



# Learning to play the game: Student publishing as an indicator of future scholarly success



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## ABSTRACT

The need to encourage future generations of students in the pursuit of scientific research has been viewed as a cornerstone of US R&D efforts. However, few indicators of student intellectual activity at the graduate level are tracked on an ongoing basis. The aim of this paper is to examine graduate student publishing as an indicator of pre-doctoral research activity and future scholarly success. This study addresses the gap in knowledge about student publishing through a distinctive dataset that merges bibliometric publication data with survey data from a study of academic scientists. These data are from a nationally representative sample ( $n=1598$ ) of scientists employed in Research I institutions. For each survey respondent, we have compiled a lifetime publication record from the Web of Science, Science Citation Index. The results indicate that the share of students with at least one publication is substantial and growing over time. Co-publication with advisors is found to be an important driving factor in publication activity, along with certain demographic and field characteristics. Our analysis also suggests that graduate student publication and collaboration are predictors of later career success and productivity, and as such an important tool in evaluating graduate programs.

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## 1. Introduction

There is growing interest in the ability to maintain competitiveness in science, technology, engineering, and mathematics (STEM) fields. Information gathered about STEM activity at the doctoral level mostly focuses on counts of graduates, their demographic characteristics, and whether or not they end up in academic or non-academic jobs. Indicators that address student research activity at the graduate level are rare. Yet publication pressures have become an ongoing feature of the research enterprise, and the ability of graduate programs to foster capabilities for research publication remains in the fore.

This paper's objective is to examine the role student publishing within the student experience and as a future indicator of career productivity. The paper posits that graduate student publishing rates are rising, associated with certain demographic characteristics and collaborations with the faculty advisor, and indicative of future career article output. The paper combines a national survey of scientists in six STEM disciplines at research universities with the publication record of respondents to the survey excerpted from the Web of Science.

The paper's findings support hypotheses that student publishing rates are increasing and co-authorship with the faculty advisor makes a difference. Underrepresented groups are observed to be less likely to publish with their advisors, with the role of early socialization evidenced in the positive and significant relationship between students with academic parents and advisor co-publishing. A strong and significant relationship between publication with the faculty advisory prior to receipt of the PhD and productivity in the post PhD career period is evidenced. As such the paper contributes to research on academic publishing by advancing student publishing as an important early indicator of academic career success.

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## 2. Theory

The increasingly competitive academic labor market in the science and engineering fields raises the expectations for doctoral students and post-doctoral candidates as they contend for a limited number of faculty positions, particularly in research universities. Faculty publication rates have been steadily increasing over the past few decades [1], with science and engineering publications showing annual increases of 2.5% from 1995 to 2007 [2]. Additionally, an increasing share of graduate students relies on research assistantships for graduate school funding [2]. These results reflect an increasing norm and expectation in the science and engineering disciplines for publication, but also the evolving scientific research enterprise as one that is collaborative on a global scale, and organized in large centers, including virtual ones, thereby changing the opportunities one has to collaborate and co-author with other researchers [3]. Mirroring this trend, in today's competitive academic labor market, the expectation is that doctoral students have a publishing "track record" that demonstrates their technical and scientific expertise, but also that they know how to "play the game" and be productive young faculty members. While academic productivity has become a matter of scrutiny [4], there has also been a growing interest on doctoral student productivity, and participation in this important aspect of academic work.

In ideal terms, the doctoral training process should socialize and prepare students for the increasingly complex world of scientific academic research, and provide a strong foundation from which new faculty may embark on productive and successful early careers. For students in STEM disciplines, a certain proportion of doctoral recipients go on to industry or government research, but many remain attracted to the professorate. In some fields, more than half will hold at least one postdoctoral position before gaining a tenure track faculty appointment, which are also competitive particularly in top institutions. Recent NSF statistics show that the percentage of doctorate recipients that go on to hold a postdoctoral position range from slightly less than 40% for engineering to almost 70% in the life sciences [5].

With regards to post graduation plans, plans to remain in academia range from 14% for engineers to 50% for those in the life sciences. Once hired, the need to publish intensifies, as preparation for interim and tenure review begins. New faculty in STEM fields must not only publish at increasing rates in the preparation for tenure, but also demonstrate grant getting ability. Even within the most competitive institutions, however, there is variation in publication patterns among faculty, with some choosing to exit, and others failing to receive tenure. The question arises about the preparation that young faculty received as doctoral students. How prepared are students for the faculty life in research-extensive academic institutions? Are student rates of publishing mirroring general publication trends to show increasing rates of publications prior to completion of the PhD? Are there demographic differences in these patterns? How do the relationships that form during the doctoral experience matter for productivity for early career faculty? In particular, how does the relationship with the doctoral advisor, particularly in co-authorship of peer reviewed journal articles coincide with publishing patterns of junior faculty? Are young faculty who have maintained collaborative ties with colleagues from graduate school showing more productive patterns early in their faculty careers? In other words, do those relationships give young faculty a "head start"?

### 2.1. The doctoral training experience in STEM

While there are a number of issues that affect the ongoing attraction and retention of motivated and productive doctoral students [6–11], the challenges continue through their subsequent entry and success in their academic careers. Graduate student experiences are multidimensional and the doctoral educational process is one that builds technical knowledge in a student's given field, but also potentially provides important professional socialization to the norms and culture of academic life [12]. Students develop skills and "know-how" that enable them to not only function within the norms of their discipline, but to also to learn the process of writing and submitting publishable research. Studies of student socialization point to the special influence of the faculty advisor in this socialization and skill development [12] but also to peers and other individuals that play a role in this developmental process.

Given this, the doctoral educational process provides, at least theoretically, the combination of these skills to enable students to complete their degrees and move forward. In STEM fields, the doctoral experience often is followed by a postdoctoral position (one or more) as a career norm and a stepping stone for faculty positions. From a retention perspective, the role of the doctoral advisor, as well as other experiences of doctoral training, have been pointed to as critical in not only quality training and career preparation, but also in retention and attrition issues, leading to the potential exit from scientific careers [10,12,13].

These issues of attraction and retention in doctoral experiences are of course critical in producing a scientific workforce. Yet, what is less understood, is how doctoral training experiences have changed over time, and how they have an effect on faculty career behavior, particularly in that all important pre-tenure/early career stage. We address the student relationships during that time with advisors and colleagues, and potentially significant effects of this doctoral experience on future career behavior and success.

### 2.2. Productivity

Participating in research is one of the fundamental duties of doctoral students in STEM disciplines, and publication output is a key indicator of research and knowledge production [14]. An expected outcome of engagement in research, and a potential and important indicator of doctoral student academic socialization may in fact be measured through the student co-authorship/publication activities and outcomes during the pre-PhD time period. Studies of the doctoral student experience show increases in involvement in research, and also the opportunity to co-author papers and make conference presentations [10].

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