

Uncovering Key Factors of Materials Engineering Graduate Student Enrollment, Retention, and Attrition: A Systematic Review

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Abstract

Background

The underrepresentation of domestic students in graduate-level STEM programs has become a critical national concern. Declining participation in STEM PhD programs poses challenges to workforce development, economic growth, and national security. Universities struggle to recruit qualified domestic students, especially in sensitive high-tech sectors, while employers face shortages of U.S. citizens in specialized STEM roles.

Purpose

This study synthesizes empirical literature on PhD recruitment, retention, and attrition in STEM. It is particularly important for materials science and engineering, a field central to advanced technologies such as nuclear energy, semiconductors, and manufacturing, where a highly skilled domestic workforce is essential. Low domestic participation threatens research continuity and national competitiveness.

Method

This review follows PRISMA guidelines, including identification, screening, eligibility, and inclusion stages. A systematic search was conducted using Scopus, ERIC, and Google Scholar with keywords related to enrollment, retention, and attrition. After applying strict inclusion criteria, 41 studies were selected and analyzed using thematic synthesis.

Results

Recruitment is driven by intrinsic motivation, early research exposure, and self-efficacy rather than salary expectations. Enrollment increases with clear career alignment. Retention depends on funding stability and advisor-student relationships. Attrition occurs early and is linked to financial strain, social isolation, and mismatched expectations. External job opportunities and limited academic positions further normalize attrition.

Conclusions

Improving domestic participation requires enhancing early research exposure, mentorship, funding stability, and alignment with diverse career paths to sustain a skilled workforce and national competitiveness.

Keywords: STEM education, graduate studies, recruitment, attrition, retention.

Note: We will present the full paper at the conference, but we do not hope to include the full paper as the ASEE conference proceeding as our paper will be under review in an academic journal. Therefore, we only submit the full abstract here.