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Survey Report

COLLABORATION IN RESEARCH

Collaborative research skills have become essential to scientists

SPRINGER NATURE

Executive Summary

Research collaborations have become more common, larger and more international over time. The incentives to collaborate are considerable – for example, collaborative papers tend to receive more citations and be discussed more widely on news and social media. Collaborative projects are also eligible to apply for bespoke funding opportunities. In a small, global survey of academics by Nature Research, we found that two-thirds of academics felt that training in collaboration in research would benefit their career development.

Research collaboration demands a diverse skill set including interpersonal skills, project management and administration and our survey indicated that only 20% of academics had accessed training in collaboration through their institution or externally.

Higher education institutions, scientific organisations and research funders can help to support collaborative research by providing training, giving recognition for collaborative research in promotion decisions and institutional evaluations, or by offering seed funding tailored to helping collaborations get started.

To meet this training need we have developed an online course for researchers on 'Effective Collaboration in Research'.

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Collaboration: The status quo

Collaborative research has become more prevalent globally across all scientific disciplines over the past 50 years. Research collaborations have blossomed with improvements in technology and the ease of travel, and the large number of complex and interdisciplinary questions that science is addressing. This paper aims to summarize the current state of scientific collaboration, highlight some of the benefits and challenges, and offer constructive solutions to help academics expand and develop their collaborative skill set.

Publications with thousands of authors are now becoming commonplace in some fields of research, such as particle physics and genomics[1], and a trend towards collaborative science is clear in almost every discipline. The frequency of inter-institutional collaborations has increased over the past few decades, for example, the United States National Science Foundation reports that globally more than half of all science and engineering papers had at least one co-author at another institution – this figure increased from 57% in 2003 to 65% in 2016[2]. In the social sciences, an analysis of over 4.6 million articles indexed in the ISI Web of Science (WoS) database reported that the number of authors per article increased steadily between 1980 and 2013[3].

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International collaboration in scientific research is also becoming more common[4,5]. For instance, an analysis of over 10 million papers in the natural sciences tracked by WoS found that between 2000 and 2015, the number of internationally co-authored papers tripled[5]. Another study of astrophysics, mathematical logic, polymer science, seismology, soil science and virology research published in Elsevier journals found that each field had expanded its collaborative network by between 18 and 60 additional nations between 1990 and 2013[4].

Why collaborate?

The rise in collaborative research has been driven by many factors, including the increased ease and affordability of travel and communication. Yet, one key motivating factor comes from the science itself – academics are dealing with more and more data-rich and computationally-heavy projects and tackling grand societal challenges like human health and wellbeing, climate change, clean energy generation, and global food security. Tackling these challenges requires such diverse skill sets and expertise that it simply cannot be undertaken by a single individual, laboratory or company[6].

More than half of all science and engineering papers published by US academics had at least one co-author at another institution

Another reason for why academics are drawn to collaborative research projects is that the resulting publications typically receive more citations[7,8]. Throughout the second-half of the twentieth century, collaborative papers and patents in science and engineering, social science and arts and humanities received more citations than single-author papers, even when accounting for self-citations[7], and this trend has persisted into recent decades. For example, one study that evaluated the co-authorship networks of almost 250,000 researchers who published their first 30 academic papers between 2000 and 2015 found that those who collaborated with a wide variety of different co-authors had a higher *h*-index (which measures the productivity and citation impact of the publications)[8] than those who collaborated with co-authors from the same institution.

Collaborations between academia and industry also produce more highly-cited, read and shared papers than academia or industry alone[9,10]. An analysis of data from Thomson Reuters (Scientific) shows that biomedical papers produced by collaborations between academics and industry have a higher citation rate than those produced by either partner alone[9]. In addition, data from the Nature Index revealed that papers with a corporate co-author had higher than average Altmetric attention scores, a measure of the impact of a paper in news and social media[10].

Furthermore, the benefits of collaborating are greatest when collaborators are further afield. For instance, an analysis of over 30,000 papers published in Elsevier's Scopus database between 2000 and 2009 found that the larger the geographical distance between collaborators, the higher the number of citations[11].

Many research funders have begun to design programs that encourage and incentivize collaborative science. For example, the EU Commission's Horizon 2020 program offered nearly 80 billion Euros of funding between 2014 and 2020 for research projects tackling societal challenges, giving priority to international and industry-academia collaborations.

In the United States, the National Institutes of Health Common Fund offers grants to biomedical research that cuts across multiple fields; the Australian Research Council offers Linkage Project grants to support collaborations between academia and industry; and the Hong Kong University Grants Committee offers awards for collective equipment and shared research as part of a Collaborative Research Fund.

Challenges for effective collaboration

Research collaboration has always been an essential motor of scientific discovery but has become more prominent and even required in certain cases to answer complex scientific questions. Yet, academic training alone does not equip early career scientists with all the skills they need to pursue successful collaborative research projects, which can help them reach their career goals.

79% of respondents identified 'Effective Collaboration in Research' as a training course from which they would benefit

In April 2018, we surveyed 679 researchers about their professional skills development and training needs. This small but global survey included senior academics, mid-tier researchers and postgraduate students from biological, biomedical, clinical, computer, engineering, social and physical sciences.

We presented the survey respondents with a list of 11 potential training courses covering a wide range of professional skills areas for researchers. Of those 11 courses, 79% of respondents identified 'Effective Collaboration in Research' as a training course from which they would benefit. 55% of the survey population stated that they were not aware that their institution already provided training in this area, which meant that of the 11 potential training areas the biggest training gap between what is needed and what is offered is for collaborative research skills.

As well as scientific and technical expertise, collaborations demand teamwork, project and people management, communication across cultures and disciplines, big data management, administrative and negotiation skills. Senior academics say that many of these skills are often not covered as part of undergraduate and postgraduate training programs.

"We are all physicists and none of us have a background in management, and we are expected to manage people... We're all learning by experience," says Tulika Bose, Physics Coordinator for the CMS experiment at the Organisation Européenne pour la Recherche Nucléaire (CERN).

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A gap in researcher training

The research findings and the results of our survey summarized in this survey report show that, although collaborative research is becoming important for academic career development, there is a gap in the training on collaborative skills provided to junior academics.

In addition to fostering training, institutions can take further independent steps to develop collaborative research projects. For example, incorporating recognition for collaboration into institutional promotion criteria and research evaluation frameworks can help early career researchers invest time into developing research collaborations that might last their entire careers. Offering seed grants for travel or strong communications infrastructures can help academics overcome some of the challenges presented in developing collaborations, particularly with partners overseas. Finally, offering clear guidance on the contractual and legislative aspects of working collaboratively can help to demystify the process and encourage academics to take the leap into collaborative science.

To meet this training need, *Nature Masterclasses* has developed 'Effective Collaboration in Research', an online course aimed at early and mid-career researchers.

The new course covers every stage of collaborative research from joining and contributing to a project, as well as how to start, lead and conclude your own collaboration.

The training is self-paced and includes guidance from leading researchers, funders, experts in academia-industry collaborations and Nature Research editors on how to structure and manage collaborative projects, foster relationships, respond to common challenges, publish the results and capitalize on the findings.

The five e-learning modules contain easy-to-follow lessons with clear advice, practical tips, insights from experienced collaborators and activities to help participants practice key concepts.

The course was developed with the support of an expert panel of academics and professionals, all of whom appear in video interview clips throughout. Their expertise spans interdisciplinary and international collaborations, publications resulting from collaborative research, the sociology of collaboration, collaborative tools and science communication.

'Effective Collaboration in Research' allows institutions to support researchers in developing the skills they need to maximize the output of their collaborative work.

Find out more and register your interest in the course.

'Effective Collaboration in Research' allows institutions to support researchers in developing the skills to maximize the output of their collaborative work

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www.masterclasses.nature.com
partnerships@nature.com

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