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The Influence of Elementary School Teachers' Social Capital on First-Year Engineering Students' Major Selection: A Comprehensive Analysis of K-12 Educator Impact

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Introduction

This empirical research work-in-progress paper examines how K-12 educators shape first-year engineering students' social capital and how that capital may influence students' decision to pursue engineering. Social capital refers to resources, such as emotional support, academic guidance, and career exposure, gained through relationships [3]. Drawing on Lin's Network Theory of Social Capital and building on previous work in engineering education [4], [8], this research emphasizes the contributions of K-12 educators across all grade levels, focusing on the often-overlooked role of elementary teachers.

While prior research highlights the importance of classroom relationships, most studies focus on middle and high school educators. Little is known about the types of engineering-related support offered earlier in students' academic journeys and how that support varies by educational grade level. This study aims to fill that gap by identifying which types of support are most common at each grade level and exploring how both educators and non-educators contribute to students' engineering-related social capital before entering their undergraduate engineering program.

Theoretical Framework

The Network Theory of Social Capital provides a foundation for analyzing how resources within students' social networks are accessed and activated to support academic and career decisions [3]. Social capital involves the availability of supportive individuals and students' ability to access and activate those resources. In the context of engineering education, strong ties, such as those with educators (e.g., teachers, principals, guidance counselors) or non-educators (e.g., family members, friends, and peers), often play a critical role in shaping identity, motivation, and opportunity.

Researchers have asserted that social capital is especially relevant for understanding how students are recruited into and persist within undergraduate engineering programs, which are often described as privileged academic pathways linked to occupational inheritance [8]. A lack of available or activated social capital can limit students' exposure to engineering, reduce access to guidance and encouragement, and ultimately influence their academic and career trajectories.

Previous research suggests that student recruitment and retention into undergraduate engineering majors are influenced by the resources available within their social networks and the activation of these resources. Role models, parents, and teachers have consistently been shown to play a meaningful role in shaping students' interest in engineering, especially by offering encouragement, information, and guidance about academic and career paths [4]. However, the specific types of support provided at different grade levels, particularly in the earlier years of schooling, remain underexplored. This study addresses that gap by examining the role of K-12 educators, especially elementary school teachers, in supporting students' decisions to pursue engineering.

Literature Review

Research in engineering education has increasingly explored how social capital influences students' academic and career decisions. As described by Martin et al. in [4], the Name and Resource Generator (NRG) was among the first instruments designed specifically to measure engineering-related social capital. The NRG combines a name generator, which asks students to identify influential individuals (referred to as alters), with a resource generator, which captures the types of engineering-related support (embedded resources) those individuals provided.

Subsequent studies using the NRG found that underrepresented students often draw on different types of support and have varied access to influential resources [8]. In particular, disparities were noted across racial, gender, and socioeconomic lines. Much of this prior literature has emphasized disparities in students' access to social capital, particularly in relation to demographic characteristics. However, the current study takes a different approach by focusing on grade-level differences in support, especially at the elementary level, which has received minimal attention in social capital research related to engineering education.

More recently, the Undergraduate Supports Survey (USS) expanded the NRG to assess expressive (emotional/motivational) and instrumental (academic/career) forms of support in undergraduate students' networks [1], [2]. The current study builds on this framework by applying the USS in a K-12 context, enabling the inclusion of elementary teachers as potential providers of engineering-related support.

The USS was specifically developed to address these issues and provide a more reliable and valid measurement of social capital, focusing on the "supports" within engineering students' networks [1]. While the original NRG was cognitively validated through think-aloud protocols [4], the USS underwent statistical validation to ensure psychometric reliability across diverse student populations [1].

Current Study

This study investigates how K-12 educators contributed to first-year engineering students' social capital before entering college. Of particular interest is how support varies across grade levels, elementary, middle, and high school, and what types of resources are most often associated with each level. While prior studies have examined demographic inequalities in students' access to engineering-related social capital, particularly at the secondary level, this study builds on that foundation by focusing on grade-level variation in educator support across the full K-12 continuum. Given the limited prior research at the elementary level, this study emphasizes identifying early sources of engineering-related support, laying the groundwork for future analyses of equity and access.

This study draws on a quantitative design using a modified version of the Undergraduate Supports Survey (USS), adapted from the original Name and Resource Generator (NRG). The instrument includes a name generator, which identifies influential individuals (alters) from students' K-12 experiences, and a resource generator, which captures both expressive (emotional/motivational) and instrumental (academic/career) forms of support. The NRG was cognitively validated in earlier studies [4], and the USS has since undergone statistical validation

[1], making it a robust tool for measuring K-12 engineering-related social capital. The survey was administered to first-year engineering students at Mississippi State University, a large public research university in the southeastern United States known for its diverse undergraduate engineering population and active STEM outreach initiatives.

The final analytic sample included 52 students who completed the survey. Participants were asked to list up to five individuals who influenced their decision to pursue engineering and identify the types of support provided. Early trends, first observed in the pilot study and confirmed in the broader dataset, suggest that educators, particularly high school teachers, were the most frequently cited source of engineering-related support. Some elementary teachers were recognized for incorporating hands-on engineering activities into instruction (e.g., building projects or robotics), although these experiences were rarely presented as explicitly connected to engineering careers. Preliminary patterns also indicate that students with social networks composed of 50% or more educators reported greater access to both expressive and instrumental resources. While still under analysis, these initial findings underscore the potential impact of educators throughout K-12 and point to missed opportunities to connect early STEM engagement with engineering career pathways.

Findings and Implications

Findings from the name generator and resource generator suggest that educators, particularly in high school, provide emotional and academic support. At the same time, elementary teachers primarily contribute through hands-on activities. Preliminary results suggest that educators contribute significantly to first-year engineering students' social network, more so than non-educators, highlighting their role in shaping students' engineering identity formation. High school teachers were the most frequently identified sources of engineering-related support within students' K-12 social networks. These supports often included advising on academic choices or encouraging persistence in STEM coursework.

In contrast, elementary teachers were less likely to be associated with direct career guidance. However, they were frequently remembered for engaging students in hands-on, project-based activities such as building, designing, or coding. However, these activities were rarely presented using the language of engineering, suggesting a potential disconnect between early engagement and professional identity formation.

Interestingly, students whose networks were composed of more than 50% of educators appeared to access a broader range of expressive (e.g., encouragement, motivation) and instrumental (e.g., course or career advice) supports. While this observation is still under analysis, it may reflect the importance of sustained educator involvement across educational stages, particularly for students navigating decisions about engineering pathways.

These early findings point to an important opportunity. While engineering-related exposure in elementary school often takes the form of hands-on activities, the framing and contextualization of those activities could be strengthened. With support from curriculum designers and educational leadership, teachers could incorporate simple language cues, such as describing building or designing activities as "engineering challenges," to help students begin identifying with engineering roles. In addition, elementary educators need accessible, developmentally

appropriate tools to explain what engineers do and introduce students to real-world engineering careers in ways that spark curiosity and align with how young learners make meaning.

Because elementary-aged students are still forming interests and are eager to learn, this period represents a critical window to foster early enthusiasm for engineering both through experience and explanation. Such efforts do not require major curriculum overhauls but can be integrated into existing instructional practices with the proper support.

These findings emphasize the pivotal role of K-12 educators, particularly at the elementary level, in laying the groundwork for engineering interest. While early exposure often occurs through engaging, hands-on activities, they are rarely framed as part of the engineering discipline. With support from curriculum designers and educational leaders, elementary teachers can enhance students' STEM learning by integrating basic engineering vocabulary and explaining what engineers do in developmentally appropriate ways. As prior studies suggest, elementary school is a critical time for developing students' interests [10], making it an ideal time to introduce engineering as a subject and a future career pathway. Empowering teachers with simple language cues, accurate career context, and institutional support can help students develop their engineering identity without placing additional burdens on classroom educators.

Future Work

These early findings lay the groundwork for future research examining how social capital patterns differ across student demographics and engineering subdisciplines. Future phases of this study will examine how social network structure, such as the strength of ties and diversity of alters, and support type (expressive vs. instrumental) influence students' persistence and identity development throughout their undergraduate engineering journey. For engineering education stakeholders, these findings suggest a critical need for low-barrier, high-impact interventions in elementary education. Strategic partnerships with schools could support educators in reframing their existing STEM activities within an engineering context without requiring significant curriculum changes. By embedding engineering language, career awareness, and identity-building into existing classroom experiences, with appropriate support and resources, educators can further enhance students' early engagement with engineering pathways.

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