

Board 425: Work in Progress: Initiating a Research Experience for Teachers Centered on Manufacturing

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Initiating a research experience for teachers centered on manufacturing (Work-in-Progress)

Introduction

Manufacturing is a foundation of economic growth and job creation across the U.S. and is constantly changing with improvements in technology, materials, and design. While this field is a pillar for economic growth within the US, manufacturing companies struggle to recruit a prepared workforce. This has spurred the development of research experience for teachers (RET) sites funded National Science Foundation whose theme centered on manufacturing.¹⁻⁴ However, no sites until now have focused on introducing teachers to manufacturing in the southeastern US and investigated regionally-important questions related to workforce development, teacher learning and professional development, and post-secondary educational pathways. Therefore a new RET site was nucleated within the southeastern US in South Carolina, where there has been a 17.51% increase in manufacturing establishments between 1990 and 2019.⁵ A significant increase in the manufacturing in this state has been due to the increase in the manufacturing of transportation equipment.⁵

This RET program was designed to increase teacher participant's knowledge about the multiple career pathways in manufacturing and increase their confidence in explaining how new manufacturing technologies depend on the advancement of engineering and science knowledge. Over the course of three summers, approximately 30 teachers will complete an initial onsite program phase and then transition to a remote phase of the program. In the first phase, each teacher completed research on the university campus. While the teacher was provided with an initial research question, they were given agency to complete the project and the support of an engineering faculty member who acted as their advisor. During these six weeks, the teacher also took part in workforce development training, visited manufacturing facilities in the region and designed a teaching module that could be piloted the following fall or spring term in their classes. The second phase of the program took place off campus and consisted of the teachers further polishing and launching their lesson plan tied to the RET experience. These teacher activities were designed so that following the programmatic goals were met:

1. Expand content knowledge of advanced and traditional materials manufacturing for teacher to support integration into new STEM and workforce development teaching and learning materials;
2. Engage teachers in advanced manufacturing research where they take on the role as the lead researcher and increase their understanding of how research leads to knowledge development;
3. Provide teachers with beneficial professional development (mentoring on curriculum development, etc.) both during their research experience and the academic year;
4. Create strong communication between the teachers, the RET Site project faculty team and the industrial advisory board during the academic year to provide the teachers with support as they refine their curriculum modules utilizing inquiry methodology;
5. Increase teacher self-efficacy related to manufacturing content knowledge and inquiry-based teaching needed to inspire their students to consider careers in advanced manufacturing;
6. Deliver workforce development specific professional development targeted to increase teachers' knowledge of regional career opportunities in advanced manufacturing to inspire their students to consider advanced manufacturing careers.

This work-in-progress paper provides an overview of the establishment of the RET framework and the experience of the first cohort within the program. Specifically, it outlines the activities within the first cohort's experience, the evaluation framework and initial results related to teachers' self confidence in discussing manufacturing changed during the program, changes that will be implemented between the first and second cohort, and reflections of the RET leadership team on the benefits and challenges facilitating a research program for teachers versus undergraduates on a research campus.

Overview

Between 2023- 2025, this RET site will host will 30 high school teachers in three cohorts that begin each summer and end the following spring. Each accepted applicant was required to engage in a six-week manufacturing research project while also completing workforce development training that and learn about the manufacturing field over a six-week intensive program and then bring back their newly gained knowledge back to their classrooms the following academic year by incorporating it into a lesson plan. This structure aligns with that of other successful RET sites.⁶

The first cohort started in the summer of 2023 and included eight (8) high school teachers in the summer of 2023. While both high school teachers and community college instructors within a one-hour drive from the research university main campus were recruited, applications only came from high school teachers. The cohort of high school teachers was diverse with respect to gender (50% self-reporting as female), ethnicity (25% African American/Black), educational level (37.5% held a master's degree) and prior research experience. These teachers went through an initial onboarding period that included completion of general paperwork (emergency contact form, etc.), safety training and responsible conduct of research training prior to meeting their research mentors. Once completed, each teacher then focused on integrating into their research team and conducting their research M-Th each week. Fri programming the consisted of workforce development training, trips to manufacturing facilities, and focused time for developing lessons plans that bring manufacturing and research concepts into their classrooms. Fieldtrips included visits to a steel recycling facility, turbine facility, a metal fabrication facility, and a testing facility that was a partnership between public and private institutions. At the end of the program, teachers were asked to develop a video highlighting their research experience, contributions to new knowledge through their research and the lessons plans they developed for their classrooms. These lesson plans were formatting according to the TeachEngineering digital library (<http://teachengineering.org/>). To highlight the work of the teachers, their videos and lesson plans were posted onto a 'Virtual Expo' website.

Program Evaluation

Project evaluation includes both an internal assessment related to participant experiences and an external evaluation focused on program fidelity. Data collected has included submitted work by the teachers such as research reports, reflections by the teachers, and survey responses. These materials are then used by an external evaluator in preparations for their end-of-program interviews with the teachers. While analysis of this data will not represent the experience teachers participating in RETs across the U.S., they will give insight into regionally-important questions related to workforce development, teacher learning and professional development, and post-secondary educational pathways. For survey development, quantitative measures such as Likert questions will result in descriptive findings of affective responses across participants and qualitative measures such as open-ended prompts will provide the contextual data particular to individual project experiences. Throughout their participation, participants will be directed through reflective feedback activities that have less structure than formal assessments but provide opportunities to participants to contribute to the ongoing direction of their work by allowing for guided input toward improved project outcomes. Assessment of project experiences, especially curricular artifacts, will focus on the teachers as instructional designers, investigating their content knowledge and pedagogical content knowledge related to manufacturing and its component science and engineering subject matter.

Teachers' self confidence in discussing manufacturing changed during the program

The first cohort is still mid program (all have not yet incorporated their teaching modules into their classrooms), all have completed the onsite research, completed professional development activities, and toured manufacturing facilities. Using surveys and focus group interviews, the program administration looked at the teacher's changing self-confidence in talking about manufacturing in their classrooms. Analysis showed that these teachers already have reported increased confidence and comfort with presenting information on advanced manufacturing to their students.

Reflections on the benefits and challenges facilitating a research program for teachers versus undergraduates

Recruiting was a more intensive process than anticipated, and we only filled 80% of the RET cohort spots in the first summer. Recruitment was impacted by the shortening of summer breaks for teachers. Summer terms for teachers have shortened to approximately 7 weeks, making 6-weeks onsite difficult for many teachers. Several applicants had prior commitments (such as personal travel and other professional development events) that conflicted with the six-week onsite research component. Reasons that teachers cited when rescinding their applications to spend more time with their own children, conflicting professional development commitments, decision to transition work locations the next academic year. In order to provide additional value to the teachers beyond salary and experience, the program administrators applied to the South Carolina Department of Education for 120 renewal course credits for teachers who completed the programming during the six-week onsite program.

Changes between cohort 1 and cohort 2

- Changes in how the program is administered will be made for the next cohort. The shifting calendar for schools in the southeastern region to shorter summers in exchange for a higher number of short breaks during the academic year, has made it more difficult for teachers to commit to being onsite for a continuous six-week research experience. To help interested teachers, the RET leadership team allowed teachers the ability to incorporate remote work or a mid-program leave.
- While we had intended the mentor training provided to faculty and graduate mentors for the high school teachers to be flexible (online), only 4 mentors completed the UM 101 Mentor training. In the next cohort we will switch to an in-person training that will occur between the end of the spring academic term and the RET program.

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