

RET Supplement: Engaging Storm Lake Community School District Teachers in Authentic Civil Engineering Research

Teachers will be engaged in hands-on authentic research experiences revolving around the theme of “Mitigating Natural Disasters” in the labs of Iowa State University (ISU) with the Civil, Construction and Environmental Engineering (CCEE) faculty during the summer. The activities will allow the teachers to bridge research experiences to improve content knowledge which will translate to improved secondary STEM education in their classrooms (Farrell 1992; Dubner et al. 2001; Silverstein et al. 2009). These experiences will be interconnected with analogous experiences offered at North Dakota State University, as proposed in NSF Award #1953102.

Description of Research

The proposed research projects will revolve around the intellectual theme of “Mitigating Natural Disasters.” Teachers will be engaged in on-going efforts undertaken by CCEE faculty to help address issues impacting the Midwest region and globally from natural disasters. ISU’s CCEE faculty have been actively working in research related to mitigating natural disasters for the past several decades. Teachers will work with faculty and graduate students on these continuing projects during the six-week summer experience towards two outcomes: (1) gain proficiency in the technical content through their research and (2) develop a curricular module related to that research focus. Additionally, through this program, teachers will be better prepared to inspire young minds to continue to solve real world problems related to natural disasters. As this program focuses on teachers that serve in underrepresented and under-served populations relative to the engineering discipline, the curricular modules will directly contribute to an increased exposure and interest to STEM opportunities that these students would otherwise not receive.

Qualifications of the Team

The PI is an early career female engineering faculty who has a proven record of publications achieved through the support of the NSF Graduate Research Fellowship (GRFP) and numerous other fellowships and scholarships including the Charles E. Via Doctoral Fellowship, Dwight D. Eisenhower Transportation Fellowship twice and the U.S. Society of Dams scholarship. She has published more than 120 journal and conference papers, of which nearly 55% of her publications are related to geotechnical issues faced during natural disasters including earthquakes, wildfires and landslides. A complete list of the PI’s publications can be found at Ajmera (2021). The PI has also been invited to deliver over a dozen presentations describing her findings at various venues. Moreover, her work has received regional, national and international attention resulting in several awards including the 2020 Thomas A. Middlebrooks Award from the American Society of Civil Engineers (ASCE) Geo-Institute (GI), the 2020 Collingwood Prize from ASCE, the 2020 Oldrich Hungr Award from the International Consortium, 2018 Orange County Engineering Council Outstanding Educator and multiple best paper awards. The PI is also a Technical Committee Member for the “Soil Dynamics and Earthquake Engineering Committee” and the “Embankments, Dams, and Slopes Committee” of the ASCE GI, an editor for the journal “Landslides,” was an Associate Editor for Volume 2 of the Fourth World Landslide Forum, Volume 4 of the Fifth World Landslide Forum, and Standing Editor for the Open Access Book Series titled, “Progress in Landslide Research and Technology,” and regularly serves as a session chair at national and international conferences related to slope stability and geotechnical earthquake engineering.

In the past six years, the PI has supervised or co-supervised fifteen undergraduate and 33 graduate students on various research projects. Of the students supervised, eight undergraduate and twelve graduate students are from underrepresented populations, including females and Hispanics. She also supervised or co-supervised 27 undergraduate students (of which nine are female) from Brazilian and Mexican universities in summer research opportunities and provided similar opportunities to 25 high school and community college students. In addition to her experiences in supervising and managing a large number of students in research experiences during the academic year and in summer, the PI has also served as a Teaching Fellow during Summer 2014 and as an instructor for a course titled, “Engineering Innovations” from 2015 to 2018 co taught at California State University with Johns Hopkins University. This course introduces 50-70 high school students to various engineering disciplines in order to increase their interest in pursuing careers in engineering. During this month-long program, the PI

worked closely with a high school science or engineering teacher to ensure the success of the program and to provide opportunities for the teacher to develop a stronger understanding of engineering curricula and the demands on engineering students. This allows the teacher to better prepare their students to pursue careers in engineering fields. The mentored high school teachers have consistently implemented curricula from this program in their classrooms. During Summer 2021, the PI served as a faculty mentor for two in-service and one pre-service teachers as part of this RET program as well as two undergraduate students as part of a REU program on the NDSU campus. Additionally, she serves as a senior personnel on a recently funded REU program (Award #2050175).

For sixteen years, the Co-PI has worked in secondary education in various capacities including as a classroom teacher, led and served on district committees related to secondary education curriculum and accreditation, and as a high school principal. She has taught thousands of students over the course of her career. In her role as an educator and principal, she has designed and led curriculum revisions for entire content areas, professional learning communities, and staff development. As a principal, she had a staff of approximately forty that reported directly to her. She also oversaw the professional development efforts for the 100 staff members in the district. She has spent much of her career developing authentic, real-world learning opportunities and guiding other teachers to create similar curricula in their own content areas. In her current role as an early career female education faculty, the Co-PI guides teachers working towards obtaining their credentials to become future principals. Her major focus is on how to develop and encourage teachers to be positive role models and establish meaningful relationships with students. The Co-PI has also participated in and led district accreditation in the U.S. to help evaluate schools for areas of improvement and powerful practices. She is also currently working on research related to New American Experiences in rural states as well as the impact of COVID-19 on K-12 and higher education faculty. Dr. Crary is the Co-PI on an active RET grant (NSF Award #1953102) resulting in two submitted publications, to date.

Mentoring

The teachers in the RET experience will receive mentoring throughout the program. The mentoring begins with an informational session for interested teachers that includes an overview of the program and also answers any questions they may have prior to applying. Once teachers are selected, they are able to reach out to the Co-PI with any questions or concerns. The summer experience begins with an orientation day designed to build a cohort community through team building activities with the PI, Co-PI as well as the faculty mentors and graduate students. The activities include a tour of the campus, lab safety training, time to meet their research team, ice breaker activities with their research teams and concludes with an overview of the summer experience expectations and schedules. During the summer program, ongoing mentoring will occur through weekly meetings to provide instruction, feedback and support for the curricular modules and research presentations. The weekly meetings will scaffold the instruction for the research presentation and curricular module. Informal mentoring is built into the summer experience through breakfast, lunch, coffee and snack breaks that are provided for the participants. The informal mentoring helped provide times throughout the week and day to answer questions and provide support. The mentoring continues after the summer experience into the academic year through the Co-PI observing a lesson from the curricular module to provide feedback and support. In addition, the teachers attend a meeting as a cohort to reflect upon their modules.

Relationship of RET Supplemental Funding

The RET Supplemental will be connected to the original award through several activities. The two sites will be connected synchronously through an online platform for the orientation day, including the ice breaker, weekly joint workshops and the capstone symposium. Through working collaboratively in the summer experience a broad network of teachers in North Dakota and Iowa will form. This network of teachers will create authentic curriculum related to engineering that is critical in smaller states, like North Dakota and Iowa, where there may only be one or two science or math teachers in the school. It is further noted that institutions are located in EPSCoR states and they cater to a diverse audience of underserved and/or underrepresented populations.

This partnership hub will assist teachers in having stronger connections to reach out to, develop ideas and continue the work well-beyond their initial experiences in the RET program. The research team envisions that the experiences provided will not only be interdisciplinary in nature, but teacher teams at each site will also be interdisciplinary finding ways to integrate social sciences and humanities with engineering curriculum. When successful, the hub will serve the leading creator of educational content that engages middle and high school students in various STEM courses, while preparing them to become the critical thinkers, team players and leaders required in the next global workforce to address the many problems posed by natural disasters.

Description of Recruitment Process

In-service teacher participants for the RET program at ISU will be recruited from Storm Lake Community School District (see attached letter of collaboration). This district was selected because of their demographics. The school population is 86.5% non Caucasian with 52.6% Hispanic and 5.9% Black. In addition, 57.7% of the students are English Language Learners and 69.5% receive Free & Reduced Lunch (39.1% for Hispanic; 4.3 % for Black). Announcements for the RET program will be sent through school district email. It is anticipated that the application will be released in mid-January. The Co-PI will host an online information session to share additional details and answer any questions in February. Application deadline of March will be set for interested teachers. Applications will be reviewed by the PI and Co-PI, to select four teachers. Applicants will be selected based on how well their courses align with the proposed research projects. Underrepresented and under-served groups including women in STEM fields, teachers from Hispanic, African American, or Native American ethnicities, veterans, teachers from rural communities, and those individuals with disabilities will receive preference. The selected participants will be notified in April.

Statement of Acknowledgment

No students will be funded through this supplemental funding.