an engineering program at a 4-year college, b) attended high school in a rural county as designated by the U.S. Census Bureau, and c) were 18 years or older. The twelve participants in this study represent a wide range of backgrounds and experiences. Five participants attended Land-Grant State and seven attended Land-Grant Tech (see Table 1). All but one participant was White, which is consistent with the demographic makeup of Land-Grant State and Land-Grant Tech's colleges of engineering and four were first-generation college students. All students attended high schools in rural counties and were classified as in-state students. Interestingly, seven of the participants were women— making our sample somewhat unrepresentative of these institution's engineering departments. Table 2 includes demographic information about Land-Grant State and Land-Grant Tech, the state in which they are located, and their respective Colleges of Engineering.

**Data Collection and Analysis**

Data collection took place in spring 2019. Students participated in a 40–90-minute semi-structured interview in private rooms at the participants' institutions or over a web-based format (e.g., Skype). Using the two theoretical frameworks, we developed an interview protocol with 31 questions focused on the students' college choice process and their rural identity. Aligned with Perna's (2006) model, we included questions about the students' family background, community, high school, interest in engineering, college perceptions,

Table 2
*Percent of Fall 2018 Enrollment by Race/Ethnicity and Gender*

| | Land-Grant Tech | | | Land-Grant State | | |
|---|---|---|---|---|---|---|
| | State Demographics | Total Enrollment | College of Engineering | State Demographics | Total Enrollment | College of Engineering |
| American Indian | 2 | <1 | <1 | >1 | <1 | <1 |
| African American/ Black | 22 | 6 | 3 | 33 | 12 | 7 |
| Hispanic | 10 | 6 | 5 | 5 | 6 | 7 |
| Multiracial | 2 | 4 | 4 | 2 | 2 | 2 |
| Asian | 3 | 7 | 8 | 2 | 4 | 7 |
| Hawaiian/ Pacific Islander | >1 | <1 | <1 | >1 | <1 | <1 |
| Nonresident | - | 4 | 7 | - | 5 | 6 |
| White | 70 | 69 | 67 | 62 | 67 | 71 |
| Unknown | - | 5 | 6 | - | 2 | 1 |
| Male | 51 | 53 | 74 | 51 | 47 | 78 |
| Female | 49 | 47 | 25 | 49 | 53 | 22 |

and college choice. Guided by Lobao et al.'s (2007) model, we included questions about the students' hometown (e.g., career opportunities, exposure to engineers) and their identity as a rural student (e.g., availability of resources, how they perceive their college-going experience compared to urban students). Each interview was audio-recorded for transcription purposes. In addition, we reviewed website content and conducted informational interviews with staff members from both colleges of engineering to better understand their admissions processes. For this study, we utilized a three-step process to analyze data. First, we began by reading transcripts and field notes to better understand the interview content. We then open-coded each interview and developed a preliminary codebook. During the open-coding process, we utilized the layers of Perna's (2006) conceptual model and spatial inequality (Lobao et al., 2007) as a guide. For example, we created categories of codes focused on students' *habitus* (e.g., parental education, parental occupation, family finances), high school and community context (e.g., coursework availability, teachers, counselors, support, hometown occupations, exposure to engineering, influence on postsecondary choices), and higher education context (e.g., major offerings, prestige of college). We also coded concepts related to spatial inequality such as obstacles for rural students in the college and major choice process, exposure to engineering, coursework availability, and college-going assistance. Figure 1 shows an example of this coding process using a selection of codes from our codebook. After initial coding, we finalized the codebook and recorded each transcript according to the final codebook. We then sorted codes under the respective research questions that they answered. Using each set of codes, we went back into the data to determine preliminary themes. Finally, we validated each theme with the codes and interviews (Miles et al., 2014).

**Validity and Reliability**

We established validity and reliability by triangulating data, performing member checks, and debriefing. After we finished analyzing the interviews, we triangulated the data by rereading the transcripts, revisiting informational interviews with college staff, and consulting admissions and program information published on each college's websites. This helped establish reliability by making sure each of our case themes was supported by the participants' words and the practices at each college (Creswell & Poth, 2018). Similarly, we performed member checks by sending each participant the manuscript to make sure we portrayed them accurately.

Finally, we engaged in peer debriefing to ensure that the case themes reflected each researcher's

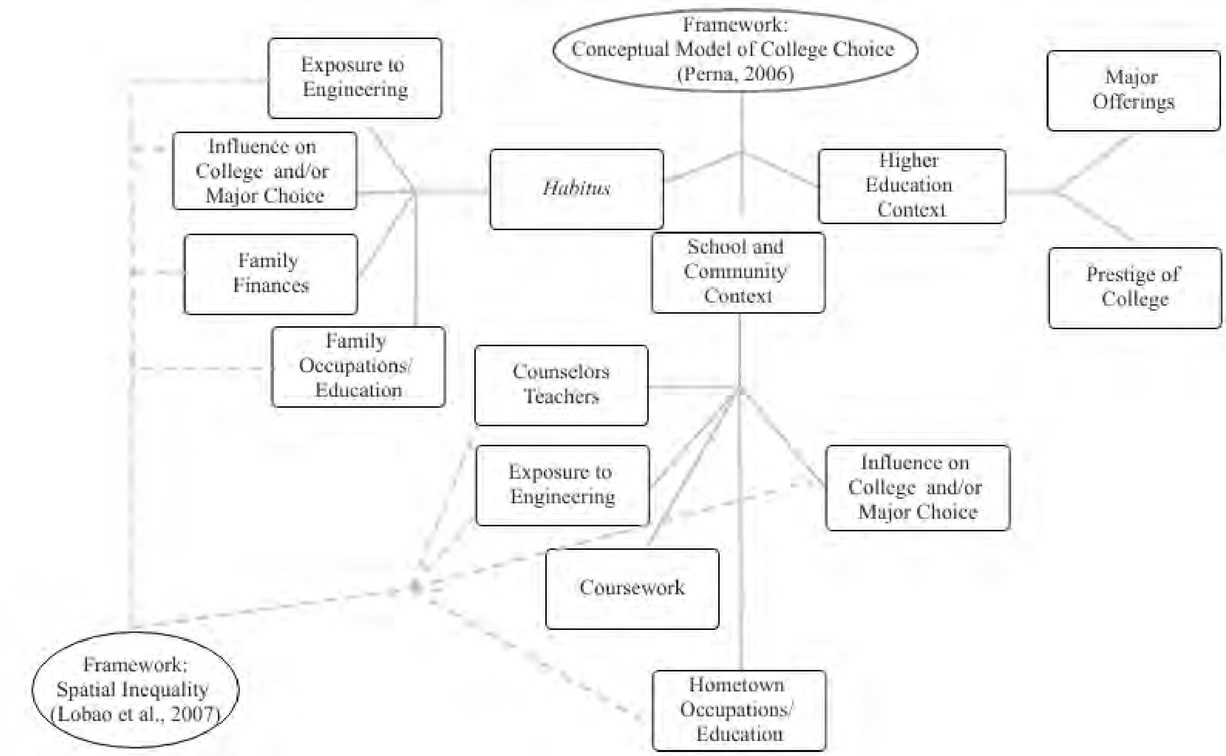


*Figure 1: Example of Framework-Derived Codes*

*Note:* Dotted lines denote codes that were drawn from Lobao and colleagues' (2007) framework of spatial inequality. Solid lines denote codes were informed by Perna's (2006) Conceptual Model of College Choice.

understanding of the data. All three authors' research interests are related to college access and underserved student populations. The first author worked as a college adviser in a rural high school, as well as assisted first-year engineers navigating the transition from high school to college in a living-learning village. The second author's research on college access, land-grant institutions, and rural students gives her a unique perspective on the college-going process of rural students. The third author has conducted extensive research on the experiences of underrepresented students in STEM majors, which provides a framework for our discussion of the challenges for underrepresented students entering engineering.

**Limitations**

There are several limitations to this study on rural engineering students. The first limitation is the racial makeup of our participant sample. We intended to construct a sample with multiple perspectives and experiences by using several living-learning villages and College of Engineering listservs to recruit participants. This strategy aimed to reach engineering students broadly at both institutions and did not limit our sample to certain subpopulations. However, this may have curbed the representative nature of our data. We hoped to have a more racially diverse sample; however, with only one Black student respondent, our results are largely reflective of rural White students' experience. This is likely due to the racial/ethnic makeup of both colleges of engineering. While both states have relatively high percentages of Black residents compared to the nation, this state representation is not reflected in the colleges of engineering or greater student bodies at either institution. At Land-Grant Tech and Land-Grant State, as seen in Table 2, Students of Color represent a little over 30 percent of the student body both overall and in the colleges of engineering. However, Black students only account for three percent of enrollment in the college of engineering at Land-Grant Tech and seven percent of enrollment in the college of engineering at Land-Grant State.

Further, both institutions have selective admissions criteria, and therefore we assume our sample has relatively high-achieving students. Our intention was to understand success stories of rural engineering students, but we recognize that many of the challenges that rural students face might not be adequately reflected in this sample of high-achieving engineering students at selective land-grant institutions. Specifically, rural students who are not as high achieving as our sample might plausibly face more challenges in accessing advanced STEM coursework, meeting admissions requirements, and enrolling in selective institutions.

## Findings

After completing the data analysis, we found four salient themes in the data across all participants: (1) The Inextricable Nature of College, Major, and Career Choice (2) "The Smart Person Thing to Do:" The Power of Prestige, (3) "Are You Sure You Don't Want to Change your Major?:" Dissonance Between Aspirations and Expectations, and (4) School and Community as Crucial Resources in College and Major Exploration.

### The Inextricable Nature of College, Major, and Career Choice

Unlike most undergraduate programs, the college of engineering at Land-Grant Tech requires that students apply directly to their majors rather than declare their program of study after they have taken general education courses. Similarly, at Land-Grant State, students are encouraged to declare their major as engineering when they apply to the university. The pressure to select engineering as a major before students begin college was evident as the participants spoke about their college choice processes. Nine of the twelve participants only applied to colleges that offered engineering programs. Sebastian remarked, "the availability of engineering was the deciding factor for me. So, I didn't really decide that that was a priority until senior year when I started choosing colleges based on that." Peter shared a similar experience, saying "I was looking for an engineering school, first and foremost." Daphne chose not to apply to a college that she aspired to attend her whole life because they did not have an engineering program. Similarly, Lewis chose not to attend a college that he felt was a good match and offered him significant financial aid because he was not admitted into their college of engineering.

The way the students in this study identified the colleges they applied to and enrolled in underlines the inextricable nature of college, major, and career choice. While the admissions approach used by Land-Grant Tech may benefit students by limiting the number of times they change majors, and subsequently decrease their time to degree completion, it could also force students to commit to a degree plan that they have not properly explored through introductory coursework. Jenny, Daphne, Tomas, and Margo admitted that they were not entirely sure what an engineer did before they began coursework at their university. Esther identified this problem when giving advice to a younger friend who was considering studying engineering:

> I think the big thing people don't understand about engineering is what you actually do when you graduate ...[where] I'm from, we just don't have people who do it. And so, I didn't know in a plant, these are your responsibilities. This is your job. And so that's what I kind of sat down and told her about. And how much problem-solving is critical thinking that is part of it. It's not just "Oh, I like math and chemistry. Would you like this?" And I think that's something that nobody really told me until I worked.

Esther's experience illuminates the dissonance between students' knowledge of careers and university policies that force career-related decision-making before students enter the institution. These students' experiences also echo tenets of Perna's (2006) model of college choice. Specifically, the broad role of institutions (layer three) in guiding student decision-making, as well as the influence of high school experiences (layer two) in informing students' college choices. This finding also highlights gaps in Perna's (2006) framework, as college choice driven by major consideration is not included in the higher education layer of the framework. We will discuss the implications of this in the discussion section.

### "The Smart Person Thing to Do:" The Power of Prestige

Across all participants, one major theme emerged when students spoke about their college choice: prestige. As discussed, students were concerned with the availability of engineering when making their college choice; however, Paige, Elizabeth, Peter, Daphne, and Sebastian also noted that the reputation of the college was a deciding factor with some describing their institutions as a "peak school" and "the best school for several states around.” Sebastian recalls deciding between two in-state schools that offered engineering saying:

> [I] narrowed down [my] options to [Land-Grant Tech], and then [Regional College] was my other pick. And [Regional College] have less of an engineering department. They also have greatly reduced tuition...I knew that [Land-Grant Tech’s] engineering program was well-known...and there would be a lot of opportunities for getting a foot in the door as to a career while studying here. So, I think between [Land-Grant Tech’s] engineering program and [Regional College’s] sort of fledgling engineering program, I wanted to go with the one that will give me better chances for the future.

Notably, Paige and Daphne not only considered the prestige of the college, but also the status of the individual departments within the university and college of engineering. Daphne recalls turning down her admission to a well-known college of engineering because of the reputation of the civil engineering program.

> I came here because ... I think in general, [Out-of-State University’s] engineering program is more prestigious, [but] their civil engineering, specifically, is discredited amongst their computer science and other programs there. So, it’s like “Oh, you study civil engineering,” they’re like, “it’s not as good.” It’s kind of made fun of. [At Land-Grant State] I think all the engineering here is more on equal terms with each other.

Sebastian’s decision to forgo cheaper tuition for a more well-known engineering program and Daphne’s choice to opt for program status demonstrates the power of prestige in college choice.

Interestingly, the students’ concern with prestige not only influenced their college choice, but also their major choice. When discussing their decision to pursue engineering as a major and career, Paige, Peter, Tomas, and Lewis expressed that the cultural cachet attached to engineering drew them to the discipline. Tomas learned about engineering from his uncle who worked as an engineer in a manufacturing plant. He remembers his uncle’s boss telling him “Engineering is where you want to be if you want to get ahead.” Lewis was attracted by the image of the engineer as an intellectual, saying, “engineering was apparently a smart person thing to do.” The conversations students had regarding major choice in the context of their college choice again demonstrate that these two decisions are linked for engineering majors. As discussed in the prior theme, these findings demonstrate certain tenets of Perna’s (2006) model of college choice. Perna notes that students undergo a cost-benefit analysis when deciding where to go to college. For these students, the prestige of the institution and the major which they chose to pursue were important factors in this calculus and appeared to be influenced by individuals in their communities.

### “Are You Sure You Don’t Want to Change your Major?”: Dissonance Between Aspirations and Expectations

Reflective of Perna’s (2006) conceptualization of the role of the *habitus* in college-going decisions, the choice to go to college for all the students was not controversial or difficult, as it was set forth as an expectation by the majority of their parents. Esther remarks, “My whole family values [education] a lot. My parents have always wanted me to go to college. And it was honestly never an option not to go.” Amari’s experience confirms that college-going was not viewed as a choice within her home. She says, “I knew that I wanted to go to a four-year college. It was put forth by my parents that I would go to college, regardless, I didn’t necessarily have a choice.” Ed believes that his parents pushed him toward college because they were not able to attend themselves:

> [My parents] didn’t go to school...My dad always talked about how he wished he had been able to go to school. So, I think ...that was a lot of motivation for me in terms of not even choosing a major, but more so just decided that I wanted to go to college after high school.

While, for most students in this study, college-going was an expectation, their desire to pursue engineering, a key component in their college choice decision, was often not supported by their environment or the people in their lives. This manifested in three ways: 1) tension between what others expected and what students expected to study, 2) a difference between what the participants and their classmates did after high school, and 3) a lack of STEM coursework.

Many students reported that their plans to pursue engineering were either directly or indirectly discouraged by people in their homes and community. Paige and Jenny felt that their aspirations were not supported by their families. Paige recalls that her “mother always wanted [her] to be a journalist." Jenny experienced varying levels of support at home. While her father supported her engineering dreams, Jenny's mother wanted her to become a math teacher and her grandmother wanted her to become a nurse. Margo and Amari also felt pressure from their communities to study nursing. The gendered nature of career expectations was distinctive to the women in this study; however, both men and women students identified a sense of uniqueness when considering their paths against their peers.

Many students felt that engineering was not a common career path for people in their high schools. Peter could not recall anyone in his graduating class that pursued engineering out of high school. He wonders whether this is because of a lack of interest or a lack of confidence, saying "I don't know [if] this [is] because they don't want to be, or if they don't feel like they could be." Margo had a similar experience to Peter and noted that students in their schools may not have considered engineering because of a lack of exposure to the field, saying "A lot of people just are very discouraged from pursuing engineering because they don't know what it is. Or there's just a lot of misconceptions about it." Esther recalled that her school did not have a strong college-going culture, so attending a four-year college and studying engineering was viewed as outside of the norm and was looked down upon:

> [My peers] either went to a two-year tech program or are working. Just a lot of people didn't go to college, and the people who did tend to come back. [My classmates were] kind of like, "you don't have to pretend like you're better...Well, why are you even trying to do that? That's too much. It's too hard. You don't have to be an overachiever. Just be like the rest of us."

The tension students experienced when choosing their major as a result of individuals within their homes and schools echo Perna's (2006) emphasis on the influence of these environments on college choices. However, as mentioned, Perna's conceptualization of the role of these environments does not encompass major choice, which is a central theme of this finding.

The students' sense that their choice to study engineering was abnormal and even frowned upon by their classmates was reinforced by their schools' lack of STEM coursework and extracurriculars. This finding highlights the influence of Lobao and colleagues' (2007) spatial inequality on students' college decision-making. Lewis, Margo, Jenny, and Amari noted that, in comparison to their urban peers, their high schools offered few opportunities for students to earn college credit in STEM courses. Jenny remarks, "I come [to Land-Grant State] and all my friends who [attended] high school in [the city] are like, 'I already have 40 hours of college credit' and I'm like, 'I have none.'" Amari, who attended a high school that offered several career and technical education pathways, noted that none of them were conducive to someone interested in engineering. She said, "[In high school] the only pathways offered were cosmetology, nursing, and auto mechanic[s]." While students felt supported in their decision to attend college, the dissonance between students' major and career aspirations and the expectations others had for the students, the examples set for them by their peers, and the types of courses offered within high schools created an environment that discouraged students from attending colleges of engineering.

**School and Community as Crucial Resources in College and Major Exploration**

Aligned with Perna's (2006) model of college choice, this theme addresses the influence of high school faculty and staff and the community on students' college choice. The findings of this theme also reflect aspects of Lobao and colleagues' (2007) concept of spatial inequality, specifically the role of community institutions in filling resource gaps in rural K-12 schools. While students' college choices were driven by their desire to pursue a degree in engineering, 11 of the 12 students in this study did not have any engineers in their immediate family (one exception: Amari's brother is an aerospace engineer) and only a few reported knowing engineers in their hometowns. All 12 students noted that school and community members played a large role in informing them about engineering and guiding their college choices.

Paige and Tomas credit their STEM teachers for recognizing their aptitude in STEM and encouraging them to consider engineering. Paige remembers the influence her AP Chemistry teacher had on her desire to pursue chemical engineering.

> My [AP Chemistry] teacher used to work for a chemical manufacturing company, and she'd talk about it all the time. I was like, "you know, if I enjoyed this, more than likely I'll enjoy what I'd do there." So, it was nice because she kind of instilled in us: here's what you can do … When I told her … "Hey, I'm considering chemical

engineering. I'm good at this class. I like it." She got really excited! And so, to see her get excited that kind of confirmed to me this is what I … would like to do.

While teachers played a large role in setting engineering aspirations for students, several participants credit community members for introducing them to engineering. Elizabeth connected with family friends and not only learned about engineering, but also received help when she interviewed for internships:

> One of the girls, who rides at the same barn that I used to, her mother works in the higher-ups of Lenovo. She's told me several times, "if you have any questions, holler at me." The hiring manager Red Storm, wonderful lady. I had an interview with Cisco, and I was texting her before I was like, "What am I [to] do for a technical interview? Like what [does] this mean?" So, she gave me tips about an interview.

Ed learned about computer science from his science club mentor's husband, who was an engineer. Ed said, "In high school, having the mentorship of my [mentor's] husband, who worked as a mechanical engineer is really important. Because I got to see, I got to learn about what he did for work and what type of work he had done. So, after talking to him and working on the electric car and stuff, I was like, 'Okay, I think I definitely want to like electrical and computer engineering.'" Similarly, Sebastian's Boy Scout Scoutmaster was a mechanical engineer who "would sometimes have presentations, and he would show us the part that he worked on that went into the [International Space Station]." Despite the lack of engineers in their nuclear families, the students were able to learn about engineering by tapping into their communities and seeking out people who could fill this informational void.

Students also showed great resourcefulness in the face of limited STEM coursework at their high schools, as they cleverly utilized another community resource, the local community college, to ensure they received a robust STEM education. Tomas, Margo, Lewis, Esther, Peter, and Elizabeth took advantage of dual-enrollment courses at their local community colleges. Tomas credits his dual enrollment program with giving him the opportunity to take advanced math courses like linear algebra and calculus two that were not available at his high school. Lewis recalls his decision to enroll in a dual-enrollment program and credits it for not only giving him college credit, but also helping guide his career and college choice:

> And I sort of felt like going [to the College and Career Academy] would give me at least some sort of experience in a major, which … really shaped my path going into college and really helped me [get] a better idea of what I want to do in college.

Unfortunately, many students felt that they navigated the college application process with little assistance from school counselors. Paige and Ed felt that their school counselors only interacted with top academic performers and those struggling- leaving students in the middle without assistance. Paige remarked, "the counselors didn't really help us because it was either if you weren't in the top 10 [percent] or you were at the bottom of the class, you were on your own, so they were like, 'do whatever, figure it out.' So, we figured it out." Amari and Jenny felt they were forced to seek out college information because their counselors were too busy performing their other duties. This theme underlines both the students' resourcefulness in overcoming barriers to college and major exploration, as well as the importance of school and community resources in encouraging and preparing students to fulfill their engineering aspirations.

## Discussion

In this study, we sought to understand the college choice process of rural students who, according to the literature, face several barriers to enrollment in college and engineering majors. Our first two themes, (1) The Inextricable Nature of College, Major, and Career Choice and (2) "The Smart Person Thing to Do:" The Power of Prestige, addressed our research question inquiring about the college choice process of rural students enrolled in engineering majors. These themes drew heavily on Perna's (2006) Conceptual Model of College Choice. When asked about the key factors that led students to attend their institution, most of our participants identified availability of an engineering major as the most important. In part, this is due to the nature of the program in which these students chose to enroll. Students entering engineering programs at these two institutions were required to simultaneously choose their college and major. The institutions' decision to combine the college and major application required these students to simultaneously solidify their career goals, as well as their vision for which university would be the best fit. Requiring students to choose their majors before they are exposed to content in the college classroom could lead to students choosing a major that does not fit their interests and skills. This may also prompt a student to change majors thereby potentially lengthening their time to degree or drop out of STEM pathways entirely (Orr et al., 2012).

Our second theoretical framework, spatial inequality, suggests that requiring students to choose their major before they enter college may be especially problematic for rural students who may be less likely to be exposed to engineering through coursework and personal contacts than their urban peers (National Science Board, 2014). Students in our study noted that, upon reflection, they did not fully understand what all engineering entailed in high school. Many credited this to not knowing any engineers in their hometown or not having co- or extra-curricular experiences that exposed them to engineering. These findings are not surprising as prior research has cited mentorship (Venville et al., 2013), access to advanced STEM coursework (Trusty, 2002), and exposure to engineering courses (Phelps et al., 2018; Miller et al., 2020) as crucial influences in students' decision to pursue engineering. Although many of the participants did not have as much exposure to engineering due to limited access to resources growing up in rural areas, they were able to learn enough to spark their interest in and intentionality to pursue an engineering major in college. However, the coursework that is designed to deepen their interest in engineering as a discipline does not take place until the first semester of their degree program. Consequently, admissions processes that require students to select an engineering major when admitted could lead rural students to make less-informed college- and major-choice decisions.

In addition to filtering colleges based upon whether the institution has an engineering program, participants also considered the prestige of the institution and the college of engineering. These findings echo elements of the higher education layer of Perna's model (2006), which cites an institution's characteristics, such as perceived prestige, as a factor that can sway college choice. Decades of research have confirmed that students are attuned to and influenced by a college's prominence and prestige in the public eye, which they often determine by rankings lists (Bowman & Bastedo, 2009; McDonough et al., 1998). Many students believe that attending an "elite" college will increase their chances of getting "good" jobs and attending top-ranked graduate schools (Stevens, 2007).

Our study also worked to understand the influence of rurality on participants' college choice processes, drawing largely on Lobao and colleagues' (2007) framework of spatial inequality. While this study was originally conceived as an exploration into college choice, our findings suggest that college, major, and career choice are inextricable for engineering majors. This prompted us to incorporate findings regarding the influence of rurality on career *and* major choice into our third and fourth theme, (3) "Are You Sure You Don't Want to Change your Major?" Dissonance Between Aspirations and Expectations, and (4) School and Community as Crucial Resources in College and Major Exploration.

Echoing Perna's *habitus* and school and community context layers, participants noted that their parents' expectations and high school environment affected their college choice process. Contrary to the literature which maintains that rural parents are less likely to expect their child to attend college outside of their communities (Demi et al., 2010; Hlinka et al., 2015), students in this study felt they were expected to go to college; however, some did not feel their choice to pursue engineering was supported by their high school environments or families. Prior literature suggests that this could be a result of a reluctance to support career aspirations that would likely draw students away from their community's post-graduation (Hlinka et al., 2015) or a misalignment between K-12 curriculum and the labor market (Mokher, 2011). These findings and supporting literature suggest that rural students' college and career choice experiences are influenced by unique societal dynamics and values within rural communities.

Similar to the lack of support some students received regarding their career aspirations, students did not report receiving much support throughout the application process especially from within their high schools. These finding echo much of the literature on spatial inequality and resource distribution within rural communities, which finds school counselors in these areas are small in number and therefore have less bandwidth to assist with the college application process (Byun et al., 2012b; Means et al., 2016). In light of this literature, this finding further demonstrates the influence of rurality and unequal resource distribution on rural students' college-going processes. In response to these challenges, students sought out other resources, like the internet, to help them complete college applications.

Although these findings (e.g., lack of STEM and engineering coursework and overburdened school counselors) may suggest rural students are at a disadvantage in the college-going process, they also identify two key qualities of rural students and communities that contribute to their success: resourcefulness and connectedness to the community. Even though many students did not have any engineers in their families and were not exposed to the discipline through coursework, they were still able to learn about the industry through teachers and community mentors who played a large role in fueling students' aspirations to become engineers. This is reflective of the role of structural supports and resources within schools that affect the college-going process, which is emphasized in Perna's (2006) framework of college choice, as well as the importance of mentorship in encouraging STEM aspirations (Venville et al., 2013) and the strength of community social capital in rural areas (Byun et al., 2012b; Nelson, 2016).

In addition to the people in their communities, students also took advantage of the resources offered at local institutions. Facing few STEM course offerings in their high schools, as is common in rural districts (Irvin et al., 2017; Johnson & Zollener, 2016), students sought out dual enrollment at their local community college. Students' use of community colleges both exposed them to advanced concepts in STEM and helped solidify their confidence in choosing engineering. This not only shows great resourcefulness on the part of students, but also the role of community colleges in ameliorating the negative impact of spatial inequality (Lobao et al., 2007) on student opportunity by supplementing the gaps in K-12 educational offerings (i.e., few STEM course offerings). These qualities and resources were crucial in helping these students choose to pursue engineering and demonstrate the impact of rural community social capital and institutions on students' college-going processes.

## Implications

The results of this study have important implications for policy and practice. We found that several participants felt that they had little exposure to engineering and STEM coursework before college. This could be remedied on several levels. At the high school level, schools should consider expanding or creating dual enrollment partnerships with local community colleges to increase engineering and STEM course offerings. Additionally, districts could work to expand career and technical education course offerings like technology, engineering, and design. In order to increase students' exposure to careers, high schools can utilize connections with local industry and bring professionals into the school for job talks or take students on externships. At the district level, administrators should consider allocating special funds for these externships and exposure activities.

In addition to a lack of engineering and STEM coursework, some students felt their high schools did not provide much assistance during the college application process. Echoing much of the literature on college advising in high schools, this study reinforces the need for additional school counselors and specialized college advising professionals in schools in order to lessen student caseloads and allow more time to engage in college advising (Clayton, 2019). In the absence of district funding, these roles can be filled by college access organizations like College Advising Corps and GEAR UP that are funded by federal grants.

Furthermore, several students in our study expressed that they entered their institutions with an incomplete understanding of what being an engineer entails. This reflects existing literature that notes that many secondary school students lack an understanding of engineering (Montfort et al., 2013). For most students, an incomplete understanding of their desired career would typically be remedied by introductory coursework and mentoring before they are made to choose a major; however, engineering students at Land-Grant State and Land-Grant Tech are encouraged to choose their major before they take their first college course. Institutions' decision to funnel engineering students into their major without introductory coursework could have implications for major and workforce retention. Institutions, especially those with admissions policies like Land-Grant Tech, should consider revising their admissions processes to allow engineering students time to learn about the discipline before declaring their major.

Importantly, this study has implications for how postsecondary institutions can better serve rural students. First, although many institutions collect demographic data pertaining to socio-economic or first-generation status of prospective students, many institutions do not track whether a student is "rural" (or "urban", "suburban"). Using zip codes and high school information, institutions can easily identify rural students for the purposes of creating targeted outreach and recruitment programming for prospective students from rural areas. Rural and regional institutions also have a unique opportunity to partner with rural high schools and communities, to expose students to engineering and STEM majors. Institutions and colleges of engineering could consider developing mentoring programs that match rural high school students to currently enrolled engineering students to encourage engineering aspirations. Institutions can also apply for federally funded programs (e.g., TRIO Upward Bound Math and Science) and grants that provide college access and mentoring resources to high school students.

Our study also has implications for future research. One of the major findings of this paper was that, for students who pursue engineering at institutions with admissions processes like Land-Grant State and Tech, college and major choice are folded into the same decision. While Perna's (2006) model is comprehensive, it does not directly account for college choice driven by major consideration. The higher education layer would be a logical place for major consideration, as it does include institutional characteristics as a factor that sways college choice. The findings of this study suggest that future research should examine both college and major choice together to better understand how students move through STEM pathways. Finally, we found that students in this study overcame barriers constructed by spatial inequality, specifically lack of exposure to STEM, engineering, and college advising, through their creative use of school and community resources. Future research should extend this discussion by exploring the unique factors that lead to rural students' successes and work to reframe the narrative around rural students and their educational trajectories.

## Conclusion

This study sought to understand the college choice process of students from rural communities who entered engineering majors at two land-grant institutions. We found that, when choosing a college, students were most concerned with whether the college offered their engineering major and the prestige of the institution. We also found that, while many students were encouraged to attend college, they did not feel that their decision to pursue engineering was supported by their families, classmates, and their high school environment. Finally, while the students in our study faced barriers in their college-going journeys stemming from lack of exposure to STEM and engineering as well as weak institutional support navigating the college application, these students were able to use school and community resources to overcome these impediments and successfully matriculate into a college of engineering.

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**Suggested citation:**

Worsham, R. E., Clayton, A. B., & Gayles, J. G. (2021). Exploring rural engineering students' college choice process at two land-grant universities. *The Rural Educator, 42*(3), 28-44. https://doi.org/10.35608/ruraled.v42i3.1181