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Work-In-Progress: Design of a Mixed-Methods Study on Rural Engineering Students' Sense of Belonging at a Midwestern Research-Intensive University

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Abstract

This theory/methods work-in-progress paper presents the design of a mixed-methods study examining how rural identity shapes engineering students' sense of belonging at large research universities. Despite growing recognition of the importance of belonging, little research has examined how rural engineering students experience belonging in these contexts – a gap this work aims to address. This study examines the factors that influence a student's self-identification as rural and the strength of their identification with rural background or experiences. It further explores how this identification shapes students' college experiences, environment, and sense of belonging. A mixed-methods approach will begin with focus groups being used to examine how students define and perceive their rural self-identification, and how this identity influences their college experiences. Findings from the focus groups will inform the development of a quantitative survey designed to capture a board view of factors contributing to students' sense of belonging and to identify patterns experienced. The survey will be administered to the full undergraduate engineering student population at the University of Wisconsin - Madison, with analysis focused on respondents who self-identify as rural. As a work-in-progress, this paper presents the study's conceptual framing and research design.

Introduction

The experiences of rural students in higher education have been examined in recent literature, particularly with respect to how pre-college inputs and external influences shape degree aspiration, enrollment, and attainment [1] – [4]. Rural students represent an underserved population in engineering, facing distinct, interconnected challenges including geographic isolation, limited social capital, and reduced access to rigorous pre-college opportunities. More recently, attention has also been given to investigating the engineering identity of rural students and their progression along the engineering pipeline [4] – [8]. However, the sense of belonging of rural engineering students, especially within large research-intensive universities, remains underexamined. Prior work suggests that rural students eventually form connections, but the development of belonging is often delayed, in some cases until the junior year [9], [10]. Because early belonging is strongly associated with persistence [11], this delay may have critical implications for retention. Building on [10], this study aims to generate new knowledge to the sense of belonging of rural students pursuing engineering degrees at large research-intensive universities.

Research Questions

The study will address the following research questions:

1. What factors influence a student's self-identification as rural and how strongly do they identify with their rural background?
2. In what ways does a student's identification with their rural background affect their college experience, environment, and sense of belonging?

3. How can the institution better support rural students to enhance their sense of belonging on campus early in their college journey?

Theoretical Background

Studying rural student identity and its impact on engineering students' sense of belonging at a large research-intensive university requires a multidimensional and integrative approach that draws upon complementary frameworks. As illustrated in Figure 1, rather than treating each framework in isolation, this study will merge Tajfel and Turner's social identity theory, Bronfenbrenner's ecological systems theory, and belongingness theory adapted from Strayhorn to offer a comprehensive lens through which to interpret the findings [11] - [13].

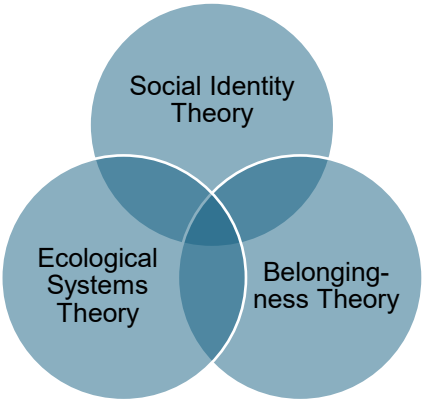

Figure 1. Multidimensional approach involving three frameworks.

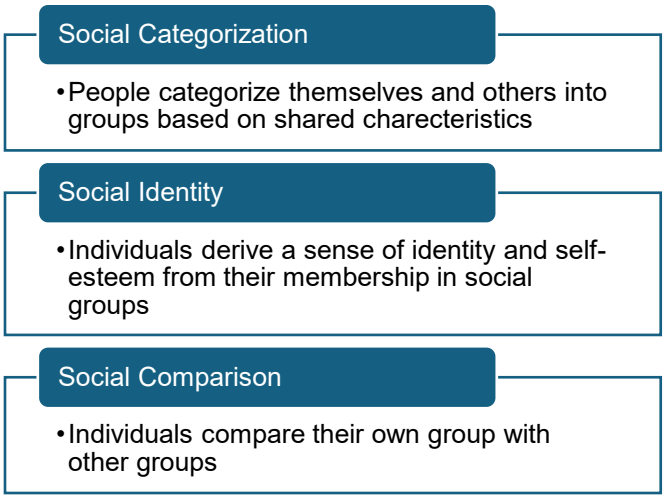

Figure 2. Key components of Tajfel and Turner's social identity theory for this study [12].

Social identity theory explains how individuals categorize themselves and others into social groups based on shared characteristics. The theory seeks to explain the cognitive processes and social conditions underlying intergroup behaviors. Key components of the theory are outlined in Figure 2. This framework will provide insight into how rural engineering students perceive their identity within the broader social context and contribute to understanding how rural identity influences educational experiences and decision-making.

Ecological systems theory compliments this by examining the impact of various environmental systems on human development. This study will examine the micro and macrosystems influencing rural engineering students' sense of belonging in and connectedness to the college environment at a large research-intensive university.

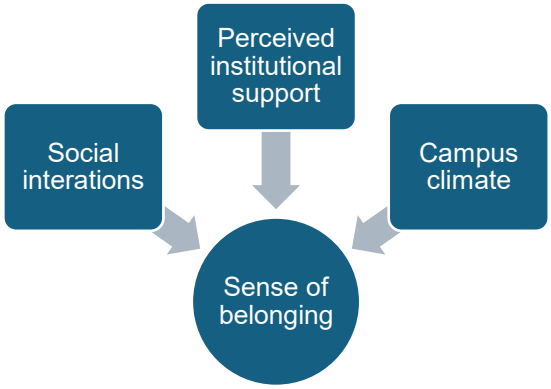

Figure 3. Belongingness framework adapted from Strayhorn [11].

Belongingness theory suggests that students' feelings of belonging within an academic environment significantly influence engagement, motivation, and success. Figure 3 highlights key components of the framework. Through focus groups and a survey, this study will investigate the influence of social interactions, perceived institutional support, and campus climate on rural engineering students' sense of belonging.

By integrating these frameworks, the study will not merely apply each theory separately but instead weave them together to form a holistic and nuanced analysis. This approach will allow the research to explore the intersections of identity, environmental influences, and belonging, providing deeper insights into rural engineering students' experiences, and informing the creation of more inclusive educational environments.

Research Design & Data Analysis

This study employs a sequential exploratory mixed methods design to investigate the sense of belonging among rural students pursuing engineering degrees at a large Midwestern research-intensive university. The research will proceed in two phases. First, qualitative focus groups will be conducted with a sample of students (first through fourth/fifth year) to explore how rural students describe, interpret, and make meaning of their sense of belonging within the engineering context. To recruit participants for the focus groups, a stratified purposive sampling strategy will be employed. This method involves categorizing potential participants based on key demographics and selecting individuals across these categories. The focus groups will provide insight into the complexities of key issues by surfacing nuanced, context-specific insights and inform the development of the survey instrument to capture a broader understanding across a larger population.

Analysis of the qualitative focus group data will involve a rigorous, systematic approach to identify meaningful patterns and insights. The focus groups will be transcribed verbatim to ensure that the data is accurately captured, and the transcripts will be thoroughly reviewed multiple times to gain familiarity with the material and identify initial impressions. Recurring themes, concepts, and patterns will be noted, and key segments of the data will be coded to allow for organization and comparison across responses. These codes will then be grouped into broader themes to uncover overarching trends and deeper insights related to the research questions. Data saturation will be assessed to ensure that sufficient data has been collected to comprehensively address the research questions and provide a robust understanding of the participants' experiences. To enhance the credibility and rigor of the analysis, the process will be subjected to review by subject-matter experts, ensuring validity and consistency in interpreting the data.

Based on these focus group findings, a quantitative survey will be developed. The survey instrument will be developed by incorporating and adapting validated instruments from previous studies on rural student identity and sense of belonging [2], [8], [10]. All survey items will be intentionally aligned with at least one of the three research questions outlined above to ensure coherence between qualitative insights and quantitative measures. The survey instrument will undergo a face validity review by experts in the field of rural education and survey design to

ensure clarity and relevance to the rural student experience. A pilot test will be conducted with a small sample of rural-identifying students to refine the instrument's reliability and usability.

Following any adjustments based on pilot feedback, the survey will be administered to the full undergraduate engineering student population (first through fourth/fifth year), with analysis focused on respondents who self-identify as rural. The expected sample size of rural students is anticipated to be 300 students, with the possibility of a higher response rate. Data collection will continue until data saturation is reached, defined as the point at which no new themes or insights emerge from the responses. This will ensure the sample accurately reflects the population. The analysis of the quantitative survey data will examine statistical relationships between students' sense of belonging and their level of identification with rurality, while also accounting for potential confounding factors such as gender, race/ethnicity, first-generation status, socioeconomic status, year in program, and engineering major. Descriptive statistics will summarize the data, reliability analysis will assess internal consistency, and exploratory factor analysis will determine whether items grouped together under constructs measure distinct dimensions. This approach will capture a board view of factors influencing a student's self-identification as rural and how this identification impacts their sense of belonging.

Expected Significance

The proposed research aims to create long-term benefits for students from rural communities by deepening our understanding of rural engineering students' sense of belonging at large, research-intensive universities. This knowledge will inform systematic monitoring programs that establish indicators to identify at-risk students early in their academic journeys. Early identification will enable targeted interventions that improve retention. Earning an engineering degree not only enhances individual earning potential but also advances social mobility within rural populations. Strengthening pathways into the engineering workforce will expand rural participation in the field and increase social capital within their communities.

Conclusions & Future Work

As a work-in-progress, this paper presented the study's conceptual framing and research design. The discussion highlighted how these design choices aim to capture the complexity of how rural identity shapes students' sense of belonging and inform future data collection and analysis. Ultimately, expected outcomes of this research include evidence-based strategies and tools to help institutions create supportive environments, identify students at risk of disengagement, and implement targeted interventions. More broadly, this work will inform and support efforts to expand opportunities for aspiring engineers by deepening understanding of how identity influences pathways into and through engineering education.

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