

Research collaboration: Cross-disciplinary training in sustainable chemistry and chemical processes

openaccessgovernment.org/article/research-collaboration-cross-disciplinary-training-in-sustainable-chemistry-and-chemical-processes/178819

2 July 2024

Greg M. Swain, Professor of Chemistry in the Department of Chemistry at Michigan State University, is researching cross-disciplinary training in sustainable chemistry and chemical processes. Here, he emphasizes the importance of teamwork for effective research collaborations

The Research Experiences for Undergraduates (REU) program in the Department of Chemistry at Michigan State University aims to educate students majoring in chemistry, biochemistry, and chemical engineering about significant societal sustainability challenges. The program provides graduate-level interdisciplinary research experiences that address various aspects of these challenges.

The Research Experiences for Undergraduates program

The REU program exposes students to how sustainable practices are impacting research and technology development in chemistry and chemical engineering. The ten-week summer program introduces students, some of whom are engaging in graduate-level research for the first time, to the steps in the research process:

1. Formulation of a research question and or a hypothesis.
2. Creation of a research design.
3. Execution of an experimental plan.
4. Analysis and interpretation of the resulting data.
5. Reporting on the findings and their significance.

In the U.S., the National Science Foundation (NSF) funds research opportunities for undergraduate students through its REU Sites program. Our program is in its tenth year and has provided education, training, and professional skills development to over 100 individuals from across the contiguous mainland and Puerto Rico. The program's core goals are:

1. To involve undergraduate students in graduate-level research projects geared toward addressing green and sustainable challenges through an interdisciplinary approach.
2. To provide a positive mentoring experience and educate the student participants on what constitutes an appropriate and effective mentor-mentee relationship.
3. To generate interest in and better prepare undergraduate students for success in graduate school.

4. To produce a research toolbox (lab safety, notebook, basic statistics, communication, team skills) for the students, and
5. To significantly enhance their professional development, confidence, and self-esteem.

In prior articles, the approach our REU program uses to educate undergraduate students in responsible and ethical conduct of research ⁽¹⁾ and to inform them about the importance of mentoring and what their responsibilities are in the mentor-mentee relationship ⁽²⁾ were described.

Additionally, the impact of the independent research experience on a student's personal and professional growth was discussed ⁽³⁾. In this article, the importance of teamwork for effective research collaborations and how our REU program introduces undergraduate students with limited research experience to the skills needed to be an effective contributor to a research team is recounted.

Collaborations among researchers

Collaborations among researchers across disciplinary, organizational, and cultural boundaries are vital to address increasingly complex societal challenges and opportunities in science and technology development ^(4,5). Solutions to complex problems in health, the environment, energy, and natural resources require the combined expertise of researchers from different disciplines working effectively and productively together in integrated research teams ⁽⁶⁾.

Modern-day scientific problems are multifaceted and cannot be adequately addressed by a single discipline. Integrated research teams bring together diverse expertise, allowing for more comprehensive approaches to complex issues and more successful outcomes. Social science data indicates that appropriately applied team training (i.e., team science) positively impacts team performance and innovation ^(6,7). Training efforts focusing on knowledge, skills, and abilities that are content-appropriate can result in positive team outcomes ^(8,9).

Effective research collaboration competencies

There are several core competencies needed within teams for effective research collaborations to evolve. These include team communication, effective management of team research tasks, collaborative problem-solving, and overall team leadership ^(5-7,9). With the increased emphasis on enhancing team outcomes, substantial effort in the social science community has been invested in comprehensive reviews and meta-analyses that have identified core competencies (i.e., knowledge, skills, abilities, and attitudes) that are needed to advance team performance ⁽⁴⁻⁶⁾.

Of course, at a foundational level, the competencies of the individual members determine the effectiveness of the team and the quality of the research collaboration. Students often have the misperception that they can simply be placed within a team and engage in team science. Instead, students must learn and practice specific skills to be effective team

members. Our REU program teaches students about some of these important skills and how to practice them so that they become engrained behaviors.

Team member skills

The program holds weekly one-hour discussions with the REU student participants, during which team skills are the focus. The skills highlighted include:

1. Team members participate willingly, efficaciously, and cooperatively on team assignments and projects.
2. Team members learn how to identify areas of personal expertise (self- evaluation) and to seek out opportunities to lend expertise to the team to maximize outcomes.
3. Team members solicit and value input from other team members.
4. Team members promote an inclusive and equitable working atmosphere through their words and actions to foster collaborative efforts.
5. Team members listen actively to constructive feedback and during conflict management.
6. Team members are dependable and follow up on action items that incorporate suggestions to achieve collective objectives.

Teamwork in effective research collaborations

In summary, good teamwork in effective research collaborations requires that the team be guided by effective leadership and management organization and that the team members have appropriate ethical awareness, virtues, and attitudes that are conducive to growth and development. A starting point is educating students with the knowledge, skills, and abilities needed for positive team outcomes.

References

1. Open Access Government 40(1): 378-379, October 2023.
2. Open Access Government 41(1): 388-389, January 2024.
3. Open Access Government 42(1): 410-411, April 2024.
4. Bennett LM, Gadlin H. Collaboration and team science: from theory to practice. *J. Investig. Med.* 2012; 60 (5): 768-775.
5. Hall KL, Vogel AL, Huang GC, Serrano KJ, Rice EL, Tsakraklides SP, Fiore SM. The science of team science: A review of the empirical evidence and research gaps on collaboration in science. *Am. Psychol.* 2018; 73(4): 532-548.
6. Lotrecchiano GR, DiazGranados D, Sprecher J, McCormack WT, Ranwala D, Wooten K, Lackland D, Billings H, Brasier AR. Individual and team competencies in translational teams. *J. Clin. Transl. Sci.* 2020; 5(1): e72.
7. Salas E, DiazGranados D, Klein C, Shaw Burke C, Stagl KC, Goodwin GF, Halpin SM. Does team training improve team performance? A meta-analysis. *Human Factors* 2008; 50(6): 903–933.
8. Lotrecchiano GR, Schwartz L, Falk-Krzesinski HJ. Measuring motivation for team science collaboration in health teams. *J. Clin. Transl. Sci.* 2020; 5(1): e84.

9. Bennett LM, Gadlin H, Marchand C. Collaboration and Team Science: A Field Guide. 2010. NIH Publication No. 18-7660.

Please Note: This is a Commercial Profile



This work is licensed under [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/).