

“Zooming” Our Way through Virtual Undergraduate Research Training: A Successful Redesign of the CONSERVE Summer Internship Program[†]

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The COVID-19 pandemic has had an enormous impact on education globally, forcing the teaching community to think outside the box and create innovative educational plans to benefit students at home. Here, we narrate how the undergraduate, laboratory-based Summer Internship Program of our CONSERVE Center of Excellence, which focuses heavily on engaging women and underrepresented minorities in STEM programming, took a turn from an in-person research experience to a fully virtual one. We share our challenges and how we overcame them. Additionally, we provide a description of our virtual internship professional development curriculum, as well as the creative research projects that our seven interns were able to achieve in an 8-week virtual internship, including projects focused on the microbiological water quality of recycled irrigation water; social media promotion, enhancement and marketing of online educational resources focused on water, microbial contamination, and food crop irrigation; decision support systems for using recycled water in agricultural settings; and the effectiveness of zero-valent iron sand filtration in improving agricultural water quality, to name a few. Upon evaluating our internship program, we observed that more than 80% of our interns were either very satisfied or satisfied with the overall virtual internship experience. Through this experience, both the educators and the interns learned that although a virtual laboratory internship cannot completely replace in-person learning, it can still result in a very meaningful educational experience.

INTRODUCTION

Hands-on undergraduate summer research experiences are highly effective at retaining students, particularly underrepresented minorities, in STEM fields, enhancing their likelihood of engaging in STEM-related graduate studies (1–3). Unfortunately, this past summer, the COVID-19 pandemic put a wrench in experiential training, forcing research mentors to create innovative ways in which students could continue to train at home (4). Here, we narrate how our

CONSERVE Center of Excellence effectively redesigned our summer undergraduate laboratory internship program to a fully remote approach.

CONSERVE (funded by the U.S. Department of Agriculture) comprises a large transdisciplinary team engaged in research, extension, and education focused on facilitating safe agricultural water reuse (<http://conservewaterforfood.org/>) (5). As part of our education initiatives, CONSERVE administers an 8-week paid summer internship program with a heavy focus on engaging women and underrepresented minorities in STEM programming (<http://conservewaterforfood.org/summer-conserve-scholar-internship-program-1>). Over the past 3 years (prior to 2020), we engaged 35 undergraduates in our program. The internship program is typically conducted in person, and each year we receive about 30 applications for five to eight positions.

The primary goals of the internship program are to (i) train future leaders in sustainable water reuse; (ii) impart skills in systems thinking; and (iii) provide research training

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and career development, enhancing the potential of our interns to go on to graduate studies.

PROCEDURE

In winter 2019, we advertised four paid internship positions (one at New Mexico State University, two at the University of Maryland, and one at the USDA Agricultural Research Service) and received 10 completed applications. By the first week of March, we had shortlisted seven interns (100% women; 70% White, 15% Black; 15% Asian). Before we were able to send out final acceptance notifications, public health scenarios country-wide were changing and states of emergency were declared across the United States due to rising COVID-19 cases. All of the positions required the interns to work in wet or dry labs, and most universities and government agencies were not allowing people to work on campus for the foreseeable future.

Challenges

We had two choices: either abort the internship program or deliver a virtual internship. Since most of the advertised positions had a strong wet lab component, our first challenge was to determine how we might organize potential virtual laboratory internships. We set up a meeting with our internship mentors and quickly brainstormed about the feasibility of a virtual internship. All of our mentors were on board with helping us launch this virtual internship, and in a 2-week span, we developed and modified project ideas that were feasible for virtual learning.

We then reached out to our accepted students, using a brief QualtricsXM survey, to inquire whether or not they (i) would be interested in a virtual internship and (ii) had reliable

Internet connections that would enable virtual learning. The interns replied that they were excited about the opportunity and appreciated that they would still be paid.

Virtual internship environment and curriculum

We chose to administer the internship through Zoom and the University of Maryland Enterprise Learning Management System, an online digital environment that allows sharing of information between students and faculty. In order to make the virtual experience more enriching and build community among our interns, we added additional components to the program (Fig. 1; Appendix 1). For starters, we introduced a week-long orientation program, where CONSERVE mentors presented research and insights into their career paths. This gave the interns an opportunity to network and understand the CONSERVE team's transdisciplinary approach. The interns were exposed to multiple aspects of recycled irrigation water use, including knowledge gaps concerning the quantity and quality of recycled irrigation water sources (6–9), cost-effective treatment technologies (10–13), farmer perceptions and knowledge (14–16), consumer response (17), and the regulatory factors governing agricultural water reuse (18, 19). Additionally, they were exposed to our innovative extension and outreach programming (20).

Next, the interns and mentors fleshed out the research projects that they would be working on for the following 7 weeks. In addition to these projects, every Wednesday the interns participated in a range of professional development webinars (Appendix 1). Additionally, we offered an experiential professional writing workshop where, each week, the interns were introduced to the different components of writing a manuscript, as well as an overview of the publication process. We also held a journal club every Friday, where each intern had the opportunity to present on recently published CONSERVE papers and interact with the authors. During the final day of the internship, our interns showcased their work through formal group presentations that focused on the outcomes of their projects.

Glimpse into our interns' research projects

An overview of our 2020 summer internship cohort, as well as detailed descriptions of their internship research projects, can be found at <http://conservewaterforfood.org/conserve-summer-interns-2020> and Appendix 1. Briefly, the interns engaged in the following research projects:

1. Social media promotion, enhancement, and marketing of online educational resources focused on water, microbial contamination, and food crop irrigation
2. Development of extension publications to communicate the benefits of using harvested rainwater for food crop irrigation



FIGURE 1. Overview of the virtual CONSERVE Summer Internship Program, 2020.

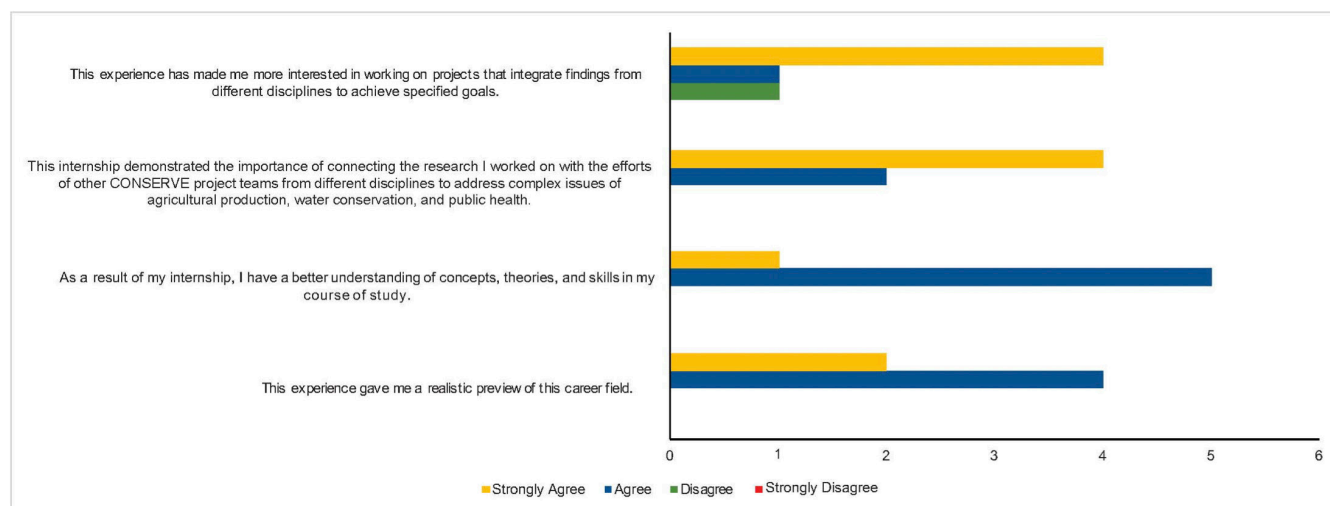


FIGURE 2. Overall results of the interns' evaluation of the virtual CONSERVE Summer Internship Program, 2020. Seven interns participated in the program, of whom six responded to the survey.

3. Analysis of two QualtricsXM-based surveys focused on (i) optimizing urban water resources and (ii) the impacts of gardening on health during a global pandemic
4. Analysis of data to help inform the development of a decision support system for using recycled water in agricultural settings
5. Exploration of future scenarios where recycled water from wastewater treatment plants could supplement the current irrigation supply for some crops
6. Development of a manuscript that reported reductions of bacterial pathogens in surface irrigation water through zero-valent iron sand filtration.

CONCLUSION

To evaluate our approach, we distributed an anonymous QualtricsXM survey after the completion of the program. The University of Maryland Institutional Review Board (IRB) completed a human subjects determination review and determined that the survey was exempt from IRB review. Overall, over 80% of our interns were satisfied or very satisfied with their experience, and 100% of our interns either strongly agreed or agreed that the internship experience gave them a realistic preview of this transdisciplinary career field (Fig. 2). Over 83% of the interns either strongly agreed or agreed that their experience has enhanced their interest in working on future projects with a transdisciplinary

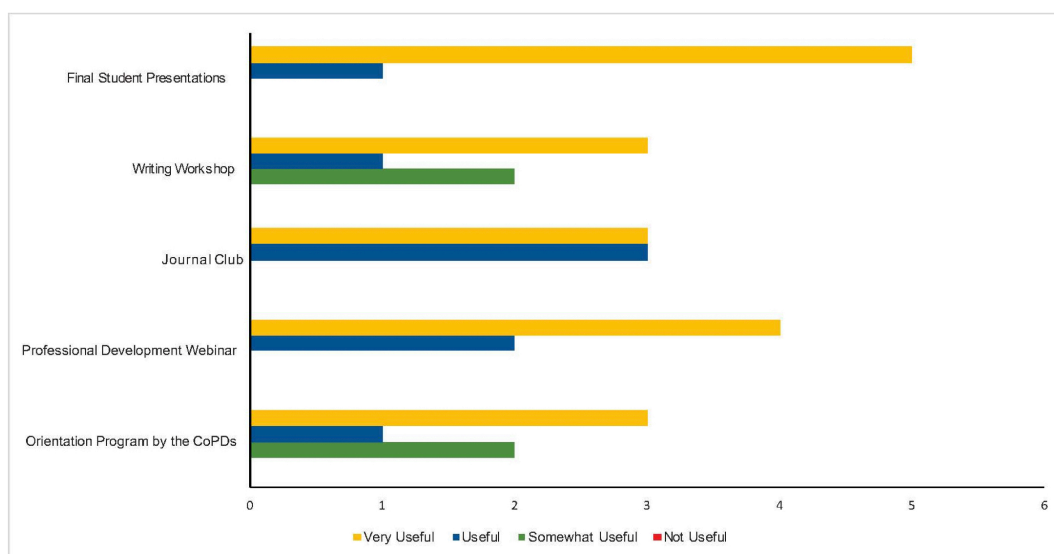


FIGURE 3. Results of the interns' evaluation of specific components of the virtual CONSERVE Summer Internship Program, 2020. A total of seven interns participated in the program, but only six interns responded to the survey. CoPDs, Co-Project Directors.

component (Fig. 2). The interns also reported that they were either satisfied or very satisfied with the professional development webinars, journal club, and final student presentations (Fig. 3). These types of professional development activities are typically lacking in laboratory-based internships (3) and hence highlight the novelty of our comprehensive research training and professional development approach. In summary, we observed that virtual laboratory internships cannot fully replace in-person programs but can still offer enriching research training and professional development opportunities.

SUPPLEMENTAL MATERIALS

Appendix I: CONSERVE summer internship positions, schedule, and curriculum

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