
The Academic Bookshelf

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I was nearly finished with my reviews for this issue when a book arrived that is so important and so timely that I decided to set aside the review I was working on and to review the book *Talking about Leaving: Why Undergraduates Leave the Sciences* and a couple of related books. A brief summary of the report version of *Talking About Leaving* appeared in the NSF report *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology*. *Shaping the Future* primarily focused on poor teaching, which was the most common complaint of able students, and the impersonal “weed out” nature of introductory courses which was second. Although I had seen the reference in the NSF report, the book really hit me. It is an extraordinarily thorough and thoughtful piece of research. I encourage you to read it.

TALKING ABOUT LEAVING: WHY UNDERGRADUATES LEAVE THE SCIENCES

*by Elaine Seymour & Nancy M. Hewitt
Westview, 430 pages, 1997.*

Talking about Leaving explores the reasons that lead undergraduates of above-average ability to switch from science, mathematics, and engineering majors into nonscience majors. It is based on a three-year study of 335 students at seven campuses and includes both statistical data about attrition and numerous comments by students. The quantitative data are insightfully and passionately illustrated by students' voices. The authors refer to an “iceberg” image throughout the book and state: “Field switching is only the tip of an iceberg: The same set of problems that prompt some science, mathematics, and engineering undergraduates to leave make persistence difficult for those who stay.” (Cover jacket).

The overview chapter (Chapter 1, 52 pages) provides excellent background and review of the research and policy literature on high ability students leaving science, mathematics, and engineering (S.M.E.). Data show that approximately 40 percent of undergraduate students leave engineering programs, 50 percent leave the physical and biological sciences, and 60 percent leave mathematics. These losses occur among the most highly qualified college entrants and are disproportionately higher among women and students of color. The authors note three issues that were dominant at the outset:

1. Science and mathematics education was failing to foster science literacy in the population.
2. Too few undergraduates and graduates were recruited and retained to meet the nation's future needs, and

3. The sciences recruited too exclusively among white males — thereby depriving the nation of the talents of women of all races and ethnicities, and of men of color.

They provide a complete review of the retention literature and interject some interesting and provocative interpretations, “The academic difficulties experienced by many S.M.E. students, and the apparent difficulty of many faculty in responding to them, may be visualized as a structural conflict between the elitism and predestinationism of science and the democratic, consumerist approach which students bring to college from high school and the wider society (p. 11).”

The 335 students were randomly selected from the seven participating universities (all 4-year with different Carnegie ranking — 2 with rank 1, 2, & 3, respectively and 1 with rank 4). All students selected had math SAT scores (or equivalent) of 650 or higher.

One of their major findings was that switchers and non-switchers are not two different kinds of people. “Contrary to the common assumption that most switching is caused by personal inadequacy in the face of academic challenge, one strong finding is the high proportion of factors cited as significant in switching decisions which arise either from structural or cultural sources within institutions, or from students' concerns about their career prospects (p. 32).” The four most commonly cited concerns leading to switching decisions (also cited by between 31 and 74 percent of the non-switchers) were:

1. Lack or loss of interest in science
2. Belief that a non-S.M.E. major holds more interest, or offers a better education
3. Poor teaching by S.M.E. faculty
4. Feeling overwhelmed by the pace and load of curriculum demands.

Criticisms of faculty pedagogy contributed to 36.1% of all switching decisions, and were the third most commonly-mentioned factor in such decisions. Concerns about S.M.E. faculty teaching, advising, assessment practices, and curriculum design, pervade all but seven of the 23 issues represented in their “iceberg” tables. The first four items on the list are:

1. The rejection of S.M.E. careers or lifestyles is partly a rejection of the role models which S.M.E. faculty and graduate students present to undergraduates
2. S.M.E. faculty are often represented as “unapproachable” or unavailable for help with either academic or career-planning concerns.
3. Students perceive curve-grading systems widely employed by S.M.E. faculty as reflecting disdain for the worth or potential of most under-classmen. Their presumed purpose is to drive a high proportion of students away, rather than give useful feedback to students on their level of understanding, or conceptual progress.
4. Harsh grading systems, which are part of a traditional com-

petitive S.M.E. culture, also preclude or discourage collaborative learning strategies, which many students view as critical to a good understanding of the material, and to a deeper appreciation of concepts and their application.

5. And so on. . .

But the students' voices tell a sad and compelling story:

"I do work hard, and my average load over these four years—even when I was transferring out—has been 17, 18 hours a semester, plus a couple of night classes sometimes. It doesn't really bother me to work that hard. But when it's a concept I don't understand and I go to get help from faculty and they just don't give it, that's discouraging." (Male white engineering switcher)

"What bothers me is the number of people who know what engineering is about, and really have the capability to do well and be good in the field, but end up going a different way for reasons other than the lack of ability." (Female white engineering non-switcher).

"You get people that would probably do well if they were given half a chance, but there's so much competition, and not a heck of a lot of help." (Female black engineering senior).

"The first two years in physics are so dull. I mean, they have absolutely nothing to do with what you'll be doing later. I'm afraid that's why you might be losing good students from engineering that are really qualified and have the intelligence. . . There are ways to make the introductory material interesting so that it doesn't drive away good people through boredom." (Male white engineering non-switcher).

Students' suggestions for the improvement of S.M.E. pedagogy were presented in several broad categories, again illustrated both by quantitative data and students' own voices.

The first suggestion was training and planning for undergraduate teaching, which covered two categories: development of teaching assistants' and faculty members' teaching skills, and development and use of departmental teaching 'teams' to address curriculum planning, teaching, student learning and assessment.

"Teachers need to have more of a focus on teaching, and their teaching skills need to be developed if they don't have them. Otherwise, people need to be hired who have good teaching skills, even if they're not doing the research that brings in all the money." (Female black engineering switcher).

"The faculty who should be planning the basic classes need to be a team, with the people who are involved in teaching included, as well as the people who know what's going on — like the advisors and the women's program director. There's not much point telling your advisors about your problems with a particular class if they can't pass that along where it can do some good." (Female white engineering non-switcher).

Other areas addressed included the structure and content of a well-taught class, and collaborative learning.

One of the longest chapters is "Issues of gender." Women have a very different experience in S.M.E. majors and courses than men, one consequence of which is that more women than men leave. They close the chapter with specific items that help women persist in S.M.E. majors — individual coping skills, bonding to other women in S.M.E. majors, faculty women and other role models and mentors, and creating a comfortable climate for women in S.M.E. majors.

The chapter "Issues of race and ethnicity" addresses the causes and consequences of S.M.E. attrition from the perspective of those whose loss rates are the highest — students of color.

I found *Talking about Leaving* extraordinarily difficult to summarize and review. There are so many features I want to highlight. You'll just have to read the book to get the rest! I encourage you not only to read *Talking about Leaving* for the authors' insights on the terrible waste of talent that occurring, but also as an exemplar of engineering education research. *Talking about Leaving* sets a standard for thoroughness, quantitative and qualitative rigor, and quality of expression that I expect will have a long lasting influence on engineering education.

LEAVING COLLEGE: RETHINKING THE CAUSES AND CURES OF STUDENT ATTRITION

(Second edition)

by Vincent Tinto

University of Chicago Press, 1993, 296 pages.

The first sentence of *Leaving College* is "More students leave their college or university prior to degree completion than stay." Tinto synthesizes far-ranging research on student attrition and on actions institutions can and should take to reduce it. Like *Talking about Leaving*, *Leaving College* provides a comprehensive summary of the literature in the second chapter titled "The scope and patterning of student departure from higher education." Tinto notes that individual departure from institutions of higher education arises from several major causes or roots, including intention, commitment, adjustment, difficulty, congruence, isolation, obligations, and finances. Student departure takes two forms, academic dismissal and voluntary withdrawal, the latter being much more common. For most departures, leaving has little to do with the inability to meet formal academic requirements or finances. Student departure primarily appears to result from what goes on in the daily interactions between students and faculty inside and outside the classroom. He outlines a "Theory of individual departure" in chapter four and extends his theory to the experiences of minority, adult, and graduate students, and to the situation facing commuting institutions and two-year colleges.

The principles of effective retention are outlined as commonalities in Chapter 5, "The dimensions of institutional action." These commonalities can be described as an enduring commitment to student welfare, a broader commitment to the education, not mere retention, of all students, and an emphasis upon the importance of social and intellectual community in the education of students. His three principles of effective retention are:

1. Effective retention programs are committed to the students they serve. They put student welfare ahead of other institutional goals.

2. Effective retention programs are first and foremost committed to the education of all, not just some, of their students.

3. Effective retention programs are committed to the development of supportive social and educational communities in which all students are integrated as competent members.

Tinto's concluding observations in chapter five are:

"Although retention programs can be most helpful, they cannot replace the absence of a high quality, caring, and concerned faculty and staff. Institutions should therefore not be misled by the use of modern technology and marketing strategies. . . The road to institutional commitment and thus to student commitment does not require very elaborate or high-cost interventions. . . Rather, effective

retention calls for sustained effort of the part of all institutional members to give to each and every student serious and honest attention on a daily basis. It requires, if you will, a continuing commitment to the education of students. No technology, however sophisticated, can replace that sort of commitment." (p. 201).

Tinto's careful research synthesis and thoughtful observations are consistent with those of Seymour and Hewitt. Implementing his recommendations could benefit all college and university students, especially those majoring in science, math, and engineering.

THE CHILLY CLASSROOM CLIMATE: A GUIDE TO IMPROVE THE EDUCATION OF WOMEN

by Bernice Resnick Sandler, Lisa A. Silverberg & Roberta M. Hall
National Association for Women in Education, 125 pages, 1996.

The dreadful situation women experience in some classes is poignantly summarized in *The Chilly Classroom Climate*. The authors claim that men and women, sitting side by side in the classroom, often have very different experiences, because faculty members may unwittingly treat them differently. Senior author Bernice Sandler notes that, "Women as well as men may often treat women in what that not only discourage their classroom participation but also lessen their self-esteem and vocational aspirations." They note that teachers can inhibit women's full participation by such behaviors as:

1. Doubting women's accomplishments, for example, attributing their achievements to "luck" or "affirmative action" but men's to "talent" or "ability"
2. Responding more extensively to men's in-class comments with praise, criticism, or coaching but to women's with "uh-huh."
3. Assuming that women who ask for help do not know the material but that men who ask are smart, inquisitive, and involved.
4. Praising men for their work and abilities and women for their appearance.

The report is presented in five parts: Part 1 describes and analyzes how teacher and student behavior create a different experience for men and women students, Part 2 examines the impact of pedagogy on student, including collaborative pedagogy and feminist pedagogy, Part 3 explores the importance of the curriculum and ways to further integrate women into it, Part 4 explores the impact of teacher style and other factors on the evaluation of faculty members by students and colleagues, and Part 6 contains numerous recommendations for institutions, faculty members, and students for improving the learning climate.

The Chilly Classroom Climate closes with 30 pages of suggestions for improving the climate, organized under the following headings: general institutional recommendations; policy recommendations for administrators; recommendations for presidents, deans, division heads, and department chairs; recommendations for individual faculty members; recommendations concerning evaluation of faculty; what students can do about the chilly climate; and the role of professional organizations. Also, an extensive resource list is included.

Embracing the over 270 recommendations for action will do wonders to improve the classroom climate for women and other groups.

Reviewing these three books has been discouragingly enlightening so I've decided to omit my usual close with a "lighthearted" book in the same genre. I encourage you to reflect on the research

summarized in these three books, carefully consider the authors' recommendations, and rally your colleagues to improve the climate for all students in math, science, and engineering classes and majors.

If like me you become overwhelmed reading the books above and need a break, the following books help put our academic life in perspective: *Moo* by Jane Smiley (Random House, 414 pages, 1995), and *The Dean's List* by Jon Hassler (Balantine, 418 pages, 1997). *Moo* is set in an institution devoted to the art and science of agriculture located in the heart of the Midwest. The short chapters address just about every aspect of academic life — "More than seven thousand new customers every August," "The first memo," "Midterm review," "Downsizing." The chapter describing a faculty meeting was a little too close for comfort. *The Dean's List* is set in Rookery State, a small state university in the upper Midwest. Of the many meanings of "Dean's List," my favorite is described as follows:

"I bring out my pocket notebook and turn to my list. It's headed, CTIWBIDU, which stands for Committee Thoughts it Would Be Indiscreet of a Dean to Utter. What I mean is, they're ideas that cry out to be expressed, but at the moment they cross my mind I have no one to express them to. I make it a point to jot something down at every meeting for two reasons. The number indicates precisely how many meetings I attend each year — a useless and depressing record if ever there was one — and it encourages my mind to wander and thus saves me from sleep or death by boredom."

I laughed out loud several times while reading these two books.