

Undergraduate Research with Impact: The NSF STEM Research for Social Change REU in Forensic Science and Recidivism

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Dr. Kellie Schneider serves as the Chief Knowledge Officer at The Foodbank Inc. where she and a team of other magical unicorns work to eliminate hunger and its root causes. Kellie supports the critical infrastructure of The Foodbank including compliance & reporting, warehouse operations, professional development, strategic initiatives, and continuous improvement. Prior to joining The Foodbank, Kellie served as an Associate Professor in the Department of Engineering Management, Systems, and Technology at the University of Dayton and an Instructor in the Freshman Engineering Program at the University of Arkansas. She holds a BS, MS, and PhD all in industrial engineering from the University of Arkansas.

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Dr. Kenya Crosson serves as Associate Dean for Faculty and Staff Development in the School of Engineering at the University of Dayton (UD), and she is an Associate Professor in the Department of Civil and Environmental Engineering and Engineering Mechanics. A UD faculty member since 2007, Kenya teaches undergraduate and graduate courses; manages an environmental engineering research program; and uses her professional skills to advance initiatives and outreach at the university, in her STEM field, and her community. Kenya teaches courses in engineering design, hydraulics, water treatment, and water quality. Her research program focuses on water treatment and water quality, and she collaborates with diverse, interdisciplinary teams to develop, characterize, and evaluate new materials for drinking water and wastewater treatment applications. Dr. Crosson's leadership activities allow her to work collaboratively to advance institutional goals and mission within her department, the School of Engineering, and the university. She facilitated the strategic planning implementation team's revisioning of the School of Engineering's promotion and tenure policies for tenure track faculty, lecturers, and professors of practice; served a three-year term as the UD Learning Teaching Center's Faculty Development Fellow for Diversity and Inclusion, provides workshops on inclusive teaching and anti-racism for the university community; participates in the American Society of Engineering Educators Committee on Diversity, Equity, and Inclusion, and provides workshops and webinars for the Sloan Scholars Mentoring Network's community of graduates of the Sloan Minority PhD Program. Dr. Crosson is a 2018 HERS Leadership Institute

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Abstract

The STEM Research for Social Change Research Experiences for Undergraduates (REU) program provides undergraduate students with immersive, interdisciplinary research experiences that connect engineering, science, and social impact. The program is motivated by the growing need to prepare STEM graduates who can apply technical expertise to address pressing societal challenges. Particular attention is paid to people and communities experiencing heightened vulnerability due to economic, geographic, or environmental factors that influence health outcomes and access to services.

As part of the STEM Research for Social Change initiative, two REU projects focused on forensic science and recidivism, and shared a community partnership. These projects will be the central focus of the work presented here. Over the course of a 10-week summer program, participants work in small teams alongside principal investigators and faculty mentors from multiple disciplines and universities, as well as a community partner, The Foodbank, Inc. This collaboration is designed to merge rigorous scientific inquiry with applied solutions to real-world challenges, thereby cultivating both technical skills and civic responsibility among participants.

Experiences from the first and second cohorts demonstrate the effectiveness of this model. Students reported growth in research competencies, professional communication, and their ability to see STEM as a vehicle for social change. Faculty mentors noted that the collaborative structure encouraged interdisciplinary problem-solving and offered authentic opportunities for students to see the impact of their work in community settings. Emerging outcomes also suggest that sustained partnerships with community organizations can strengthen both the research relevance and the student learning experience.

This work will highlight the collaborative framework that bridges forensic science and recidivism research with community needs, describe lessons learned from Cohorts 1 and 2, and discuss implications for scaling and sustaining socially engaged REU programs. The work will also outline plans for Cohort 3 and strategies to further strengthen faculty, community, and student partnerships.

Introduction

The STEM Research for Social Change REU program was launched in 2024 through a collaboration of three mission-aligned universities, Central State University, the University of Dayton, and St. Mary's University. Funded by the National Science Foundation, this three-year initiative engages underrepresented undergraduate students in interdisciplinary research that advances the United Nations Sustainable Development Goals. The program emphasizes equity, ethical scientific practice, and community transformation through immersive summer research experiences.

Central State University is its state's only public Historically Black College or University (HBCU) as well as an 1890 land grant institution. It fulfills this dual mission by advancing

educational access and driving innovative, community-focused agriculture and STEM research. The University of Dayton and St. Mary's University share a Catholic and Marianist mission rooted in faith, community, and service dedicated to educating the whole person. Together, all three institutions foster leadership and prepare students to serve the common good through justice, peace, and purpose-driven engagement. In addition to collaboration among the three institutions, the two Ohio-based institutions have long-standing partnerships with The Foodbank, Inc.

The Foodbank serves as Miami Valley's primary source of hunger relief. This is accomplished through the acquisition and distribution of food through a network of more than 100 partner agencies. The Foodbank operates under the guiding vision that "no one should go hungry" and a mission dedicated to "eliminating hunger and its root causes." As such, The Foodbank recognizes that food insecurity is deeply intertwined with broader structural inequalities and actively promotes work development strategies that stabilize lives, reduce dependency on public assistance, and foster long-term economic mobility. The Foodbank seeks to empower individuals, particularly those facing barriers to employment, with the tools, resources, and support necessary to secure gainful employment and attain economic stability.

One group of people who regularly experience barriers to gainful employment are justice-involved individuals who have been convicted of felonies and/or incarcerated. This work considers a justice-involved individual as one who has either been previously incarcerated or on probation but is not currently incarcerated. On any given day, 3.7 million Americans are on probation or parole, and another 2 million Americans are incarcerated in jails and prisons [1]. Advances in forensic science have provided objective scientific evidence, such as DNA analysis, ballistics, and fingerprinting to help identify and prosecute offenders. Unfortunately, flawed forensic methods and invalid testimony by experts have been significant factors in wrongful convictions [2]. In addition, cases involving forensic evidence can lead to longer sentences for those found guilty of serious crimes [3]. Upon release, returning citizens, whether wrongfully or justly convicted, face collateral consequences of incarceration which include systemic barriers to housing, employment, professional licensure, property rights, mobility and even access to public benefits. These collateral consequences contribute significantly to the United States' high recidivism rates [4].

Research Projects and Participant Activities

Over the course of three years, the STEM Research for Social Change REU will engage 30 undergraduate students. In Year 1, eight students participated; in Year 2, twelve joined; and ten are expected in Year 3. Of the 20 participants in the first two years, seven engaged in community-based research focused on forensic science and recidivism. Students were assigned to one of two interdisciplinary research focuses, recidivism or forensics, each grounded in real-world challenges and supported by faculty mentors and The Foodbank, Inc. While the research goals of each track differed, both groups participated in a shared foundation of activities designed to foster technical growth, civic awareness, and collaborative skill development.

Shared Learning and Community Engagement: All participants engaged in weekly journal clubs throughout the program to build foundational knowledge in recidivism, forensic science, and

social determinants of health. The first session introduced a structured note-taking and thematic analysis framework, which students then applied as they rotated presenting peer-reviewed articles. These discussions helped students develop critical reading, synthesis, and communication skills while deepening their understanding of the social implications surrounding their research.

To foster empathy and build rapport with the community partner, students volunteered at The Foodbank one full day per week for the first five weeks. These mid-week shifts immersed students in the organization's daily operations and allowed them to form authentic connections with staff, many of whom later participated in interviews. Students reported that this experience enhanced their understanding of the systemic barriers faced by justice-involved individuals and enriched the quality of their interview interactions.

Interview Design and Data Collection: A central component of both projects was the development and implementation of a shared interview protocol. The survey instrument was crafted to elicit insights relevant to both research tracks while minimizing participant burden. Faculty mentors obtained IRB and organizational approvals for working with justice-involved individuals, and the student researchers completed CITI training, coordinated logistics, and conducted interviews with justice-involved Foodbank employees. The interviews took place during paid work hours, with participants receiving a \$25 grocery gift card as an incentive.

Students took ownership of the interview process, dividing responsibilities for scheduling, conducting interviews, and transcribing and cleaning data. To protect the confidentiality of the interview participants, all individuals selected a pseudonym for use in transcripts, notes, and any subsequent publications. Each interview was recorded via Zoom and transcribed using automated tools, with students editing transcripts for accuracy. This collaborative process not only built qualitative research skills but also fostered cross-project relationships, as students from both tracks participated in each interview and shared a common workspace for coding and analysis using MAXQDA, a qualitative analysis software.

Recidivism Project: Students in the Recidivism group focused on understanding how The Foodbank's employment practices influence social determinants of health and recidivism outcomes for justice-involved employees. To prepare, they completed an online certification in system dynamics and learned to use Vensim, a system dynamics modeling software. Their primary goal was to replicate a published stock-and-flow model of recidivism, with a stretch goal of adapting it to reflect Ohio-specific data and foodbank practices. One student concentrated on coding and model replication, while the other conducted a literature review and data search to inform model parameters and situational insight.

Forensics Project: The Forensics group engaged in hands-on laboratory investigations to explore the reliability and limitations of forensic techniques. Activities included fingerprint development using various powders and fuming methods, hair and fiber analysis, toxicology testing, blood typing, and DNA extraction. Students critically examined how these techniques are used in legal frameworks and discussed their potential to contribute to wrongful convictions. These lab experiences were paired with interview data to explore how forensic evidence had impacted the lives of justice-involved individuals.

Professional Development: In addition to research, students participated in workshops on research ethics, graduate school preparation, resume and curriculum vitae development, and fellowship opportunities. These sessions were designed to build confidence and prepare students for future academic and professional pathways. The REU also emphasized personal development, encouraging students to reflect on their values, build community with peers, and engage meaningfully with the populations they were studying.

Together, these activities created a holistic research experience that blended technical rigor with social responsibility. The integration of community engagement, interdisciplinary inquiry, and professional development helped students see themselves not just as researchers, but as agents of change.

Challenges and Lessons Learned

Feedback from the Year 2 cohort revealed challenges and opportunities for the REU managers and project mentors to make changes to improve the experiences of students in the final year of the programming.

Challenge: *Inexperienced Undergraduate Students*

The Year 2 REU cohort included mostly early-career students—25% rising sophomores, 67% juniors, and only 8% seniors, meaning most had limited professional experience. The program required students to relocate, work independently, and engage with community partners, which demanded a level of professionalism and maturity that some were still developing. This mismatch occasionally created challenges. However, since the REU is designed to introduce students to research, excluding those without prior experience would be counterproductive. Future programs should anticipate a range of readiness and build in structures that support professional growth alongside research training. Lessons learned that are related to inexperienced students are discussed below.

Lesson Learned: *Giving and Receiving Feedback*

Feedback is an important component to research and the research experience that allows participants to work with diverse personalities and perspectives. Attention should be given to developing the ability to give and receive constructive feedback in students early in the program. Both students and mentors would benefit from opportunities to exchange constructive feedback and learn from one another. A venue where this is possible could be to schedule a mid-program performance review in the mentor-mentee agreement or while practicing draft oral presentations.

Lesson Learned: *Setting Expectations*

Communication and understanding are key components of research. If professional experience is not required to be a participant, then it should not be assumed that students inherently know the time and professional expectations of the research they are working on. Clear guidelines related to attendance, time commitment, and availability of transportation should be set, discussed and published for future reference. Deliverables, due dates, and close-out procedures should be discussed and documented in advance of the end of the program. Consequences resulting from the failure to adhere to the guidelines and established expectations should be presented to

students early in the program along with a pathway to reconcile deviations from the guidelines where possible.

Challenge: *Scaling and Sustainability of the Program*

One of the goals of the REU is to provide undergraduate students with a transformative summer experience. Beyond research, this experience is expected to also include professional development, interest in graduate education, and an enhanced sense of belonging for underrepresented populations. To effectively sustain and scale a program that is expected to produce a transformative experience, successful coordination and implementation of many moving parts must occur. This is challenging to accomplish because the REU occurs over the summer when university resources are limited and campus life/culture is substantially reduced. Lessons learned that are related to scaling and sustainability are discussed below.

Lesson Learned: *Program Management*

REU programs require planning and management of student travel and housing, tracking of program requirements and their completion, monitoring of participant attendance and deliverables, and coordination of financial disbursements. If the program manager is also a faculty research mentor, these tasks and responsibilities can become overwhelming. An assistant or co-manager should be designated to aid in the management of the REU and ensure its successful implementation.

Lesson Learned: *Community Building*

While the REU experience is centered on performing research that affects social change, it must also include opportunities for participants to engage in community with their cohort and host site. To ensure that there are adequate opportunities for participants to bond with each other and sufficient events for them to engage with the local community, a designated coordinator should be established by the start of the program. This coordinator should be responsible for creating social activities and identifying local events throughout the 10-week program, sharing them with the participants in a timely manner, and helping to arrange or coordinate transportation when appropriate.

Conclusions and Future Work

The STEM Research for Social Change REU offers a model for integrating technical training with civic responsibility. Future efforts will expand interview analysis, refine forensic assessments, and enhance outreach. The program demonstrates how engineering, chemistry and forensics education can empower students to address systemic challenges through socially engaged research.

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