

THE LINK BETWEEN RESEARCH AND TEACHING

1. Does It Exist?

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For the past half-century, research performance has been the main—and sometimes the only—criterion for tenuring and promoting engineering faculty at research universities, and it's becoming increasingly important at institutions whose primary mission has traditionally been teaching. This trend has had unfortunate consequences. Intense pressures to bring in grants and publish papers force professors to spend most of their time on their research and the minimum they can get away with on their teaching, relationships, and health—and the quality of the latter three often shows it. Faculty members with strong research records and below-average teaching routinely get to be full professors, while outstanding teachers with below-average (and sometimes average) research productivity don't get tenure. Depressingly many research papers are published that have little or no impact on technology or society and are never cited by anyone other than their authors, and core engineering courses stagnate, even though globalization has dramatically changed the skills engineers will need in the coming decades.

If university administrators were being honest, they would state that they need massive amounts of external research funding to function, and while teaching also matters, the main determinant of a faculty member's value to them is scholarly achievement. No administrator would dare say that publicly, though, since to many stakeholders—parents, potential and current students, alumni, donors, and legislatures—education is more important than research. The chancellor of a university that proclaimed teaching to be of secondary importance would have to face some hard and unwelcome questions.

So what happens instead is rationalization. Chancellors, provosts, and deans routinely declare that teaching is their institution's most important function, and to justify the heavy dominance of research in the criteria for faculty hiring, ten-

ure, and promotion, they claim that research and teaching are inextricably linked—so much so that only productive researchers can be good teachers. They offer that proposition as a self-evident truth with (ironically, considering the subject) no supporting evidence whatever.

There is no logical reason to expect productivity in research and effectiveness in teaching to be closely related, since research and teaching have different goals and require different skills and personal attributes. The goal of research is to advance knowledge, while that of teaching is to develop and enhance abilities. Excellent researchers must be observant, objective, skilled at drawing inferences, and tolerant of ambiguity; excellent teachers must be skilled at communication, familiar with the conditions that promote learning and expert at establishing them, approachable, and empathetic. Having both sets of traits is clearly desirable but not at all necessary to succeed in one domain or the other. Moreover, first-class teaching and first-class research can each consume well over 40 hours a week, so that time spent on one activity is inevitably time taken from the other. It should therefore come as no surprise if studies reveal no significant correlations between research productivity and teaching effectiveness.

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As it happens, many studies have been performed and that's exactly what they reveal. Most arguments for requiring all faculty members to be active researchers relate to how research *can* enhance teaching, but a recent review of the literature^[1] demonstrates that the potential enhancements are not generally found in practice. The next few paragraphs list the most common arguments and summarize what the studies show about them. For details and citations, see Reference 1.

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Argument: *Research productivity correlates positively with teaching effectiveness.*

Fact: Wrong. Correlations between numbers of papers and grants and measures of teaching quality such as student evaluations, peer evaluations, and learning outcomes are mostly negligible and sometimes negative.

Argument: *Research-intensive universities provide the best undergraduate education.*

Fact: Wrong. In reality, significant negative correlations have been found between a university's research orientation and numerous student learning and satisfaction outcomes.

Argument: *Only active researchers are sufficiently current in science and engineering to be viable teachers.*

Fact: Never demonstrated, and almost certainly wrong for all but advanced graduate courses on the instructors' research specialties. In recent decades applications of most core undergraduate and graduate courses have expanded and impressive resources for teaching those courses have become available, but basic course content has not changed by all that much and little research is now done on that content. Pedagogical experts are much more likely than disciplinary researchers to know how to modernize most core courses appropriately.

Argument: *Faculty with active research programs bring their research into the classroom and use it to inform and enliven their teaching.*

Fact: Usually wrong, especially in undergraduate classes, and when research is integrated into teaching it's not always a good thing. Most current research is well beyond the scope of all but advanced graduate courses, and rigid curricula make it challenging to bring in new material. Some instructors do discuss their research in class and some of their students appreciate their enthusiasm, but other students complain about excessive digressions from basic course content and/or the instructors' apparent lack of interest in teaching that content.

Argument: *Research experiences enhance undergraduate education.*

Fact: True for some students. Participation in undergraduate research correlates significantly with curricular retention of African-American students (but not of other groups), a number of self-reported growth measures and research skills (but not externally measured cognitive skills), and pursuit of graduate study. Even when the argument is supportable, however, it does not justify requiring all faculty members to be active researchers. For one thing, it presumes that active researchers are likely to be better than their more teaching-oriented colleagues at designing and supervising undergraduate research. No supporting evidence exists for this presumption; in fact, much undergraduate research directed by research faculty has students functioning more as unpaid lab technicians than as true researchers. Moreover, undergraduate research is resource-intensive, and at most universities relatively few undergraduates engage in it. Incorporating inductive methods such as inquiry-based, problem-based, and project-based learning into core class instruction could produce many of the same benefits as undergraduate research for more students at a lower cost.^[1]

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In short, the unwritten rule that all university faculty should be active researchers places unreasonable and unhealthy demands on faculty members (especially untenured ones); weakens departmental teaching programs; keeps potentially outstanding teachers from devoting enough time and energy to teaching to realize their potential; deprives students of some inspirational and possibly life-changing instructors, mentors, and role models; and is unsupportable by either logic or research.

Which leaves us with two questions. (1) If most of the potential synergies between research and teaching are not being achieved in practice, what can be done to better achieve them? (2) How can schools and departments recognize, reward, tenure, and promote outstanding teachers with little interest in traditional research without compromising their institution's research mission or cash flow? Answers will be suggested in the next column.

REFERENCE

1. Prince, M.J., R.M. Felder, and R. Brent, "Does Faculty Research Improve Undergraduate Teaching? An Analysis of Existing and Potential Synergies," *J. of Eng. Educ.*, **96**(4), 283 (2007), <[http://www.ncsu.edu/felder-public/Papers/Teaching-Research\(JEE\).pdf](http://www.ncsu.edu/felder-public/Papers/Teaching-Research(JEE).pdf)> □

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