Broadening the Participation of Rural Students in Engineering: Preliminary Findings on the Perspectives of Key Community Members

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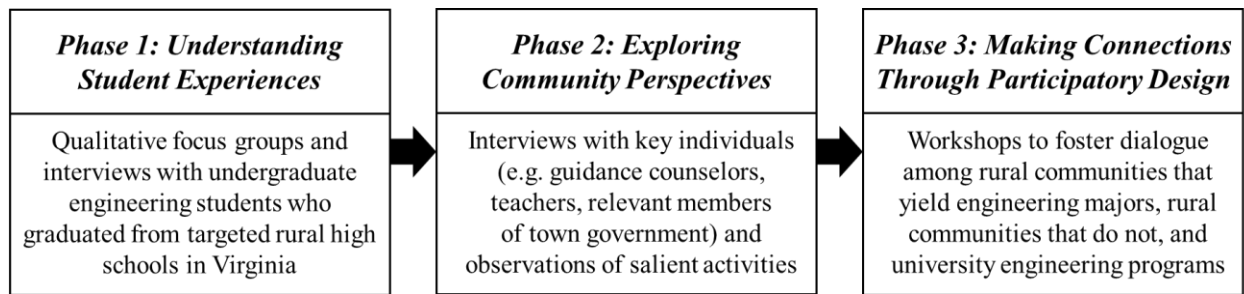
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Project Overview

A robust and diverse engineering workforce is essential to national security and economic competitiveness, and current rates of higher education enrollment in engineering are not sufficient to support the need. Thus, broadening participation in engineering from underrepresented groups is a critical priority. To address this need, this project focuses on economically disadvantaged rural students. Given the unique geographic and cultural factors that impact rural students' career choices, it is critical to study choice in context [1, 2]. In rural communities, students career choices are heavily influenced by the people and values of the local community; family, teachers, and friends, in particular, often played a key role, in helping students connect general interests in engineering or related areas (e.g., math, physics) to college majors and careers [3, 4]. As a result, this project shifts the focus from individual students to the communities themselves to understand how key stakeholders and organizations support the career choices of rural youth. Specifically, we will address the following research questions:

RQ1.   What factors do current undergraduate engineering students from rural high schools describe as influences on their choice to attend college and pursue engineering as a post-secondary major?

RQ2.   How does the college choice process differ for rural students who enrolled in a 4-year institution immediately after high school and those who transferred from a 2-year institution?

RQ3.   What beliefs, experiences, and practices characterize community members or organizations who support or encourage rural students to choose engineering?

RQ4.   How are these supports transferable or adaptable by other schools? What community-level factors support or inhibit transfer and adaptation?

To address the research questions, we employ a three-phase qualitative study shown in Figure 1. The first two phases involve rural high schools in the study region that consistently send students to Virginia Tech as engineering majors. Phase 1 focuses on the college choice process of alumni from these schools currently enrolled in undergraduate engineering at Virginia Tech (RQ1 and RQ2); Phase 2 explores these students' high schools and home communities to better understand the goals, attitudes, and experiences of not only school personnel but also local community members as they work with students (RQ3). Finally, in Phase 3 we will employ a participatory design workshop to foster collaborative dialogue among the schools and communities that seeks to better understand the rural context and identify school-level supports and challenges, statewide policies, resource allocations, and programs that could more effectively support communities in helping students considering engineering as a possible career choice (RQ4).

Phase 1: Understanding Student Experiences	Phase 2: Exploring Community Perspectives	Phase 3: Making Connections Through Participatory Design
Qualitative focus groups and interviews with undergraduate engineering students who graduated from targeted rural high schools in Virginia	Interviews with key individuals (e.g. guidance counselors, teachers, relevant members of town government) and observations of salient activities	Workshops to foster dialogue among rural communities that yield engineering majors, rural communities that do not, and university engineering programs

Figure 1. Study Phases

Conceptual Framework

To frame our exploration of engineering major choice among rural high school students, we draw on Perna's conceptual model of student college choice [5]. Perna's model, illustrated in Figure 2, integrates the economic and sociological approaches that are frequently used to examine college access and choice. The model assumes that an individual's assessment of the expected benefits and costs of investing in college is shaped by their habitus, as well as the school and community context, the higher education context, and the social, economic, and policy context. The inclusion of multiple layers of context highlights how structures or resources may facilitate or impede college enrollment and, in particular, how aspects of context may restrict access for underrepresented groups.

Our study primarily focuses on how the two innermost layers of Perna's model (habitus and school and community context) influence students' decision-making. The literature demonstrates that various aspects of these layers are important for predicting rural youths' educational aspirations. Past studies have found that rural students have limited access to information about college and financial aid [6, 7], rural schools often lack necessary resources to prepare students for higher education [6, 8], and rural communities face significant economic challenges and do not foster a college culture [9, 10]. However, several researchers have also emphasized the critical role community values play in shaping rural students' educational aspirations [4, 11]. These findings led directly to the current study, which seeks to explore communities more holistically to understand how they effectively support and encourage college enrollment and engineering major choice for rural students.

We also recognize that it is important to consider the broader contexts, particularly since we are exploring the two-year to four-year pathway. For example, the third layer of context considers the ways in which higher education institutions shape student college choice. Higher education institutions may influence the process through their marketing and recruiting efforts, location, institutional characteristics, and admission requirements [5]. Past research has revealed that location is particularly important when considering the rural context. The desire of rural youth to maintain their connections with their family, community, and rural lifestyle often lead them to choose local educational and career options rather than leaving the community [10, 12].
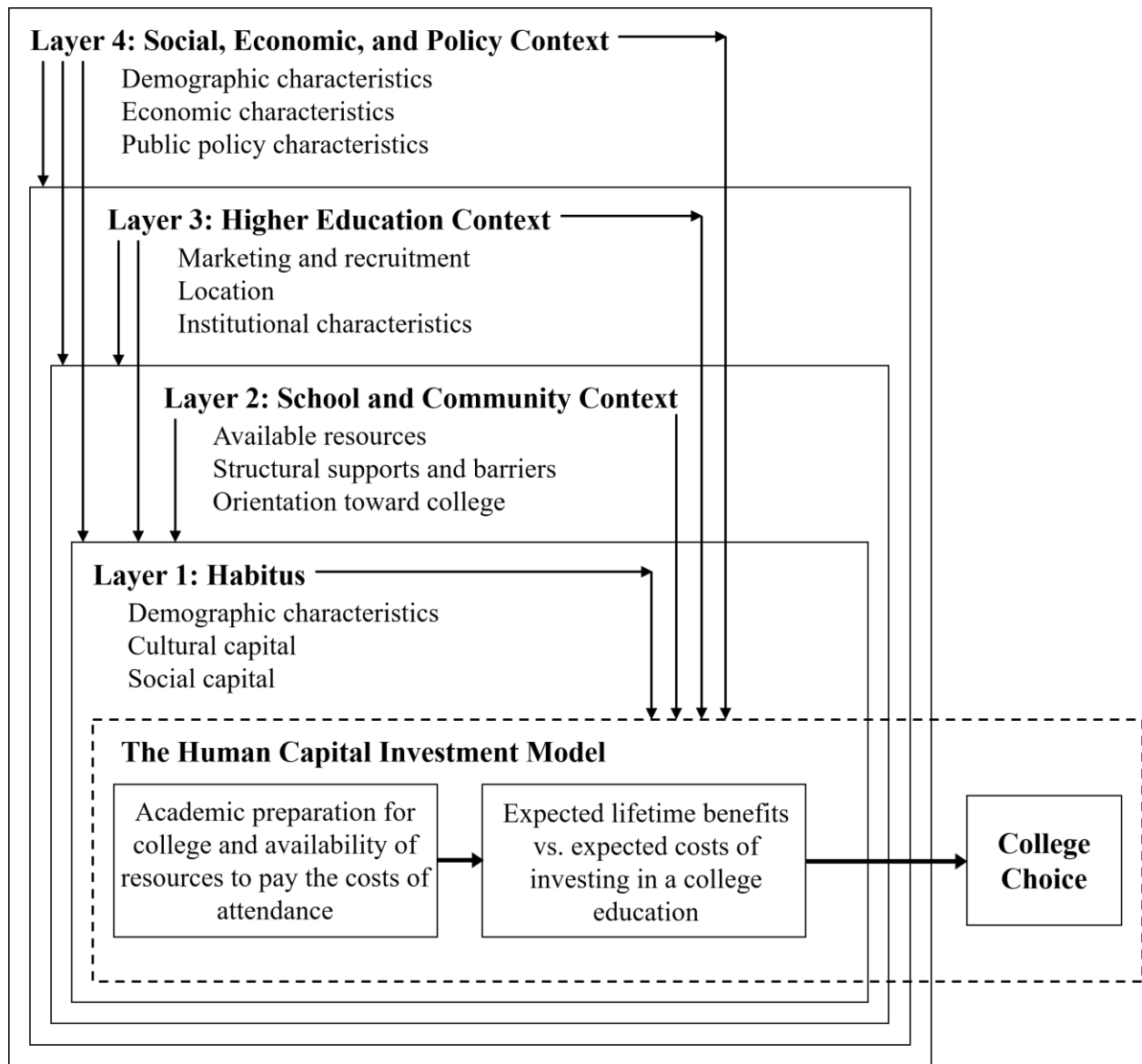
Layer 4: Social, Economic, and Policy Context
  Demographic characteristics
  Economic characteristics
  Public policy characteristics

Layer 3: Higher Education Context
  Marketing and recruitment
  Location
  Institutional characteristics

Layer 2: School and Community Context
  Available resources
  Structural supports and barriers
  Orientation toward college

Layer 1: Habitus
  Demographic characteristics
  Cultural capital
  Social capital

The Human Capital Investment Model

| Academic preparation for college and availability of resources to pay the costs of attendance | → | Expected lifetime benefits vs. expected costs of investing in a college education | → | **College Choice** |

Figure 2. Perna's Conceptual Model of Student College Choice (Perna, 2006)

Progress of Work

In the first phase of the project, we conducted focus groups and interviews with undergraduate engineering students at Virginia Tech who graduated from higher-producing, rural schools. Our selection of high schools was guided by data from the Office of Undergraduate Admissions at Virginia Tech that summarized admission trends over the past four years (2013-2016) for all students from Virginia high schools. We narrowed the search to the rural southwest regions of Virginia, or regions 6 and 7 as defined by the Virginia Department of Education (see Figure 3).
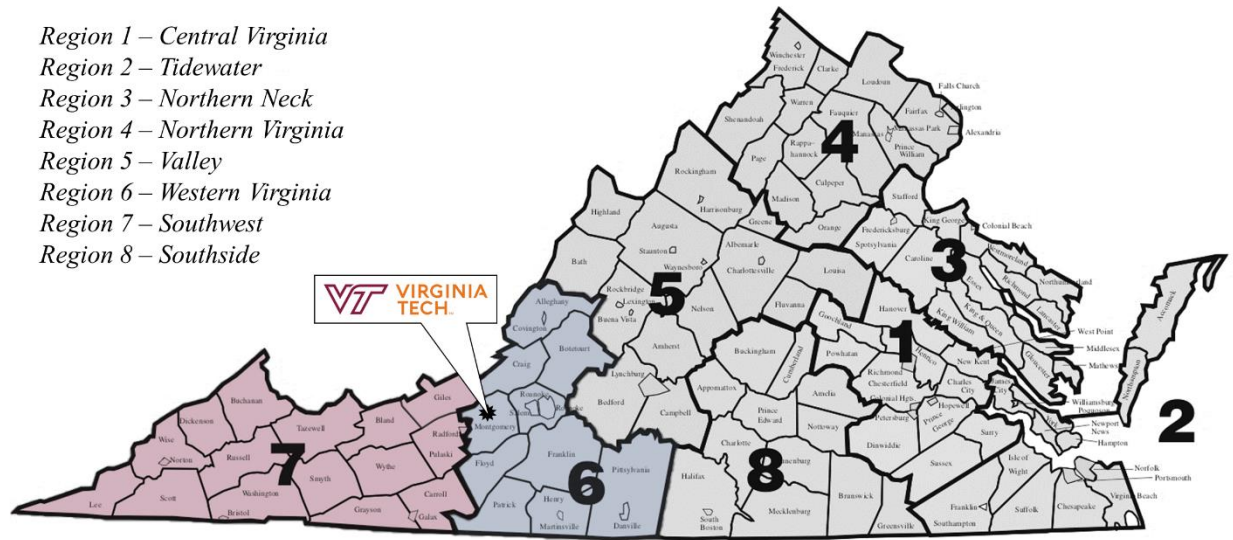
Region 1 – Central Virginia
Region 2 – Tidewater
Region 3 – Northern Neck
Region 4 – Northern Virginia
Region 5 – Valley
Region 6 – Western Virginia
Region 7 – Southwest
Region 8 – Southside

Figure 3. Virginia Department of Education (VDOE) Superintendent's Regions

Focus groups

We conducted seven focus groups with a total of 21 students in Year 1. The focus group questions aimed to understand (a) how and why participants chose to enroll in college generally and major in engineering specifically, (b) the community-level factors that influenced their decision, and (c) general perceptions in their communities regarding college and engineering careers as well as who should/should not pursue such aspirations. Focus groups not only provided rich data to begin exploring RQ1, but also informed the sampling process and interview protocol for the individual interviews in this phase.

The analysis of focus group data involved developing participant summaries and categorizing supports, barriers, and major influences described by participants. Consistent with previous research [1, 3, 12], the analysis revealed family members, teachers, and other school personnel as particularly formative influences. Key barriers mentioned by participants included family concerns about the costs of investing in higher education and personal concerns about the level of difficulty of engineering programs. The growth of community college access programs in rural regions, which offer full funding for two years of community college for graduating seniors with GPAs above a certain threshold, emerged as a significant support for some participants. This led us to expand the sampling frame for the individual interviews, adding additional students from the regions of interest who transferred to Virginia Tech from regional community colleges so that we could further explore the two-year to four-year pathway.

Individual interviews

We conducted semi-structured interviews with 36 students, 15 of which attended community college before transferring to an engineering program at Virginia Tech. Interview questions were

similar to those explored in the focus groups but included more detailed questions about participants' community experiences, influential adults, and cultural values. To analyze the interview data, we developed a list of provisional codes based on Perna's model [5], which were grouped by the five layers of the model: human capital investment model, habitus, school and community context, higher education context, and social, economic, and policy context.

Preliminary analysis of the interviews confirmed many findings from the focus group interviews. Parents and family were key influences and many participants mentioned that they were expected to attend college by their family and the community. Findings related to the school context were mixed among participants. About half of the participants indicated that they did not have access to rigorous coursework or other necessary resources to prepare for college. The other half felt they were prepared for college and discussed various resources available within their school, including AP courses, dual enrollment, and well-informed teachers and counselors. This difference will be explored further in future work, as well as the experiences of students who transferred to Virginia Tech from community colleges.

Next Steps

Based on the findings from Phase 1, we used snowball sampling to identify participants for Phase 2. We are currently conducting interviews with individuals that students identified as influential in their choice of major. In addition, in each community the high school principal, guidance counselors, teachers, personnel from other local education institutions (e.g., Governor's schools, career and technical schools, community colleges), the director of education, and relevant members of town government (e.g., chamber of commerce head, cooperative extension agent) were recruited for interviews. Interview protocols for this phase focus on participants' perceptions of the community, expectations about the future, goals and hopes for students, and perceptions of engineering as a field both generally and for students from that community. These interviews will be used to identify salient beliefs, practices, and experiences of community members. In addition, we will identify key community resources that support college enrollment and engineering major choice as well as barriers that hinder enrollment and strategies for addressing those barriers.

Acknowledgements

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