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Understanding Barriers To Engineering as a Career Choice among Rural Appalachian Students: A Review of the Literature

Abstract

Discussions of diversity in engineering often focus on race and gender, but rarely address class or cultural issues. Students in Appalachia and other rural cultures also represent a lost opportunity; they are no less capable and no less valuable to engineering than other underrepresented groups. At the same time engineering has the potential to provide a powerful career path in areas of the country that suffer disproportionate economic losses from shifts in the global economy. Yet little work to date has been done on recruitment of engineering students from these marginalized rural cultures. To address this gap, this paper presents a review of literature on career choice in Appalachian students, identifying potential barriers to engineering and suggesting possible interventions that may help overcome these barriers. Audiences for this work include agencies interested in implementing intervention programs to provide rural Appalachian students with the necessary tools to perceive engineering as a possible career choice. These include, but are not limited to, universities, public school systems, and other educational institutions invested in the growth of the Appalachian region. The literature review includes studies of the culture of the Appalachian region, career choice within the region, and characteristics of Appalachian youth. To address the potential gaps and barriers identified through previous studies, the paper concludes by drawing on the concept of future possible selves. This framework has been used to study populations of youth facing similar barriers, including barriers raised by cultural biases and socio-economic class. The possible selves framework thus provides one potentially useful lens to better understand what Appalachian students would like to become, what they are afraid of becoming, and what outreach steps can be taken to engage this population in careers in engineering in the future.

Introduction

Geographically, the Appalachian region of the United States follows the Appalachian Mountains from southern New York to northern Mississippi as seen in Figure 1¹. This area is characterized as rich in cultural heritage, strong sense of kinship, love of the land, and commitment to personal freedom and self reliance². Although rich with culture, the area also tends to isolate its residents from educational and economic opportunities that occur in more populated areas. Research indicates that many Appalachians don't graduate from high school, perceive many obstacles in attaining post-secondary education, and lack exposure to a full range of career models, which in turn limits their learning experiences³. This lack of exposure leaves students without the socio-cultural experiences needed to envision their futures in professional careers not commonly found locally – including careers such as engineering that offer entrepreneurial frameworks that could generate local economic development.

Figure 1: Map of the Appalachian region of the United States

Despite the economic and educational struggles facing the Appalachian region, little research has been done regarding the vocational developments of rural Appalachian students², and no studies identifying barriers that limit engineering in particular as a career choice for this population have been identified. As described in detail later in this paper, the work that has been done regarding vocational choice in rural Appalachia shows that self-efficacy and role models are key variables²⁻⁵. While some parental and community support does exist, a lack of role models with post-secondary education and professional careers limits the information and encouragement available to these students^{6,7}. However, schools within the Appalachian region provide a very important link to the majority culture and can provide students with important views of available careers⁵. Thus school-based outreach programs that focus on engineering careers have the potential to effectively serve this population. To make such programs effective, however, stakeholders interested in economic diversification need a clear understanding of the barriers that limit career choice within the region.

This paper begins to provide such understanding. Without existing research directly related to engineering as a career choice, we begin with broader-based research on the area, including both

the characteristics of the region and past research on Appalachian youth. We then offer the possible selves framework as a lens to view the problem. The study closes with a discussion on how the barriers identified may impact student career choice and suggests future work that can enrich our understanding of the problem and provide tools to effectively reach out to this population. Further research will assist agencies interested in implementing intervention programs to provide rural Appalachian students with the necessary modeling to perceive engineering as a possible career choice.

Characteristics of the Appalachian Region

In describing Appalachia, geographic, cultural, and economic characteristics all come into play. Geographically, these oldest mountains in North America extend from Newfoundland in Canada to central Alabama in the United States, a distance of about 2000 miles. It is usually divided into northern, central, and southern regions. In northern Appalachia, Mt. Washington in New Hampshire rises to 6,280 feet. In central Appalachia, The Catskills in New York and the Alleghenies are the best known. Mount Mitchell in North Carolina at 6,680 feet has the highest elevation of the entire range. Well-known mountains in the southern region include the Alleghenies, the Blue Ridge, the Cumberland, and the Great Smoky Mountains.

The Appalachian Mountains contain the world's largest deposits of asbestos, anthracite and bituminous coal. The Southern Appalachian Mountains also contain the world's largest broad-leaved deciduous forest. Throughout the system runs an elaborate water network of waterfalls, streams and rivers. Northeast of the New River in Virginia, the waterways flow into the Atlantic Ocean; southeast of the New River, the waterways drain into the Ohio River. Historically, the Appalachian Mountains proved a barrier to westward expansion; Daniel Boone's story of guiding early settlers through Cumberland Gap has been told for generations to elementary school children. The rough terrain of southern Appalachia delayed road construction for years; it is also a critical factor in the development of so many unique, isolated cultures across the region⁸.

Economically, Appalachia is defined as the 200,000 square mile region where economic hardship exists from southern New York to Northern Mississippi. The Appalachian Regional Commission (ARC) oversees the region. The origin of the ARC is traced to PL. 89-4 passed on March 9, 1965, during the Johnson administration. At the time of its inception, one-third of the Appalachian population lived in poverty, the per capita income was 23 percent lower than the average for the United States, and high unemployment had driven many Appalachians from their homes¹. Despite many gains, the region today still does not enjoy the same economic status as other areas of the nation. Traditional industries such as manufacturing, textiles, and wood are in decline due to global competition. Migration out of the region is among the highest in the country, and the region currently faces a decline in the population of individuals of prime working age.

In large part, these challenging economic conditions result from the isolation and lack of economic diversification over the previous decades¹. The region is approximately 42 percent rural, compared to 20 percent nationally¹. In addition to the scarcity of population, which limits the available workforce, many industries and businesses have been kept from the area because of an ingrained cultural perception that work should be physical rather than technical and

professional; as a result, the region has fewer white-collar jobs (as cited in Bennet³) and instead continues to rely on industries dependent on heavy manual labor – industries that, as noted above, have declined steadily.

Cultural barriers limit economic development in other ways as well. Historically, education led many Appalachians to leave the region. The resulting exodus means that, as Ali notes, “Appalachians commonly view education as a modernizing force that in some way strips them of their roots and heritage”². In addition, the isolation, lack of white-collar employment, and persistent poverty have become self-sustaining; the region has seen very little change either economically or culturally in recent decades⁵. Finally, despite what many middle-class Americans might consider difficult or unsatisfactory living conditions, research indicates that “many [Appalachians] favor remaining in the region because of connections to the area, support from family and friends, and relatively high satisfaction with life”³. The culture provides strong family and community ties, lower crime rates, close friendships, and a highly supportive community³ – a support structure many are unwilling to give up.

Past Research on Appalachian Youth

Although research on the career decisions of Appalachian youth is very limited², some work does exist, including several studies by Ali along with work by Bennett, Chenoweth, and a few others. The existing research describes Appalachian individuals as having a strong sense of self-reliance, leading researchers to believe that helping students to maintain high levels of self-efficacy beliefs is crucial in the achievement of their educational goals⁴. For example, a study by Ali² found that students who choose to enter the workforce directly after high school do so as a result of perceptions of obstacles, lack of confidence in their ability to obtain postsecondary education, and low vocational/educational confidence and outcome expectations. Bennett³ provides further support for the role of self-efficacy in noting that Appalachian students are not likely to choose a career they have not experienced.

The role of experience is critical because, as Bennett³ also notes, students in Appalachia may lack exposure to a full range of career models. The lack of career models for students starts at home, where parents who may be supportive of higher education often lack the personal experience necessary to provide their children with meaningful support⁷. Similarly, Ali observed, the “lack of available role models could be part of the negative feedback loop that indirectly contributes to the lower socio-economic status of students and their reluctance to set higher career aspirations”⁹.

Ali also ties low career aspirations to “perceptions that the education they need to attain career advancement is not possible nor would they be socially accepted at institutions of higher learning”⁹. This perception that Appalachian students are not accepted stems from stereotypes displaying Appalachians as uneducated, lazy, and unintelligible and their differences in dialect and communication patterns³. These stereotypes have been found to negatively impact students’ pursuit of higher education and career advancement⁹.

Importantly, these researchers also demonstrate that efforts to address these critical areas have positive results. For example, Ali² found that efforts to increase the self-efficacy and outcome expectations for Appalachian students interested in attending college is an important direction for

practice. Ali⁶ found that students with high levels of vocational/educational self-efficacy showed strong expectations to attend college, and to build a high level of self-efficacy, students rely on the influence of, in descending order, parents, peers, and teachers⁷. Support from these groups was found to be key in helping high school students achieve their career goals⁴. Bennett³ indicated that college aspirations tended to be higher for students who have been exposed to college preparatory curriculum, role models who attended college, and parental and peer support. To support the claim that academics and role modeling were important factors for college decision making, Chenoweth⁵ found that students' perceptions of their own intelligence, preparedness for college, and comfort in school settings were highly associated with college plans. Bennett³ found that regardless of the source of encouragement, students who experienced greater educational and occupational support were likely to have higher efficacy and outcome expectations, more educational choices, and were more likely to follow these opportunities.

The results of these studies suggest possible barriers to engineering, including its white-collar nature and its tendency to move students away from a highly positive home culture. They also suggest, though, possible strategies for addressing those barriers through efforts to increase both exposure and self-efficacy. However, the cultural biases against white collar work and the deeply held community values suggest that role modeling and self-efficacy may not be sufficient if students do not also perceive ways in which engineering can enable them to remain a part of their local community and bring back value that the community will accept.

Possible Selves

As noted above, research shows that Appalachian students with high levels of vocational/educational self-efficacy were most likely to display aspirations of college and are likely to imagine a broader array of occupational choices. Research also suggests that many Appalachian students lack exposure to individuals with the experiences necessary to provide support for post-secondary education. None of this work, however, specifically addresses engineering. That is, even as increased self-efficacy and available role models may increase the likelihood that Appalachian students will pursue higher education broadly, there is little evidence to indicate whether that pursuit would include careers in engineering. The question is critical because engineering is the type of white-collar profession that has historically engendered resistance, and it can be perceived as a career path that has strong potential to take students away from the family and social networks and the way of life they value. Yet the recent emphasis on entrepreneurship within engineering education, and the potential for engineering entrepreneurship to generate local, meaningful work suggests that engineering may be both a viable and a valuable career path for many students.

To better understand how Appalachian students view the engineering field and to help understand the types of role models and exposure that can support students' matriculation into engineering majors, we suggest the possible selves framework. The possible selves framework, first proposed by Markus in 1986, provides a means to represent "individuals' ideas of what they might become, what they would like to become, and what they are afraid of becoming, and thus provides a conceptual link between cognition and motivation"¹⁰. Markus¹⁰ explains that individuals are free to create any variety of possible selves but the possibilities are derived from social experiences.

This framework is an excellent fit for the deficiencies identified in research which impact career choice within rural Appalachia because of its strong connection to socio-cultural factors in shaping future possibilities. Marcus explains that “an individual is free to create any variety of possible selves, yet the pool of possible selves derives from the categories made salient by the individual's particular socio-cultural and historical context, and from the models, images, and symbols provided by the media, and by the individuals immediate social experiences”¹⁰. Prior studies of both Appalachian culture and the career choices of Appalachian youth bear this out, even when the studies do not employ this framework. Erikson¹¹ updated the framework in 2007 to include the idea that possible selves are “conceptions of ourselves in the future, including at least to some degree, an experience of being an agent in the future situation.” The characteristics of Appalachian culture suggest that this experience of agency may be particularly important for this population.

Importantly, this framework has been used to study populations with economic and social characteristics similar to those of the Appalachian region. Oyserman¹² developed an intervention using the possible selves framework targeting inner city middle school students where over 40% of the families lived in poverty, and students experienced a lack of role models. The purpose of the study was to “enhance youth’s abilities to imagine themselves as successful adults and connect these future images to current school involvement”¹². Yowell¹³ used possible selves to study Latino boys and girls in an urban setting, noting that both information about possible futures and skills needed to achieve those futures are critical. This work is particularly salient both because of the role of information and because many Latino cultures share the strong attachment to family that characterizes Appalachia. More directly, Robinson¹⁴ used the framework to study the most hoped for and feared possible selves among rural Appalachian women, and the results yielded useful findings to support career counseling and educational support for this population.

Conclusions and Future Work

The Appalachian region of the United States represents a unique geographical and cultural region within the nation. Historically, mining, forestry, agriculture, chemical, and heavy industry provided the region with a strong economy¹. While attempting to diversify, the region still does not enjoy the same economic strength other regions possess.

Given the characteristics of the community, an attempt has been made to understand the factors that contribute to engineering as a career choice among Appalachian youth. Research indicates that many Appalachians don’t graduate from high school, perceive many obstacles in attaining post-secondary education, and lack exposure to a full range of career models which limit their learning. In addition, students within Appalachia often have parental and community support, but lack role models with exposure to post-secondary careers. Studies show that exposure to post-secondary careers and educational opportunities provide Appalachian students with the necessary experiences to pursue higher education.

While the literature outlined here provides a wealth of information about Appalachian culture and students’ career choice generally, more study is needed to broaden participation in the engineering field in particular. Common conceptions of engineering careers, however, may still limit the degree to which the field draws students from this region. The possible selves

framework, with its attention to values and socio-cultural contexts, provides a potentially useful lens to better explain engineering as a career choice among Appalachian students and identify barriers which prevent students pursuit of an engineering career. Identifying critical barriers can provide agencies that seek to implement intervention programs for rural students with a framework for developing necessary tools to help these students see engineering as a possible career choice.

To achieve these goals, future work includes performing a study across the region to build a theory that explains engineering as a career choice among Appalachian students. Once the barriers which limit student's decision to choose an engineering related field are understood, school systems, universities, and other stakeholders can begin to use the knowledge in the design of intervention programs. This work can go a long way in helping to economically diversify a region, and reach a typically underrepresented group within the engineering field.

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