STUDIES IN ENGINEERING EDUCATION

Gender-Career Bias in Rural, Secondary School Engineering Students

EMPIRICAL RESEARCH

LAINE SCHREWE

VIRGINIA TECH PUBLISHING

ABSTRACT

Background: The gender disparity in engineering remains an unresolved problem, and this study investigates the role gender-career bias has on rural secondary school students and the impact that bias has on whether or not women decide to pursue a career in engineering.

Purpose: The study aims to identify any trends that exist in secondary school engineering students' perception of gender roles and careers and to leverage this understanding to develop intentional instructional practices that would lead to improved recruitment and retention within engineering programs – specifically for women.

Design/Method: An instrumental case study foregrounded in the constructivist paradigm was used in this multiple methods study. Both quantitative and qualitative data analysis were used to interpret the data obtained from engineering students in a rural Midwestern high school.

Results: Four themes related to gender and career bias emerged: (1) Men and women have similar views regarding when it is acceptable for women to work yet different views on the purpose of a woman's income; (2) The type of job one obtains should be based on qualifications and interest, though qualifications may differ by gender; (3) Women feel they can have any career they want, whereas men discuss women's career potential with limiting factors; and (4) The type of household tasks/chores one performs should not be based on gender, but instead split in a way that works for each family.

Conclusions: The impact of this bias on women's recruitment into engineering is discussed, and areas for improvement within engineering education are identified based on these results.

CORRESPONDING AUTHOR:

Laine Schrewe

Otterbein University, Ohio, US

laineschrewe@gmail.com

KEYWORDS:

gender career bias; rural; engineering education; gender disparity

TO CITE THIS ARTICLE:

Schrewe, L. (2026). Gender-Career Bias in Rural, Secondary School Engineering Students. *Studies in Engineering Education*, 7(1), 23–42. DOI: https://doi.org/10.21061/see.179

1. INTRODUCTION

Women have long been underrepresented in STEM fields (Bix, 2004; Khan et al., 2020; Merchant, 2025), and this inequity is shaped not only by gender but also by place, particularly within rural educational contexts that remain underexamined in STEM education research. Research aimed at improving this disparity has been tackled by researchers for decades (Beasley & Fischer, 2012; Liu et al., 2014; Murphy et al., 2007; Syed, 2014; Wilson et al., 2015; Zeldin & Pajares, 2000; Zeldin et al., 2008), but despite the abundance of research dedicated to this global issue, very little has been uncovered to significantly impact or improve women's representation in STEM fields (van Aalderen-Smeets & van der Molen, 2018) and women still comprise only a small percent (16%) of the workforce in engineering (Khan et al., 2020). While considerable attention has been placed on college and professional retention, fewer studies explore early influences on career decisions, especially in secondary education. This study addresses that gap by examining gender-career bias among rural secondary school engineering students, positioning rural context as a critical lens for understanding how gendered beliefs about engineering careers are formed.

Societal expectations, cultural narratives, and the persistent underrepresentation of women in technical fields all influence how students perceive their potential fit within engineering (Eagly & Wood, 2012; Zeldin et al., 2008). Adolescents' aspirations are shaped not only by access or interest, but also by how closely they align with gender norms reinforced by families, schools, and media (Cheryan et al., 2017; Eccles, 1994). When students internalize the belief that certain careers "belong" to a particular gender, it limits their sense of agency in imagining future roles. This study focuses specifically on secondary school students enrolled in rural engineering electives. While many STEM recruitment efforts target college-aged students, earlier interventions are necessary to address biases before they become entrenched. Furthermore, rural youth face unique challenges related to geographic isolation, fewer role models in STEM, and sociocultural expectations about career paths that may be perceived as more or less "realistic" (Ali & McWhirter, 2006; Matusovich et al., 2017). These dynamics make it especially important to explore how gendered career beliefs take shape in these environments.

In this paper, the degree to which students perceive career options as gendered is explored, and how these perceptions align with or challenge broader ideologies about work, gender, and identity is analyzed. The study uses a survey instrument based on the Social Roles Questionnaire (SRQ) to investigate gender-career bias in parallel with qualitative responses that offer insight into students' reasoning. By situating this study in a rural setting and analyzing both quantitative and qualitative data, this work contributes to emerging conversations about STEM identity formation, gender bias, and the impact of community context on students' educational trajectories.

2. PERSPECTIVES FROM LITERATURE

Research aimed at understanding and improving women's limited representation in the engineering field has identified several factors that impact women during the career selection phase of adolescence. Perhaps most notable is the finding that gender stereotypes about what an engineer looks like and gendered societal expectations about who can become an engineer often limit what fields women believe they can pursue (Baber & Tucker, 2006; Eagly & Wood, 2012; Lorber, 2001). Similarly, the lack of female role models and targeted, supportive educational environments within the field exacerbates the lack of belongingness and connection women feel in the field (Bix, 2004). These factors, along with others, have been shown to compound and negatively impact women's belief that they can be successful in the engineering field (Marra et al., 2009; Singh et al., 2013).

In recent years, researchers have begun to focus on how different factors affect recruitment and retention in the engineering field with the goal of uncovering new information that can be used to increase both the number of people entering and staying in engineering careers and the diversity of those people. The growing body of research related to this topic has uncovered several noteworthy ideas that may incrementally help move the needle toward a more balanced gender

distribution (Baber & Tucker, 2006; Beasley & Fischer, 2012; Benedict et al., 2017; Benson et al., 2017; Frehill, 2013; Heilman et al., 2004; Herbert & Stipek, 2005; Khan et al., 2020; Lorber, 2001). For example, the disparity in men's and women's representation in engineering is a function of how men and women view equality in terms of career selection (Baber & Tucker, 2006; Lorber, 2001). Fundamentally, the ideology and consideration of gender as two distinctly different constructs influences the way people behave on a daily basis in terms of their behaviors, the activities they choose to participate in, and what power balances exist between people (Lorber, 2001) and may be at the heart of the issue of gender disparity within the engineering field. Engineering, in particular, has been found to reflect culturally masculine norms – such as individualism, control, and objectivity – that may discourage participation from those whose identities do not align with those norms (Murzi et al., 2016). These norms are culturally embedded and separate from biological sex, yet they shape who feels welcome or successful in engineering spaces.

Engaging adolescents at the secondary level is critical: this is when STEM identities and career aspirations begin to crystallize, and when rural students face unique barriers (such as limited exposure to engineering role models, fewer advanced coursework options, and strong local-stay norms) that can divert them away from college STEM pathways. To probe how gendered beliefs factor into that pipeline, we draw on Baber and Tucker's (2006) Social Roles Questionnaire (SRQ), a validated instrument designed to measure participants' acceptance of traditional gender norms across work, family, and political domains.

Baber and Tucker found that young women consistently scored higher than young men on "egalitarian and gender-transcendent beliefs" (p. 1), suggesting greater openness to non-traditional career roles. Although each SRQ item is phrased in binary terms (e.g., "Men should be the primary wage-earner"), respondents rate their agreement on a continuum. This approach both acknowledges the prevailing binary categories and invites nuance – participants can indicate any level of acceptance or rejection of a given norm – thereby surfacing variation in how adolescents endorse or challenge gender stereotypes.

It should be noted that this study was sensitive to the fact that the sample includes cisgender boys and girls as well as students who identify as non-binary. While the original SRQ does not offer non-binary response options, its continuum of agreement still allows one to capture how all students position themselves relative to traditional norms. By situating SRQ items alongside self-reported gender identity and rural contextual factors, this study illuminates how secondary school students' beliefs about gender roles may facilitate – or inhibit – their entry into engineering pathways.

A feature of this study that is particularly novel with respect to other published data is that it is conducted in a rural context. The US Census Bureau broadly defines a rural area as a region with a population density of less than 500 per square mile (2016). For the purposes of this paper, however, the specific definition of rural from The National Center for Education Statistics (NCES) locale framework will be used, as this classification aligns with most rural education research and can be linked directly to district-level data. In this framework, "rural" school districts are defined as those assigned NCES locale codes 41–43 (rural fringe, distant, or remote) (National Center for Education Statistics, n.d.). The specific district in which this research was conducted is further classified as "rural: fringe" according to the National Center for Education Statistics (NCES) locale codes, meaning it lies outside an urbanized area but within proximity to an urban cluster.

While studies that focus on engineering recruitment/retention in urban settings are not difficult to find (Chen et al., 2015; Ilumoka et al., 2017; Roche & Manzi, 2019), studies that consider rural settings are more limited. However, the combined body of work is starting to generate a foundational understanding of this rural context (Carrico et al., 2019; Grohs et al., 2020). For example, studies have shown that rural students often have reduced access to advanced coursework and extracurricular activities and are often exposed to a narrower range of career role models (Iatarola et al., 2011; Irvin et al., 2017; Peterson et al., 2015). Additionally, students from rural communities have been shown to be particularly influenced by their community, family, and even religious institutions (Byun et al., 2017) in terms of the social roles they should fill. These

influences do not limit students inherently, but they shape how students come to view viable pathways for themselves, particularly when engineering is not visible within their immediate surroundings.

A growing body of work specifically targeted specifically at Appalachia – which is similarly defined by the U.S. Appalachian Regional Commission (ARC) and which foregrounds economic and geographic consistency across studies rather than cultural stereotypes (Appalachian Regional Commission, n.d.)) – is helping to illuminate the factors that influence career choice in rural American settings (Ali & Saunders, 2006, 2009; Ali & McWhirter, 2006; Cain et al., 2024; Carrico et al., 2019; Chenoweth & Galliher, 2004; Dyk & Wilson, 1999; Matusovich et al., 2017; Meece et al., 2014; Petrin et al., 2014). While the context of this study is not located within the federally designated Appalachian region, it lies just outside its northern boundary, making it geographically proximate and culturally adjacent to many Appalachian communities.

Supporting the previously noted trend in rural adolescents, Appalachian studies have consistently shown that environmental influences – such as parental, peer, and community expectations – play a significant role in shaping career aspirations (Ali & Saunders, 2009; Carrico et al., 2019). For instance, Carrico et al. (2019) found that more than half of the students in their study selected careers based on environmental factors rather than personal interests. This aligns with earlier work by Ali and Saunders (2009), who demonstrated that self-efficacy beliefs, socioeconomic status, and perceived support systems significantly predicted career aspirations among rural Appalachian youth. Self-efficacy, outcome expectations, and perceived barriers also were found to be influential factors for determining career aspirations for Appalachian youth (Ali & McWhirter, 2006; Ali & Saunders, 2006).

The desire to remain in one's home community also emerges as a salient theme, often constraining students' perceived career options to those visible within their immediate environment (Carrico et al., 2019; Petrin et al., 2014). This localized orientation may contribute to the persistence of traditional gendered career pathways, with women gravitating toward caregiving or domestic roles and men toward blue-collar or trade occupations (Dyk & Wilson, 1999). However, these patterns are neither universal nor fixed. More recent findings complicate this narrative. Meece et al. (2014) reported that Appalachian girls were more likely than boys to express interest in non-traditional careers, a trend echoed in broader rural studies (Baber & Tucker, 2006). These findings underscore the importance of addressing both individual and contextual factors in rural career development.

Recent research has also begun to explore how rural identity intersects with STEM interest and persistence. Cain et al. (2022) found that rural college students' STEM interests were sparked and sustained through a combination of internal motivation and external support, including family encouragement and school-based opportunities. Similarly, Cain et al. (2024) highlighted how rural schools and communities shape students' academic trajectories in STEM, often in ways that reflect both cultural capital and structural limitations. Matusovich et al. (2017) further emphasized the role of organized experiences—such as exposure to engineering curricula—in sparking interest among Appalachian students, particularly when those experiences align with students' existing preferences for math and science.

Together, these studies suggest that while rural youth face unique structural and cultural constraints, they also demonstrate agency and aspiration – particularly when supported by affirming environments. Rather than viewing rural culture as inherently limiting, this study engages with rural contexts as complex social spaces where gender norms, opportunity structures, and identity formation are actively negotiated. The lack of depth in research exploring how these dynamics vary by gender in rural communities is precisely what this study aims to address.

As this review demonstrates, gendered beliefs about engineering careers are shaped through complex interactions among individual identity, social norms, and educational context, and these interactions are particularly salient in rural communities. To interpret these dynamics clearly, it is important to clarify the terminology that guides this study before turning to the theoretical framework. In this paper, sex refers to biological attributes typically assigned at birth (e.g., male, female), while gender is understood as a socially constructed and contextually situated identity that encompasses gender

roles (societal expectations for behavior), gender expression (how individuals present themselves), and gender identity (how individuals self-identify, including non-binary identities) (American Psychological Association, 2015). These distinctions are important in educational research, as students' responses to career expectations are informed not only by personal interests but by how gender is constructed, reinforced, and negotiated within families, schools, and communities. Attending to gender as socially embedded rather than biologically determined supports an asset-based interpretation of rural cultural norms, recognizing them as meaning-making frameworks that shape, rather than constrain, students' perceptions of viable futures.

3. THEORETICAL FRAMEWORK

This study is grounded in social roles theory, which posits that individuals internalize expectations associated with the social roles they observe and occupy, including those defined by gender (Eagly & Wood, 2012). According to this perspective, societal structures—such as education, work, and family—reinforce beliefs about what behaviors and occupations are appropriate for people based on perceived gender. Adolescents absorb these messages from an early age, often through family dynamics, peer interactions, media, and institutional practices, shaping their understanding of what careers are accessible or desirable to them (Cheryan et al., 2017; Eccles, 1994). This ideology will be utilized to better understand the impact a rural context may have on the engineering students in this study.

In engineering, these social roles intersect with the field's masculine-coded disciplinary culture. Engineering is often perceived as a domain emphasizing technical prowess, autonomy, and rationality—traits historically aligned with masculinity—while underemphasizing care, collaboration, or creativity, which are culturally associated with femininity (Murzi et al., 2016). These cultural associations may marginalize students who do not identify with stereotypical masculine norms, creating barriers to entry even when interest or aptitude is present.

Additionally, this theory suggests that the division of labor that men and women are often socialized to abide by in the United States is based on two main physiological differences: women's reproductive capacity and men's average size (Eagly & Wood, 2012). It further suggests that people are impacted by this socialized idea of what they may or may not be physically suited for (Eagly & Wood, 2012). For instance, because of women's childbearing capability, women's roles in motherhood and as caretakers are socialized. Or, because of a man's "greater" size and strength, men are more likely to be socialized to believe they should have jobs in manual labor.

This dynamic is particularly salient in rural communities, where traditional views about gender roles and career pathways may be more visible or reinforced due to tight-knit social structures and limited exposure to non-traditional career models (Ali & McWhirter, 2006; Byun et al., 2017; Cain et al., 2024). For example, rural students may face social expectations to remain close to family, pursue familiar occupations, or conform to binary gender norms. These pressures can restrict their perceptions of what is possible, especially for students whose career aspirations diverge from local norms. Outside of these physiological differences, differences in social structures may also impact young women's career decisions. Still in the 2020s, a disproportionate number of men are seen in STEM fields (Khan et al., 2020; Merchant, 2025), and the impact of this on women's perceptions of what role they should fill may clearly be impacting their decisions related to whether or not they pursue engineering careers.

While engineering does not specifically fall into either of the two socialized physiological categories, the implication of these role socializations may still be impacting whether or not women choose to pursue a career in engineering. For example, women may not feel they will be able to have the work-life balance they desire through their childbearing years if they pursue the engineering field. Or, because the stereotypical image of an engineer is a person, usually a man, on a job site with a hard hat and safety vest, women may inherently believe there is some physical requirement to the field that they may not be able to fulfill successfully. At the very core of the issue, social roles theory suggests that these socialized perceptions may impact what areas women even think it is okay to express an interest in (Eagly & Wood, 2012).

Social roles theory is employed in the framing of this study, though it is not without limitations. While it does acknowledge that social norms people are shaped by cultural and societal influences (Eagly & Wood, 2012), its framework may not fully reflect the evolving nature of gender roles in contemporary U.S. society. The theory acknowledges that women's roles are shifting into "new educational and employment arenas" (Eagly & Wood, 2012) and that this may impact the socialization that occurs; however, more recent data suggest that gendered socialization is becoming less rigid, particularly as women now surpass men in educational attainment in both urban and rural areas (United States Department of Agriculture Economic Research Service [USDA ERS], 2022; Parker & Funk, 2017). For instance, by 2020, 71% of rural young women had attended college after high school, compared with just 61% of rural young men (USDA ERS, 2022). That said, trends in rural communities – like the one considered in this study – often lag behind national cultural shifts, and traditional norms may still exert a strong influence in shaping youth perceptions of gender and career. Thus, despite its limitations, the ideological framing of Social Roles Theory remains a valuable lens for understanding the findings of the present study.

Despite the seemingly clear link between social roles theory and the gender disparity in the engineering field, little published work was found that considers the gender gap in engineering through the lens of social roles theory. This gives further value to the present study, in that it may produce novel ideas related to this connection. The use of social roles theory *has* been used to consider career selection broadly, however. While engineering was not specifically discussed, research grounded in social roles theory confirmed that men not only pursued careers they had been socialized to believe they should have, but – not surprisingly – they also had more inherent interest in male-dominated fields and vice versa (Evans & Diekman, 2009). This suggests that simply trying to increase women's exposure and interest in engineering fields, as many current outreach programs do, may be somewhat futile if the socialization element of this matter is not also addressed.

The review of literature and theory presented has shown the need for continued research aimed at considering what impact a rural context may have on secondary students gender-career bias, and the application of this framework supports a deeper understanding of how gender-career bias emerges at the secondary level, particularly for students in rural engineering programs. It also offers interpretive tools for examining how students' beliefs about who "should" do engineering are shaped by social structures, internalized expectations, and cultural messaging across gendered and geographic contexts. Therefore, this study will address the following research question: What trends, if any, exist in rural secondary school engineering students' perceptions of gender roles and careers, and how are these perceptions formed within their educational and community contexts?

4. METHODS

This study is framed as an instrumental case study (Stake, 1995) within a constructivist paradigm (Guba & Lincoln, 1994; Creswell & Poth, 2018). An instrumental case study focuses on a single bounded instance – in this case, one rural high school – to illuminate broader processes of gendered career choice among rural adolescents, rather than to generalize about the school itself. The constructivist stance assumes meaning is co-constructed between researcher and participants; consequently, the methods emphasize participants' own perspectives and the contexts that shape them. This multiple methods study utilized both quantitative and qualitative data analysis, allowing for a rich, complementary interpretation of the findings, with the qualitative inquiry serving as the primary analytic approach and the quantitative analysis playing a supportive, exploratory role. Following the subsequent researcher's positionality statement, details of the study's context, data collection, and analysis procedures will be explained.

4.1 POSITIONALITY

The researcher for this study holds a bachelor's and master's degree in mechanical engineering and worked as an engine design engineer for nine years before transitioning into engineering education. She worked as a high school engineering teacher in the district where the data was

DOI: 10.21061/see.179

collected before transitioning to teaching at the collegiate level as an assistant professor. After completing a master's degree in workforce development education, she completed a Ph.D. in education exploring areas that can be optimized in a secondary school engineering classroom to improve women's recruitment and retention in engineering. Throughout her training and tenure as an engineer, the researcher witnessed the cycle of recruitment and attrition for women in the engineering field. Now with nine years of experience as an engineering educator, she has witnessed notable differences in how men and women view their abilities in engineering classes and is working to understand these phenomena through structured research. The combined experiences of the researcher as a former engineering student, a woman in engineering, and an engineering educator create a unique insider view through which to explore this topic and detect nuances related to this field that may go unnoticed by others.

Specifically, the researcher has noticed a shyness (that is often perceived as a lack of confidence) in many of the women in her engineering classes that results not only in less vocal participation in the class, but in an apparent hesitation to pursue the engineering field in general. The researcher, however, did not experience this shyness in her own life, despite being raised in a rural community that parallels the context of this study. In fact, her experience was quite the opposite. She felt confident and proud to excel and succeed in areas that were predominantly male-dominated, not only in secondary school but throughout her academic and professional career in engineering. This study was developed to address the disconnect between her teaching observations and personal experiences through structured research.

4.2 CONTEXT

As noted previously, this study was conducted in a rural-fringe (per the NCES definition) community in Madison County (population: 4,425 (U.S. Census Bureau, 2022)), located approximately 25 miles from Columbus, Ohio (Franklin County). According to the county's reported data, 88% of the county is devoted to farmland (Madison County, Ohio, 2022). Noteworthy demographics of this rural county from the 2021 U.S. Census reports relative to this study are shown in Table 1, including comparison data from both the nearby urban/suburban county that houses Columbus and many of its suburbs for reference.

Table 1 Contextual Demographics (U.S. Census Bureau, 2022).

	CATEGORY	RURAL REGION (NEAR COLUMBUS, OH)	URBAN/SUBURBAN REGION (SURROUNDING COLUMBUS, OH)
Population	Population per square mile	**94**	2,486
Diversity	Percent White/Caucasian	**90**	66
	Percent non-White	**10**	34
	Percent foreign-born persons	**1**	11
Education	High school graduate (age 25+)	**87%**	91%
	Bachelor's degree or higher (age 25+)	**18%**	40%

Per the information in Table 1, the rural county in which the studied district resides is distinctly different from nearby urban areas in two main ways: racial/ethnic diversity and education. This county is significantly less racially diverse and has far less of an immigrant presence than the nearby urban communities. Regarding education, even though the county in question has only a slightly smaller percentage of people with a high school diploma than the nearby urban county, the percentage of the population with a college degree is less than half of the urban result.

The specific district in which this study was performed averages approximately 190 students per grade with an average student/teacher ratio of 23. The majority of the students in this district are White, though there is a growing Hispanic population (8%) and a small percentage (<3%) of students of other ethnicities who attend as well. This district was selected because it has an engineering pathway built into its programming that allows students to participate in engineering

DOI: 10.21061/see.179

electives throughout secondary school, despite being a standard public school (as opposed to being a school specifically geared toward STEM studies). Students can participate in engineering electives starting in the 7th grade, with a variety of different courses offered through graduation. This district's engineering pathway was built in partnership with the local career and technical center as a way to promote and develop the engineering know-how and expertise needed to enter the engineering workforce. In addition to the noteworthy engineering pathway, this engineering course also boasts higher-than-average female participation rates, with enrollment in high school ranging from 35–40% each year compared to the national average of 18% (Khan et al., 2020). It should be noted that the researcher was the engineering teacher for grades 9–12 in this district.

4.3 DATA COLLECTION

Upon securing permission from the school district to conduct research, data collection for the research question began. To gather the largest sample size possible for this case study (in order to draw more meaningful numerical trends), all students who participated in an engineering elective during the 2022–2023 school year, and thus, all students enrolled in an engineering elective in grades 9–12 (n = 132) were recruited to participate in this portion of the study. A recruitment letter and consent form were sent home with all enrolled students and parents to explain the study. Students were informed that their participation was optional and would have no impact on their grades or standing in the engineering class in which they were enrolled. Once consent was received, participants were sent an email with a link to an SRQ-based questionnaire used to generate the data for this study (consistent with the ethical approval for this study in process currently). After the questionnaire link was sent to student participants, a two-week window was given to students in which to complete the questionnaire, and students were informed that they could skip any questions that made them uncomfortable. Upon submission of the questionnaire, the participatory obligation for this portion of the study was complete. Of the 132 students enrolled, 110 gave their consent and returned the necessary form for participation (83%), and all the students who returned their consent form participated in the survey. Completed questionnaires were downloaded and de-identified. This resulting data set was reviewed to ensure that each questionnaire was filled out with serious intention, and questionnaires with less than 50% of the questions answered or with inconsistent answers (such as students misrepresenting their grade level or the class they were enrolled in) were removed from the sample. Upon completion of this review and removal process, the resulting data set had 104 responses.

The questionnaire began with a series of introductory questions to help build a foundational understanding of each participant, including gender and experience in engineering. It then posed statements related to social roles theory, adapted from the SRQ Baber and Tucker developed in 2006 to measure individuals' attitudes toward gender, as seen below:

1. For many important jobs, it is better to choose men instead of women. (1–5 "agree" scale)
   Please explain your answer to the previous question. (open-ended response)
2. Some types of work are just not appropriate for women. (1–5 "agree" scale)
   Please explain your answer to the previous question. (open-ended response)
3. Tasks around the house should be assigned by sex/gender. (1–5 "agree" scale)
   Please explain your answer to the previous question. (open-ended response)
4. Mothers should only work when necessary. (1–5 "agree" scale)
   Please explain your answer to the previous question. (open-ended response)

Please note that the wording of these statements does not reflect researcher bias and holds to the wording of the previously developed and validated questionnaire. The strong reaction many people have to this wording and the ideology of some of these statements elicited thorough responses to the open-ended questions related to why students agreed or disagreed with these statements.

In addition to these social roles statements, the questionnaire posed statements related to general self-efficacy, engineering self-efficacy, expectancy-value and subjective task value, and

DOI: 10.21061/see.179

effort. This paper is specifically focused on the results related to the social roles statements, however, and the results from the other categories are not included in this paper. For each question category, four Likert-scale statements were posed and open-ended follow-up questions that allowed participants to expand upon their answers in a deeper, more personal way were included for qualitative analysis.

4.3.1 Participants

The gender-identity breakdown of the students who were recruited for the large sample questionnaire is shown in Table 2.

Table 2 Participant Breakdown.

	MEN	WOMEN	NON-BINARY	TOTAL
9th grade	16	11	1	28
10th grade	18	22	0	40
11th grade	7	7	1	15
12th grade	11	7	0	18
Participant total	52	57	2	104
Engineering student total	74	57	2	132

Of the 132 total students enrolled in engineering electives, 56% identified as women, 43% identified as men, and 1% of students identified as non-binary. Non-binary students' data were retained for descriptive reporting and analyzed separately, but excluded from gender-comparison analysis due to how small the sample size was.

4.4 DATA ANALYSIS

The multiple methods data analysis strategy used for the questionnaire was based loosely on the study of self-efficacy in science by Webb-Williams (2018), which began with a quantitative analysis that compared cisgendered Likert-scale results by finding and differencing the mean results for each numerically-based question. The purpose of the quantitative analysis in the present study was not to make broad statistical inferences, but to identify areas in which statistically significant differences between men and women students exist to focus the in-depth qualitative analysis. Statements that exposed a delta (between the average results of each gender) of more than half a point on the Likert scale were then examined more closely using independent-samples t-tests comparing SRQ statement mean scores across gender identities (cis male vs. cis female). This step was used as a heuristic to prioritize items for qualitative exploration, rather than as a comprehensive test of group differences. P-values were calculated to determine which statements/topics have statistically significant differences between the gendered responses, as defined by having a p-value < 0.01. The choice to adopt $p < 0.01$ as the cutoff for statistical significance was driven by two considerations. First, because multiple independent-samples t-tests (one for each SRQ item showing a mean-difference of ≥0.5 on the 5-point scale) which can inflates the family-wise Type I error rate, a lowered p value (as compared to the conventional $p < 0.05$) helps to reduce the chance of falsely flagging differences as 'significant' simply by chance (Bland & Altman, 1995; Perneger, 1998). Second, many STEM-education and psychology researchers recommend a more conservative threshold when testing broadly for numerous related hypotheses to strengthen the credibility of findings and to improve replicability (Benjamin et al., 2018). We therefore use this threshold to highlight only the most robust gender differences for subsequent qualitative exploration. Topics that were identified as showing statistically significant differences between men's and women's responses were then analyzed qualitatively to gain insight into the quantitative differences that were found.

The qualitative analysis process began by analyzing the 104 open-ended student responses with in-vivo, inductive coding per Saldaña's (2015) two-cycle coding framework and Creswell and Poth's (2018) inductive approach. Areas of commonality (such as students' language about gender

DOI: 10.21061/see.179

norms, local influences, and career choice) between the open-ended responses in each subset of statements within the questionnaire (Creswell & Poth, 2018; Saldaña, 2015) were captures using in-vivo coding, which captures and highlights the actual words from the participants (Creswell & Poth, 2018). This strategy was selected in order to capture the students' voices and perspectives for the data analysis. Then, those first-cycle codes were grouped into higher-order categories aligned with social roles theory constructs (such as self-efficacy, internalized role norms, cultural stereotypes) as well as emergent rural-gender themes.

5. FINDINGS

Students' responses to the Social Roles Questionnaire (SRQ) revealed distinct patterns related to gender-career bias. Of the 13 SRQ items posed in the complete survey, all four items related to social roles showed statistically significant gender-based differences. Women consistently disagreed more strongly with statements that reflected traditional gender roles. Table 3 presents these item-level differences.

Table 3 Social Roles Statement Quantitative Data (by Gender).

STATEMENT	WOMEN AVERAGE	STD. DEV (W)	MEN AVERAGE	STD. DEV (M)	DELTA	P-VALUE
1. For many important jobs, it is better to choose men instead of women.	1.43	1.21	2.52	1.15	−1.09	0.0000
2. Some types of work are just not appropriate for women.	1.46	1.32	2.49	1.39	−1.03	0.0000
3. Tasks around the house should be assigned by sex/gender.	1.18	1.15	1.78	1.11	−0.60	0.0008
4. Mothers should work only if necessary.	1.68	1.11	2.65	1.16	−0.97	0.0000

To explore the reasoning behind these responses, students were asked to reflect on their response to the SRQ statements with open ended responses. These reflections were analyzed inductively and organized by themes aligned with specific SRQ statements. The following themes emerged from the combined mixed methods data collection. Quotes are presented inline to highlight how students articulate, negotiate, and challenge prevailing gender norms in relation to career and domestic roles.

SRQ #1: "FOR MANY IMPORTANT JOBS, IT IS BETTER TO CHOOSE MEN INSTEAD OF WOMEN."

Theme: Strength and Suitability in Perceptions of "Important" Jobs

In response to this statement, students frequently anchored their reasoning in ideas about physical strength. While most women firmly disagreed with the statement, men's responses were more evenly distributed across the scale. Open-ended responses from both groups revealed how physical ability was frequently linked to career suitability, especially for jobs viewed as "important."

Several students equated job difficulty with physical labor. One male student wrote, "It depends on the job. In, like, construction men are more useful," suggesting a view of career fit that ties strength directly to value. Yet other students complicated this framing. For example, a female student reflected, "In some situations men do have a different body type so if it's an incredibly physically demanding job, maybe... But you should DEFINITELY not choose a job based off of what gender someone is." Her response highlights an awareness of biological differences without endorsing restrictive norms, affirming that career paths should remain open regardless of gender.

Some male students suggested women may be less suited for specific physically intensive fields, naming jobs like construction, maintenance, and/or landscaping. At the same time, the responses also revealed a tension, with many students acknowledging that ability should matter more than assumptions. Even those referencing strength often couched their comments with qualifiers like "depends" or "maybe," reflecting internal negotiations rather than fixed beliefs.

DOI: 10.21061/see.179

Taken together, these reflections suggest that while traditional narratives about strength and work remain salient, many students – particularly young women – are actively challenging the idea that strength should define access to or success in a given career. Their voices point toward shifting norms and a desire for more inclusive understandings of qualification and professional value.

SRQ #2: "SOME TYPES OF WORK ARE JUST NOT APPROPRIATE FOR WOMEN."

Theme: Diverging Views on Appropriateness — Gendered Interpretations of Work

Responses to this statement revealed a clear difference in how male and female students framed and justified their beliefs. While the quantitative data showed that most women disagreed strongly with the statement, male students' responses were more varied, ranging from strong support for equal opportunity to endorsement of traditional or biologically grounded role distinctions.

Female students' open-ended responses largely rejected the idea that any type of work should be off-limits based on gender. Many voiced frustration that this belief still exists, such as one who exclaimed, "NO! Oh my gosh this topic shocks me... Women are just as (if not more) capable compared to men!" Others expressed determination to challenge gendered norms: "I think that a woman can do anything that a man can do in our society although I think people are taught otherwise. But it is important to break those social norms." While a few students referenced religious or scientific frameworks to explain differences – such as "The Bible specifically states that... both [genders] can do things that the other cannot and should not" – even those reflections were delivered with a sense of affirmation, not limitation.

In contrast, male students' responses covered a broader spectrum and included more statements that linked physical ability or tradition to job suitability. Some showed support for inclusion, with one stating, "I believe in equality; no one shouldn't be able to work just because of their gender," and another writing, "A woman can do anything if they put their minds to—but a lot of companies would rather have men work for them... I don't understand why, but it's the world we live in." Others expressed more limiting perspectives, such as: "Some career paths should not be open for women. For example, I don't believe women should be allowed to be in combat... they're built to help on the home front," or "Women could mess stuff up because they could not understand stuff fully."

There were also male responses that reflected ambivalence – acknowledging bias while still reinforcing it subtly. For instance, one student wrote, "If [a woman] wants to work in a dirtier industry, be my guest," while another remarked, "I don't think that some jobs are inappropriate for women, but I think that some will just not happen." These comments often pointed toward structural or cultural barriers rather than personal belief, but in doing so, still reinforced gendered norms as natural or expected.

Taken together, the responses suggest that while female students overwhelmingly challenged the idea that work should be gendered, male students were more likely to either reinforce or wrestle with traditional expectations. Importantly, however, even among male students expressing limiting beliefs, there were signs of internal questioning and openness to change. These findings highlight the need for continued dialogue—especially among male students—about how social norms, media, and local culture shape perceptions of who belongs in which careers.

SRQ #3: "TASKS AROUND THE HOUSE SHOULD BE ASSIGNED BY GENDER/SEX"

Theme: Shared Responsibility — Broad Support for Equity in the Home

Among all the items on the Social Roles Questionnaire, this statement yielded the most consistent responses between male and female students. Both groups overwhelmingly disagreed with the statement, and open-ended responses reflected a shared belief that domestic responsibilities should be distributed fairly, regardless of gender.

Students commonly emphasized flexibility and mutual contribution based on household context. As one male student wrote, "I think that whatever works for your family is what you should do," while another added, "Why should your gender matter when everyone is capable of doing

it?" These statements highlight how many students value adaptability and collaboration over traditional role assignments.

Some students acknowledged the persistence of cultural expectations but did so without endorsing them. One male student noted, "It depends on what it is. You usually don't see men sweeping the floors, just like you don't usually see women weeding the yard," reflecting an observational rather than prescriptive perspective. This type of commentary signals students' awareness of social patterns, even as many appear ready to move beyond them.

Female students largely echoed the belief in shared responsibility. One wrote, "I think that both genders in a house are capable of doing any chore/task," and another elaborated, "Gender should not make you liable for taking care of a house... the responsibility lies on both of them." Several students also emphasized the importance of practical life skills for all. As one student expressed, "Men need to learn to cook and clean. Women need to learn how to work on cars and change tires." These statements demonstrate not only a commitment to equity but a recognition of the value in preparing all individuals for independent and cooperative living.

Compared to earlier themes – particularly around career choice – there was notably less evidence of gender-based restriction or role segregation in the context of household work. While physical strength was a frequent justification in career-related responses, it was absent from most discussions about chores. This suggests that for many students, domestic tasks are already conceptualized as shared responsibilities, shaped more by practical arrangements than by traditional gender roles.

Together, these reflections point to a hopeful shift: students in this context appear increasingly open to—and even expect—equitable participation in household labor. This shared stance across gender may provide a foundation for more expansive conversations about equity in other domains, including education and career pathways.

SRQ #4: "MOTHERS SHOULD WORK ONLY IF NECESSARY."

Theme: Valuing Choice — Contextual Views on Mothers' Employment

Responses to this statement showed more variation than other social role items and revealed nuanced perspectives shaped by personal values, family context, and evolving social norms. While most female students disagreed with the statement, approximately 20% selected a neutral position—suggesting more complexity in how this issue is perceived. Among male students, the trend was nearly reversed: most selected neutral responses, while about 20% strongly disagreed.

Female students' written reflections consistently emphasized that the decision to work should rest with the individual. One explained, "Mothers should work if they want to or if they have to provide for their family just as a father should," reinforcing the idea of equal expectations and agency. Another acknowledged the emotional dimension of parenting but upheld personal choice: "While I do think it's important for a mother to be close to her children, if a mother wants to go to work, she should do it. It honestly depends on the situation." These responses reflect both a respect for caregiving and a recognition that work and parenting are not mutually exclusive roles.

Male students also expressed support for maternal choice, though often framed in terms of family need or financial contribution. One noted, "They should be able to have a job. Even if it's part-time to help pay for the kids and house," while another wrote, "The mom doesn't have to work, but if she wants to work then she can... if her family needs her to work then she should work." These perspectives suggest a general endorsement of flexibility, though sometimes couched within traditional family provider dynamics.

Notably, few students, regardless of gender, expressed strong opposition to mothers working. Instead, responses from both groups emphasized that circumstances vary by household and that decisions about work should consider both personal preference and family context. The concept of caregiving was present in many responses but rarely used as a rationale for limiting employment; instead, it was acknowledged as one factor among many.

Taken together, these findings indicate that most students support a model of shared family responsibility in which mothers can—and should—decide whether and how to work. The differences between male and female responses, while subtle, suggest that women may be more attuned to the autonomy aspect of the decision, while men more often frame it in relation to family economics. Still, the broad agreement on the importance of choice points to shifting expectations in how gender and caregiving are conceptualized; one where flexibility and mutual support are valued across the board.

6. DISCUSSION

This study suggests that women's consideration of engineering careers may be shaped by broader social biases related to gender roles, which can be particularly salient in rural communities. That said, research related to this topic found that women are more likely than men to hold "gender transcendent beliefs" (Baber & Tucker, 2006, p. 1) and this study parallels that finding: students identifying as women generally expressed fewer limitations about what types of careers are appropriate for different genders. While this is encouraging, the fact that these students share educational spaces with peers who hold more traditional views may still influence how comfortable they feel expressing interest in male-dominated fields like engineering.

A dominant theme from this study is that both men and women believed that career selection should be based on both individual interests and qualifications. However, there was some discrepancy about what careers different individuals were qualified for. Eagly and Wood (2012) have argued that socialized ideas about what people may or may not be *physically* suited for can also come into play for career selection, and this dynamic appeared in many students' comments – especially among male participants – regarding physically demanding jobs being more appropriate for men. Although engineering itself is not inherently physically demanding, students often referenced careers like construction or maintenance in relation to this topic. This is a particularly important finding to note for students in secondary school who are considering and contemplating different careers. Despite the reality that many engineers work in an office setting, the first 10+ results of a Google image search for the word "engineer" (Figure 1) returns images of people in hard hats at job sites – an aesthetic also associated with physical labor in fields like maintenance (Figure 2) and construction (Figure 3), which were specifically mentioned by students as "better fits" for men. These associations may shape students' ideas about engineering in ways that are not aligned with the day-to-day work of many engineers.

Please note that Figures 1–3 consist of a screenshot of search results from Google Images captured in 2023. These figures were reproduced for the purpose of analysis and critique of representational patterns in search outputs. The results are considered transformative in terms of the scholarly output of this study and therefore fall under Fair Use. The resolution and scope of the reproduced material are limited, and the inclusion of the figures does not substitute for or diminish the market value of the original images. All underlying images are the property of their respective copyright holders.

Figure 1 Google Image Search Results for Engineer (accessed: February 8, 2023).

DOI: 10.21061/see.179

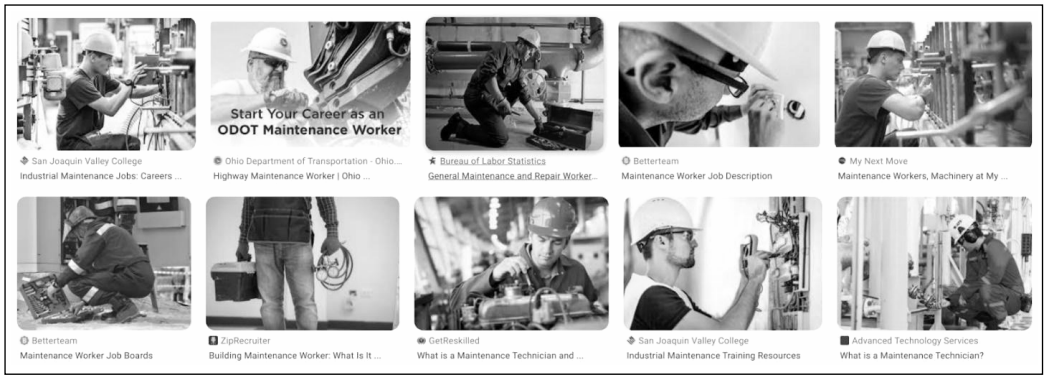

Figure 2 Google Image Search Results for Maintenance Worker (accessed: February 8, 2023).

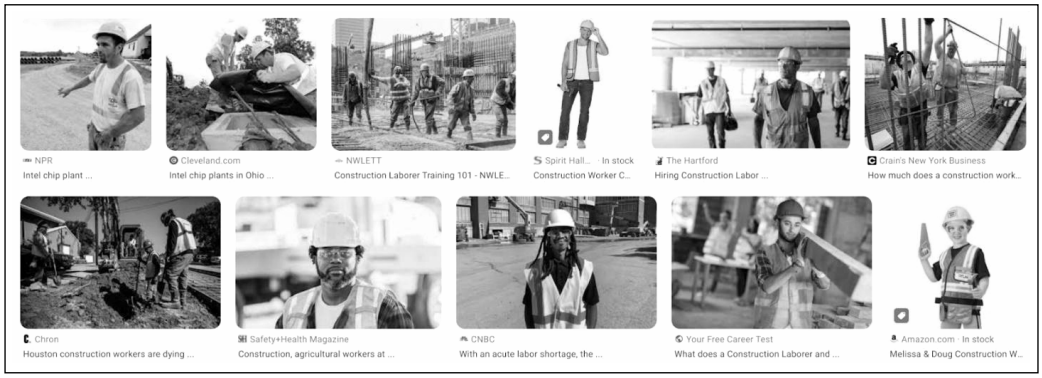

Figure 3 Google Image Search Results for Construction Worker (accessed: February 8, 2023).

While broader cultural shifts toward gender equity continue, this study reinforces the fact that early perceptions of engineering – particularly those tied to physical work and masculinity – remain a potential barrier to inclusion. Efforts to present engineering in more diverse and accurate ways may help expand students' sense of possibility.

Interestingly, the students' perspectives related to people of different genders being better suited for different roles did not appear as strongly in responses related to household labor. Although traditional domestic roles are often deeply socialized (Dyk & Wilson, 1999), both male and female students largely rejected the idea that household tasks should be divided by gender. This contrast suggests that beliefs about gender roles may be more entrenched in the realm of career than in day-to-day home life. In other words, even when students envision equity in shared domestic responsibilities, their career-related views may still reflect older stereotypes about professional suitability.

In summary, prior research has shown that career decisions are shaped by the social roles individuals are taught to see as appropriate (Evans & Diekman, 2009). The present study illuminates how those roles are still actively interpreted and negotiated by rural secondary students. While some male students expressed views that aligned with traditional gender norms—such as suggesting women are less suited for "important" or physically demanding jobs—others questioned those assumptions. Female students, meanwhile, more often challenged stereotypes directly and emphasized individual choice and capability. These findings suggest that gender-career bias is present in this setting, with different patterns across gender groups, and that students are drawing on both inherited norms and personal reasoning in articulating their views. Continued efforts to understand and shift these perceptions are needed to support more inclusive pathways into engineering, particularly in rural contexts where cultural expectations may influence student aspirations.

6.1 STUDY LIMITATIONS AND ETHICAL CONSIDERATIONS

The first limitation of this study is that, consistent with the definition of case study research, the findings of this study are specific to the context in which it was conducted and therefore is not

immediately transferable and/or generalizable to a wider context. However, the alignment of this study's findings with existing research and the new findings it presents can be used to guide future research that tackles these new ideas through studies developed to prove the generalizability of these findings.

The second limitation is that, while there are several benefits of having the researcher also fill the role of the teacher for the students in the study, it is incredibly difficult to ensure the study was performed without bias. Several elements of the study's design were purposefully included to help mitigate this potential bias, but the potential for bias to still be a factor in these results should be acknowledged.

In addition, there are some limitations related to the survey instrument. For example, the item, "Mothers should only work when necessary," did not have a corresponding question about fathers. This omission may have influenced how students interpreted or responded to the question. Given the participants' age, they may not have been positioned to extend their reflections to broader parental roles without direct prompting.

Participant selection also presents a limitation. All students were enrolled in engineering electives, which may bias the sample toward students with more positive or open attitudes toward STEM-related careers. It is unclear whether students not enrolled in these courses would have responded in similar ways. Including perspectives from students outside of engineering pathways in future studies could provide a broader picture of gender-career perceptions in rural contexts.

Finally, it should be noted that although gender-career biases were uncovered through this study, the results were not shared between students. Therefore, no specific actions were needed to protect students in this study with vulnerable perceptions or social identities between students.

6.2 SUGGESTIONS FOR FUTURE RESEARCH

This study highlights multiple areas that would benefit from continued research. First, the introductory study of literature related to gender-career bias in rural versus urban communities exposed a gap in the body of literature that exists in that field. While this study references prior national datasets suggesting rural students may hold more traditional gender views, it does not include urban student data for comparison. A more robust, comparative study would be of value for continued conversations about the impact of gender on career selection in diverse geographic settings.

Also related to social role biases, research specifically aimed at how the overall perceptions of engineering (at the most basic level) can be adjusted to be more authentic to the actual practice is critical for improving recruitment and retention. As this study showed, even the most basic investigation of what an engineer is does not offer an accurate representation of the field and/or the many (different) job roles it entails. It instead gives students a caricature of an outdated idea of what engineering is. Diving into how to make real social change in this area is a huge but necessary hurdle for future research to address.

Finally, this study sheds light on the presence of gender-career bias in the rural context of this study, but continued work to validate this finding in a more generalizable way is needed to propel this finding into an actionable plan of attack that considers how to address this issue.

7. CONCLUSIONS AND IMPLICATIONS

As this study shows, there are still strong gender-career biases among youth in rural America. While these biases are generally stronger for men, even women's perceptions of what their future careers should be are likely impacted by these biases. There are two main ways this can be addressed by engineering educators. First, it is important to make sure all students are treated equitably. It should go without saying that educators must take care not to assign roles to students that confirm outdated, stereotypical gender roles (such as only having men engage in physical labor

activities or having women perform clerical/secretarial tasks). In addition, it is critical to make sure all voices are heard in the classroom. Oftentimes men are more willing than women to speak up in an engineering classroom based on their stronger self-efficacy perspectives, but equally as often, women are willing and able to showcase their knowledge when given an appropriate nudge. Similarly, making sure to give positive feedback to students – especially women – to explicitly discuss their successes and competency is important and does not go unnoticed by students.

A second way to help improve gender/social roles ideology for students is to tie real-world examples of engineering practices into the curriculum. When students realize their day as engineers might not solely be filled with hard hats and large scrolls of technical drawings on a construction site but instead might be filled with 3D modeling, quality testing, customer/client meetings, business trips, and other practices they can better see themselves participating happily in, their image about whether or not they feel they could appropriately fill that role may change. It is important for students to understand different types of engineering and what the reality of that practice might look like, whether this is through thoughtfully curated discussions, guest speakers, or even related media.

To conclude, engineering educators have a responsibility to students to prepare them for a field that is constantly evolving, both in the technical content it covers and the shift from heavily technically-based skills to more career-preparedness skills (such as problem-solving and critical thinking). These constant changes can feel overwhelming on their own for engineering educators without being asked to consider new areas – like gender-career bias – that this study suggests are important to understand in order to help bring students into the engineering field. However, it is important to acknowledge that the responsibility does not solely fall on educators, and that changes need to be made at a societal level to overcome inequitable gender stereotypes that perpetuate the issues uncovered through this study. This study intends not to add another layer of difficulty to the role of an engineering educator, but instead to help make engineering educators aware of the pervasiveness of this gender-career bias and cognizant of the ways in which small classroom changes may be able to positively impact the students they serve. In acknowledging this bias and continuing to propel research forward, the gender gap in engineering can be addressed with greater nuance, care, and impact.

DATA ACCESSIBILITY STATEMENT

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

ETHICS AND CONSENT

The questionnaire and methodology for this study were approved by the Human Research Ethics Institutional Review Board of the University at Buffalo (Ethics approval number: 00006783).

The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

I provide consent for the publication of the manuscript detailed above, including any accompanying images or data contained within the manuscript.

ACKNOWLEDGEMENTS

This manuscript is based in part on material from the doctoral dissertation, *How Hard Someone Is Willing to Work Is Not Defined by Their Gender: A Case Study Exploration of the Relationship Between Effort, Gender, Self-Efficacy, and Career Selection in a Rural Secondary School Engineering Program*, submitted to the University at Buffalo in 2023, which is publicly available via ProQuest. The dissertation provided foundational research and early drafts that informed this work, and was enhanced by the feedback of Dr. Tiffany Karalis Noel, Dr. Andrew Olewnik, and Dr. Noemi Waight, whose mentorship and insight helped shape the path of this study.

COMPETING INTERESTS

One of the authors' doctoral committee members, Dr. Andrew Olewnik, became a member of the editorial team of this journal after the initial submission of this manuscript. He had no involvement in the peer review, editorial evaluation, or publication decision for this article.

AUTHOR CONTRIBUTIONS

Author 1 led the conceptualization of the study, data collection and analysis, and writing of the manuscript.

AUTHOR AFFILIATIONS

Laine Schrewe orcid.org/0000-0003-2316-6065
Otterbein University, Ohio, US

REFERENCES

Ali, S. R., & **McWhirter, E. H.** (2006). Rural Appalachian youth's vocational/educational postsecondary aspirations: Applying social cognitive career theory. *Journal of Career Development, 33*(2), 87–111. https://doi.org/10.1177/0894845306293347

Ali, S. R., & **Saunders, J. L.** (2006). College expectations of rural Appalachian youth: An exploration of social cognitive career theoryfFactors. *The Career Development Quarterly, 55*(1), 38–51. https://doi.org/10.1002/j.2161-0045.2006.tb00003.x

Ali, S. R., & **Saunders, J. L.** (2009). The career aspirations of rural Appalachian high school students. *Journal of Career Assessment, 17*(2), 172–188. https://doi.org/10.1177/1069072708328897

American Psychological Association. (2015). Guidelines for psychological practice with transgender and gender nonconforming people. *American Psychologist, 70*(9), 832–864. https://doi.org/10.1037/a0039906

Appalachian Regional Commission. (n.d.). *The Appalachian region*. Retrieved June 27, 2025, from https://www.arc.gov/appalachian_region/

Baber, K. M., & **Tucker, C. J.** (2006). The social roles questionnaire: A new approach to measuring attitudes toward gender. *Sex Roles, 54*(7), 459–467. https://doi.org/10.1007/s11199-006-9018-y

Beasley, M. A., & **Fischer, M. J.** (2012). Why they leave: the impact of stereotype threat on the attrition of women and minorities from science, math and engineering majors. *Social Psychology of Education, 15*(4), 427–448. https://doi.org/10.1007/s11218-012-9185-3

Benedict, B., Verdín, D., Godwin, A., & **Milton, T.** (2017, October). Social and latent identities that contribute to diverse students' belongingness in engineering. In *2017 IEEE Frontiers in Education Conference (FIE)* (pp. 1–5). IEEE. https://doi.org/10.1109/FIE.2017.8190644

Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E.-J., Berk, R., Bollen, K. A., Brembs, B., Brown, L., Camerer, C., Cesarini, D., Chambers, C. D., Clyde, M., Cook, T. D., De Boeck, P., Dienes, Z., Dreber, A., Easwaran, K., Efferson, C., … Johnson, V. E. (2018). Redefine statistical significance. *Nature Human Behaviour, 2*(1), 6–10. https://doi.org/10.1038/s41562-017-0189-z

Benson, L., Potvin, G., Kirn, A., Godwin, A., Doyle, J., Rohde, J., Verdin, D., & **Boone, H.** (2017, June). Characterizing student identities in engineering: Attitudinal profiles of engineering majors. In *2017 ASEE Annual Conference & Exposition*. https://doi.org/10.18260/1-2--27950

Bix, A. S. (2004). From "engineeresses" to "girl engineers" to "good engineers": A history of women's US engineering education. *NWSA Journal*, 27–49. https://doi.org/10.2979/NWS.2004.16.1.27

Bland, J. M., & **Altman, D. G.** (1995). Comparing methods of measurement: why plotting difference against standard method is misleading. *The Lancet, 346*(8982), 1085–1087. https://doi.org/10.1016/s0140-6736(95)91748-9

Byun, S. Y., Meece, J. L., & **Agger, C. A.** (2017). Predictors of college attendance patterns of rural youth. *Research in Higher Education, 58*, 817–842. https://doi.org/10.1007/s11162-017-9449-z

Cain, E. J., Akcaoglu, M., Wright, K., Dobson, A., & **Elkins, T.** (2022). "I've Always Loved Science": a qualitative exploration of rural college students' STEM interest development and maintenance. *Journal for STEM Education Research, 5*(3), 439–457. https://doi.org/10.1007/s41979-022-00072-8

Cain, E. J., Valauri, A., Perry, J. R., & **DeLoach, A.** (2024). Exploring how rural schools and communities influence the academic journeys of college students in STEM majors. *The Rural Educator, 45*(3), 15–33. https://doi.org/10.55533/2643-9662.1417

Carrico, C., Matusovich, H. M., & **Paretti, M. C.** (2019). A qualitative analysis of career choice pathways of college-oriented rural central Appalachian high school students. *Journal of Career Development*, *46*(2), 94–111. https://doi.org/10.1177/0894845317725603

Chen, P., Hernandez, A., & **Dong, J.** (2015). Impact of collaborative project-based learning on self-efficacy of urban minority students in engineering. *Journal of Urban Learning, Teaching, and Research, 11*, 26–39. https://eric.ed.gov/?id=EJ1071407

Chenoweth, E., & **Galliher, R.** Factors influencing college aspirations of rural West Virginia high school students. *Journal of Research in Rural Education 19*(2), 1–14. https://jrre.psu.edu/sites/default/files/2020-06/19%282%29.pdf

Cheryan, S., Ziegler, S. A., Montoya, A. K., & **Jiang, L.** (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin, 143*(1), 1–35. https://doi.org/10.1037/bul0000052

Creswell, J. W., & **Poth, C. N.** (2018). *Qualitative inquiry & research design: Choosing among five approaches* (4th ed.). SAGE Publications.

Dyk, P. H., & **Wilson, S. M.** (1999). Family-based social capital considerations as predictors of attainments among Appalachian youth. *Sociological Inquiry, 69*(3), 477–503. https://doi.org/10.1111/j.1475-682X.1999.tb00882.x

Eagly, A. H., & **Wood, W.** (2012). Social role theory. *Handbook of Theories of Social Psychology*, (Vol. 2, pp. 458–476). https://doi.org/10.4135/9781446249222.n49

Eccles, J. S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly, 18*(4), 585–609. https://doi.org/10.1111/j.1471-6402.1994.tb01049.x

Evans, C. D., & **Diekman, A. B.** (2009). On motivated role selection: Gender beliefs, distant goals, and career interest. *Psychology of Women Quarterly*, *33*(2), 235–249. https://doi.org/10.1111/j.1471-6402.2009.01493.x

Frehill, L. (2013). *Comparing women's and men's attrition from engineering: Summary of findings from the society of women engineers' surveys*. Society of Women Engineers. https://doi.org/10.13140/RG.2.2.34502.27201

Grohs, J. R., Gillen, A. L., Matusovich, H. M., Kirk, G. R., Lesko, H. L., Brantley, J., & **Carrico, C.** (2020). Building community capacity for integrating engineering in rural middle school science classrooms. *Journal of STEM Outreach, 3*(1), 1–12. https://doi.org/10.15695/jstem/v3i1.01

Guba, E. G., & **Lincoln, Y. S.** (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105–117). SAGE Publications.

Heilman, M. E., Wallen, A. S., Fuchs, D., & **Tamkins, M. M.** (2004). Penalties for success: Reactions to women who succeed at male gender-typed tasks. *Journal of Applied Psychology*, *89*, 416–427. https://doi.org/10.1037/0021-9010.89.3.416

Herbert, J., & **Stipek, D.** (2005). The emergence of gender differences in children's perceptions of their academic competence. *Journal of Applied Developmental Psychology*, *26*(3), 276–295. https://doi.org/10.1016/j.appdev.2005.02.007

Iatarola, P., Conger, D., & **Long, M. C.** (2011). Determinants of high schools' advanced course offerings. *Educational Evaluation and Policy Analysis, 33*(3), 340–359. https://doi.org/10.3102/0162373711398124

Ilumoka, A., Milanovic, I., & **Grant, N.** (2017). An effective industry-based mentoring approach for the recruitment of women and minorities in engineering. *Journal of STEM Education: Innovations and Research, 18*(3). https://www.jstem.org/jstem/index.php/JSTEM/article/view/2102

Irvin, M., Byun, S. Y., Smiley, W. S., & **Hutchins, B. C.** (2017). Relation of opportunity to learn advanced math to the educational attainment of rural youth. *American Journal of Education, 123*(3), 475–510. https://doi.org/10.1086/691231

Khan, B., Robbins, C., & **Okrent, A.** (2020, January 15). *The State of U.S. Science and Engineering 2020*. National Science Board. Retrieved from: https://ncses.nsf.gov/pubs/nsb20201/u-s-s-e-workforce

Liu, Y. H., Lou, S. J., & **Shih, R. C.** (2014). The investigation of STEM self-efficacy and professional commitment to engineering among female high school students. *South African Journal of Education, 34*(2). https://doi.org/10.15700/201412071216

Lorber, J. (2001). *Gender inequality: Feminist theories and politics*. Roxbury Publishing Company.

Madison County, Ohio (2022). *Welcome to Madison County, OH*. Madison County, Ohio. https://www.co.madison.oh.us/

Marra, R. M., Rodgers, K. A., Shen, D., & **Bogue, B.** (2009, January). Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *Journal of Engineering Education, 98*(1), 27–38. https://doi.org/10.1002/j.2168-9830.2009.tb01003.x

Matusovich, H. M., Carrico, C. A., Paretti, M. C., & **Boynton, M. A.** (2017). Engineering as a career choice in rural Appalachia: Sparking and sustaining interest. *International Journal of Engineering Education, 33*(1), 463–475. https://dialnet.unirioja.es/servlet/articulo?codigo=6892609

Meece, J. L., Askew, K. J., Agger, C. A., Hutchins, B. C., & **Byun, S. Y.** (2014). Familial and economic influences on the gender-related educational and occupational aspirations of rural adolescents. *Journal of Educational and Developmental Psychology*, 4(1), 238. https://doi.org/10.5539/jedp.v4n1p238

Merchant, W. (2025, June 16). *Women in STEM statistics 2025: Trends, gaps, and action steps for young women*. STEMblazers. https://www.stemblazers.org/blog/women-in-stem-statistics-2025-trends-gaps-and-action-steps-for-young-women

Murphy, M. C., Steele, C. M., & **Gross, J. J.** (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science*, *18*(10), 879–885. https://doi.org/10.1111/j.1467-9280.2007.01995.x

Murzi, H., Martin, T. L., McNair, L. D., & **Paretti, M. C.** (2016). A longitudinal study of the dimensions of disciplinary culture to enhance innovation and retention among engineering students. In *2016 ASEE Annual Conference & Exposition.* https://doi.org/10.18260/p.26351

National Center for Education Statistics. (n.d.). *Locale lookup*. Retrieved June 27, 2025, from https://nces.ed.gov/programs/maped/LocaleLookup/

Parker, K., & **Funk, C.** (2017, December 5). *Gender discrimination comes in many forms for today's working women*. Pew Research Center. https://www.pewresearch.org/social-trends/2017/12/14/gender-discrimination-comes-in-many-forms-for-todays-working-women/

Perneger, T. V. (1998). What's wrong with Bonferroni adjustments. *Bmj*, *316*(7139), 1236–1238. https://doi.org/10.1136/bmj.316.7139.1236

Peterson, B., Bornemann, G., Lydon, C., & **West, K.** (2015). Rural students in Washington State: STEM as a strategy for building rigor, postsecondary aspirations, and relevant career opportunities. *Peabody Journal of Education, 90*(2), 280–293. https://doi.org/10.1080/0161956X.2015.1022397

Petrin, R. A., Schafft, K. A., & **Meece, J. L.** (2014). Educational sorting and residential aspirations among rural high school students: What are the contributions of schools and educators to rural brain drain? *American Educational Research Journal*, *51*(2), 294–326. https://doi.org/10.3102/0002831214527493

Roche, R., & **Manzi, J.** (2019). Bridging the confidence gap: Raising self-efficacy amongst urban high school girls through STEM education. *Am. J. Biomed. Sci. Res, 5*, 452–454. https://doi.org/10.34297/AJBSR.2019.05.000964

Saldaña, J. M. (2015). *The coding manual for qualitative researchers* (3rd ed.). SAGE Publications. https://doi.org/10.1108/QROM-08-2016-1408

Singh, R., Fouad, N. A., Fitzpatrick, M. E., Liu, J. P., Cappaert, K. J., & **Figuereido, C.** (2013). Stemming the tide: Predicting women engineers' intentions to leave. *Journal of Vocational Behavior*, *83*(3), 281–294. https://doi.org/10.1016/j.jvb.2013.05.007

Stake, R. (1995). *The art of case study research*. SAGE Publications.

Syed, N. (2014). *Motivations, interests and retention of female minority engineering students*. ProQuest Dissertations Publishing. https://www.proquest.com/docview/1563364226?pq-origsite=gscholar&fromopenview=true&sourcetype=Dissertations%20&%20Theses

U.S. Census Bureau. (2022). *American Community Survey 2021 1-year estimates*. Retrieved November 21, 2022, from https://data.census.gov/

U.S. Census Bureau: Defining Rural at the U.S. Census Bureau; 2016. https://www.census.gov/content/dam/Census/library/publications/2016/acs/acsgeo-1.pdf

U.S. Department of Agriculture Economic Research Service. (2022, September 12). Rural women are now more likely than rural men to hold college degrees. https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=104900

van Aalderen-Smeets, S. I., & **van der Molen, J. H. W.** (2018). Modeling the relation between students' implicit beliefs about their abilities and their educational STEM choices. *International Journal of Technology and Design Education*, *28*(1), 1–27. https://doi.org/10.1007/s10798-016-9387-7

Webb-Williams, J. (2018). Science self-efficacy in the primary classroom: Using mixed methods to investigate sources of self-efficacy. *Research in Science Education, 48*(5), 939–961. https://doi.org/10.1007/s11165-016-9592-0

Wilson, D. M., Bates, R., Scott, E. P., Painter, S. M., & **Shaffer, J.** (2015). Differences in self-efficacy among women and minorities in STEM. *Journal of Women and Minorities in Science and Engineering*, *21*(1), 27–45. https://doi.org/10.1615/JWomenMinorScienEng.2014005111

Zeldin, A. L., Britner, S. L., & **Pajares, F.** (2008). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research in Science*

Teaching: The Official Journal of the National Association for Research in Science Teaching, *45*(9), 1036–1058. https://doi.org/10.1002/tea.20195

Zeldin, A. L., & **Pajares, F.** (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal*, *37*(1), 215–246. https://doi.org/10.2307/1163477

TO CITE THIS ARTICLE:
Schrewe, L. (2026). Gender-Career Bias in Rural, Secondary School Engineering Students. *Studies in Engineering Education*, *7*(1), 23–42. DOI: https://doi.org/10.21061/see.179

Submitted: 06 May 2024
Accepted: 13 January 2026
Published: 27 April 2026

VIRGINIA TECH PUBLISHING