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**Becoming an Engineer in Public Universities. Pathways
for Women and Minorities.**

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REVIEW

This edited book is a welcome opportunity to revisit some of the central arguments in relation to the retention of engineering undergraduates, especially underrepresented groups such as minority students and women. The book presents rich empirical material gathered in a three year research effort across five public Universities in the state of Florida in the USA. The research team manages to clearly present the main difficulties and obstacles that prevent successful socialization into the public engineering programs, which range from individual factors, such as self-esteem, to organizational aspects tied to departmental climate and (missing) institutional support structures. New insights are offered, especially in relation to the reasons why students have left engineering programs and the inherent tensions that confront the necessity for supporting students with individual and institutional (research) needs. Apart from these strong points, an academic readership might wish for a more thorough dialogue with existing research, whereas administrators and program managers would probably find a more synthetic list of key policy recommendations helpful.



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The book is divided into eight chapters with the core arguments discussed in detail in chapters three to seven. Chapters one and two set the stage with detailed introductions to the research rationale and the educational context of the Florida State University System. The project deploys a mixed methods approach, mostly centred on qualitative interviews, focus groups, and field observations, alongside a survey on program climate.

Chapter 1 (Borman, Halperin and Tyson) starts by situating the objectives of the project in the wider context of the scarcity of engineers and scientists in the US. Furthermore, the concept of *program efficacy* is introduced, which is used to compare the representation of female, Black, and/or Hispanic students in a specific program throughout various stages in relation to other programs and the overall student population.

Chapter 2 (Cotner, Whaler and Tyson) introduces the four principal universities where the research was carried out, describing briefly their institutional history; student demographics; program efficacy; resources and infrastructure; and, campus climate. Interestingly, most of these institutions exhibit a high *program efficacy*, especially for women. Although this chapter provides important contextual information, it falls short of delivering an integrated picture of how program climate, infrastructure and campus ecology in general might relate to changes in program efficacy, as developed in the remaining chapters. At this point it would also have been beneficial to note, at least in passing, the potential differences between various engineering degrees, especially in relation to female students. It would, for example, have been interesting to read about potential differences between more ecological and environment oriented engineering degrees, where the participation of women is usually higher, and electrical- or computer engineering degrees, where it is lower.

Chapter 3 (Tyson, Smith and Ndong) delivers a first highlight of the book. It focuses on the reasons why 'switchers' left engineering programs. One of the key strengths of this study is that the researchers have tracked down 17 students who had left engineering for other degrees, and their reasons for leaving the engineering programs are discussed. Together with interviews with faculty and administrators, a holistic impression of the main reasons for the switch emerges: (1) difficulties in mathematics preparation; (2) too narrow focus on mathematics and science at the expense of direct engineering experiences during initial years; and, (3) the image of engineering as an especially difficult and time consuming degree that requires one to give up one's social life. Interestingly, this latter reference to the 'nerdy' image of engineering was the only gender-related dimension highlighted by participants as a decisive factor to switch programs. In general, aspects tied to the masculine culture and image of technology did not form part of the reasons listed by students, administrators, or academic staff.

Chapter 4 engages with the role of pedagogy and the curriculum as two important aspects that frame engineering students' undergraduate

experience. The authors of this chapter (Heppner, Lee and Wao) do a great job in uncovering the discrepancies, through interviews and classroom observations, between the faculty rhetoric of pedagogical innovation and student's experiences of largely teacher-centred lectures. Conceiving the use of PowerPoint as an innovative teaching style appears to be a widely held misconception among faculty, with often deadly-boring results for students! Interactive, student-centred learning opportunities coupled to real world applications emerges, from interviews with the students, as the most promising way for involving and engaging students. Crucially, this chapter contains an important message to university management in that it leaves no doubt that the implementation of a student-centred pedagogy has to be tied to additional staffing or a reduction of curricular content in order to allow for this more time consuming teaching approach.

Chapter 5 (Wao and Lee) in turn deals with program climate while chapter 6 focuses on program culture. Program culture is conceived in terms of the fundamental ideologies, assumptions, and values espoused by the members of a given university program, whilst program climate refers to student perceptions and experience of this culture. The results on program climate are based on a student survey (n=881), involving 44 student interviews and 8 focus groups. As the quantitative analysis shows, no statistically significant differences in student perceptions of program climate associated with program efficacy for female and minority students could be found. Nevertheless, *Faculty Support*; *Personal Agency and Peer Support*; and, *Social Fit* were predictive for *Intent to Leave*. Apart from the quantitative analysis, interview data suggests that student-faculty relations could be improved, especially through tighter integration of students in research teams.

Chapter 6 (Forde, Grace and Cotner) on the other hand espouses important differences between administration, faculty and students in program culture - manifest through the relative importance attributed to research, quality teaching, or collaboration among others. While faculty and administration perceived the increased need of an enhanced research agenda, students believed that an overemphasis of research distracts from teaching and student support. This criticism of institutional support was raised most frequently by women and minority students. None of the departments, for example, had formal mentoring programs in place. A further discrepancy concerns the value attributed to student/faculty diversity by the university administration and the lack of concrete promotion strategies designed to address issues of diversity. Overall, the project team detected that clear systematic commitment to recruiting and retaining female and minority engineering students was missing across the case studies.

Chapter 7 engages with a dimension of STEM graduates rather specific to the US, namely the transition from community colleges to university. As the authors of this chapter (Whaler and Miller) point out, community colleges are important for the subject under investigation because they serve a proportionally greater number of minority and female students. In the case

of Florida, they often work as direct 'feeder' colleges from which the universities draw their students. Due to the smaller class size and more intimate setting of community colleges, recommendations are given to ease the transition of community college students to a STEM field at a four-year institution. Findings echo earlier concerns voiced in this book with smaller classes, improved student-faculty relations and support, the importance of social networking and peer support among students in the form of mentoring programs.

Finally, chapter 8 (Borman, Tyson and Whaler) provides further 'voices from the field' on how to develop a more inviting culture and climate for engineering programs. The discussion of previous issues is continued, emphasizing again, through extensive interview quotes, the importance of bridging gaps in academic preparation from high school to college or the need to get students into contact with real world engineering problems right from the start. Pedagogical innovation is highlighted alongside personal advice and communication between student and faculty. At this point readers might appreciate a more synthetic summary and discussion of the results. In an edited book where many authors touch upon a whole variety of different concepts, a stronger synopsis to integrate the material of the individual chapters would have been welcomed.

Overall, the evidence assembled by this project constitutes a welcome contribution to existing data. Although it does not necessarily add new insights, the fact that it integrates opinions from administrators, faculty and students demonstrates the diverging agendas that co-exist within the universities. Thus, the book clearly situates the issue of the continued underrepresentation of women and minority students on a political agenda where it has to compete with financial pressures, questions of institutional (research) prestige, or struggles over curricular content. Its major weakness might be the absence of any clear reference to the masculine culture of engineering, given its centrality as explanatory factor for the underrepresentation of women in the wider literature (e.g. Cockburn, 1999; Faulkner, 2000, 2007; Cohoon & Aspray, 2006). As a result, the authors miss an important opportunity to engage with the potential benefits of a more interdisciplinary, problem oriented, de-gendered engineering curriculum for women and minority students (Wistedt 2001). Nevertheless, the empirical data offers an invaluable tool for institutions undertaking their first steps to improve the situation for women and minority students.

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