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Promoting STEM through summer research experiences for K-12 teachers in a group setting

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Promoting STEM through summer research experiences for K-12 teachers in a group setting

Abstract

Hispanics are consistently underrepresented in U.S. STEM employment. One possible explanation for this disparity could be that Hispanics are less likely to have a science or engineering background that would facilitate their STEM employment. According to the recent Texas Academic Performance Report, more than 75% of total students in South Texas are Hispanics, which is much higher than the state percentage of around 53%. While the majority of the students in this region and Texas are Hispanics, their academic achievements in STEM disciplines are much lower than those of the other groups. This disparity may be due to the lack of involvement of primary language and culture in education settings, which is increasingly recognized as important to engage students from diverse backgrounds effectively. When educators are from similar social and cultural backgrounds, they are more equipped to support students' academic success. Through support from the National Science Foundation (NSF) and the U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA), Texas A&M University-Kingsville offers summer research programs to K-12 teachers in a group setting to promote STEM in the region, and to create a dynamic multidisciplinary environment and a Community of Practice where K-12 teachers, teacher educators, researchers, industry professionals, and graduate students share a common goal of expanding and sharing knowledge to promote STEM education in South Texas. The goal of the program is to equip educators with similar social and cultural backgrounds with STEM content and curriculum implementation skills to promote student success in regional STEM classrooms. In this paper, the authors share details of the program design, summaries of projects included, and outcomes of analysis of feedback from a total of 31 teacher participants. Pre- and post-surveys have been conducted along with a follow-up phone interview to collect feedback from the teachers. Performance and feedback between the two groups of teachers (6-week and two-and-a-half-week) are compared and analyzed. In addition, the perception of school administrators, such as principals and superintendents, is discussed along with the experience and lessons learned in teacher recruitment, communication, and program implementation.

Project Background

According to the Texas Academic Performance Report [1], 74.4% of the 2023-24 annual graduates and 75.8% of total students in South Texas are Hispanics, much higher than the state percentages of 52.3% and 53.2%, respectively. In 2024, only 11% of the Hispanic students in South Texas were at Masters Grade Level for all grades in Mathematics, compared to 24% for those classified as white and 50% for Asians [1]. Masters Grade Level refers to those students who are expected to succeed in the next grade or course with little or no academic intervention as they demonstrate the ability to think critically and apply the knowledge and skills gained [1]. In 2024, for all grades in Science, only 8% of the Hispanic students in South Texas were at Masters Grade Level, compared to 24% of students classified as white and 38% for Asians [1]. For the 2022-23 annual graduates in South Texas, 19.2% were at or above SAT/ACT criterion (lower than the state average of 28.9%), with only 13.3% of Hispanics at or above SAT/ACT criterion, whereas the rate is 33% for whites and 53.2% for Asians [1]. Therefore, while the majority of the students in South Texas and Texas are Hispanics, their academic achievements in STEM disciplines are much lower than the other racial/ethnic groups. One of the main reasons for this disparity may be the lack of consideration of language and culture in education, which is becoming more and more important to effectively engage students from diverse backgrounds [2], [3], [4], [5], [6], [7]. When educators are from social and cultural backgrounds similar to their students, they are more equipped to support student academic success [7], [8], [9]. Hispanics are also consistently underrepresented in the U.S. STEM employment [10]. Another possible explanation for this disparity could be that Hispanics are less likely to have a science or engineering background that would facilitate their STEM employment [10], a supposition the performance gaps noted above appear to support. The National Science and Technology Council recently identified STEM education goals. They are to "increase diversity, equity, and inclusion in STEM", and "prepare the STEM workforce for the future" for the U.S. to be the global leader in STEM literacy, innovation, and employment [11]. To achieve sustainable growth in the STEM workforce, it is imperative to train educational professionals in a way that would enable them to motivate their students from all backgrounds to pursue careers in STEM fields.

Project Design

Two summer research programs were designed and offered to K-12 teachers in the targeted region. The 6-week NSF summer research program targets middle and high school (Grades 6-12) STEM teachers and recruits 10 teachers per year, while the two-and-a-half-week USDA summer research program targets K-8 teachers and recruits up to 16 teachers per year (8 teachers per cohort with two cohorts per year). Both programs give preference to teachers who are Hispanics, women, and/or teachers who were first-generation college graduates, because of the high percentage of Hispanic students and potential first-generation college students in the region and the strong relationship that has been established between students' academic success and similarities in student-educator social and cultural backgrounds. In both programs, two teachers are paired to work on the same project and develop learning modules. Each team of teachers is supported by research and education faculty members, graduate students, and an advisor employed in the industry. The research projects are tailored toward the teachers' backgrounds and teaching tasks.

The 6-week NSF summer program started in Summer 2023 and has recruited two cohorts in the last two years, while the two-and-a-half-week USDA program started in Summer 2024. Since the programs allow teachers to participate at most twice, 31 teachers participated in both programs in the last two years. Table 1 shows the demographics of the teacher participants. Since several teachers participated in the program twice, the total number of participants is less than the sum of individual program participants.

Table 1: Demographic Information of Teacher Participants

Programs	Hispanics	Non-Hispanics	Female	Male	First-generation college graduates
NSF (2023)	6	4	5	5	4
NSF (2024)	4	6	8	2	5
USDA (2024)	7	7	13	1	9
Total	15	16	24	7	17

On the first day of each program, orientation and basic research training are provided to all the teacher participants. Additional training on basic research skills, such as data analysis and modeling, and effective curriculum development processes are also provided in the first week of each program. During the summer program, in addition to conducting the research activities as a team, the teachers also develop curriculum modules, attend webinars, seminars, and field trips, and complete posters and project reports. Additionally, the 6-week program participants are required to do an oral presentation at the end of the program. Weekly group meetings are scheduled for the teacher participants to present their progress. The project team visits teachers' classrooms during the school year following the summer program. As a result of all these activities, a Community of Practice (CoP) is established and growing. Figure 1 summarizes the participants' activities.

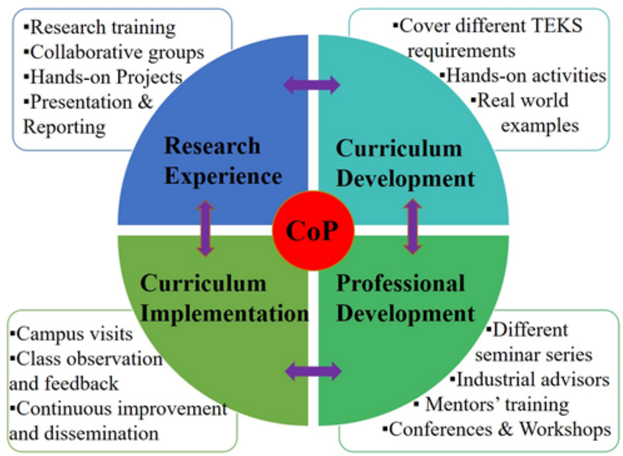

Figure 1: Overview of Participants' Activities.

The research projects conducted in both programs are listed below.

- Solar Radiation Big Data Analysis to Increase the Efficiency of Organic Solar Cell (NSF, Summer 2023).
- Solar Radiation Big Data Analysis for Strategic Positioning of Residential Solar Panels (NSF, Summer 2024).
- Analysis of Wind Speed Pattern Changes before and after Wind Farm Operations (NSF, Summer 2023-2024).
- Effect of Daylighting on Students' Learning and Classroom Electricity Consumption (NSF, Summer 2023-2024).
- The Potential of Converting Food Waste into Renewable Energy in the Backyard (NSF, Summer 2023-2024).
- Wind Farm Layout Study, Future Development, and Cost Analysis (NSF, Summer 2023-2024).
- Fundamental Understanding of Tearing and Fracture Behavior of Food Packaging Films (USDA, Summer 2024).
- Basics of Soil and Water Conservation for Agriculture and Ecosystems (USDA, Summer 2024).
- Design Solar Panel Systems for Different Types of Land (USDA, Summer 2024).

- Developing Decision Making Support Systems for Sustainable Agriculture Product Supply Chain (USDA, Summer 2024).

Connection to Educational Theory and Context

The project activities are based on educational theory. Each is founded on the simple supposition that people perform better when provided with basic, broad understanding and opportunities to gain initial experience prior to being asked to perform tasks independently and at a professional level. This is the basic theorem supporting higher education. Thus, for teachers to provide innovative, up-to-date, engaging research presentations to and experiences for their students, it is important that they first be provided an understanding of how research is conducted and be given an opportunity to engage in the full cycle of research activity from identifying a topic and research question to completing a presentation of findings and conclusions. High school and middle school teachers have additional requirements; they must produce curricular materials consistent with the state requirements for their discipline, state standards relevant to the audience they serve, and material appropriately scaled and pitched for their audience. That is why this project was planned with four interconnecting areas of emphasis (Figure 1), research experience, curriculum development, professional development, and curriculum implementation. A group of high-impact practices for higher education were selected for integration into the four areas of activity: project-based learning, collaborative assignments, hands-on experiences, mentoring, research experience, and forming a learning community [12], [13]. The mentoring includes input from peers (cohort members), near peers (graduate students conducting research in the field), and professionals (faculty and industry professionals) and is implemented in three of the four quadrants of Figure 1. Educational faculty were included on the project team and programming to ensure the educational requirements set by the state, the needs of high school and middle school students, and best practices for curriculum development and implementation were followed. Additional professional development opportunities, seminars, workshops, conference attendance, and site visits are intended to supplement the other activities by providing specific forms of instruction and experience, placing concepts in context and/or expanding horizons, or providing opportunities to practice and refine skills. Constructing and completing presentations of research endeavors and their findings functions as a means of reviewing and reinforcing learning achieved through the entire summer program and providing the teachers an opportunity to present research like they might describe it to students and providing them professional-level feedback throughout the process. All the programming functions in a social learning context [14] that involves continuous interaction and support as well as regular assistance from a variety of parties bridging from one concept or skill to the next [15].

In the two years under discussion, supplemental workshops were offered in various topic areas, including instructional coaching, teaching effectiveness, data collection, modeling, analysis, and visualization, economic analysis and decision-making, mental wellness, career planning, etc. The information from these efforts expanded the understanding of participants and provided them material from which they could select to develop and complete their research or include in the curricular materials they developed. Selection and inclusion were based on the needs of the project, the pattern of experience to be offered to the secondary education students, the experience level of the secondary student audience, the facilities available at the schools where the curriculum would be implemented, and the amount of time available for implementing the curriculum the teachers planned based on their own experience with research. These processes were facilitated by mentoring that included co-learners, more advanced learners, research faculty, education faculty, and industry professionals.

While not targeted specifically for the benefit of Hispanic students in secondary education, the project will impact a large number of them. Given the demographics of the region in which the project is implemented, 31 participants to date, six teaching sessions per day, and class sizes of 25 students, the curricular elements developed in the project would be enacted with 4,500 or more students a year; half or more of those students would have Hispanic heritage. The intention is to provide well-constructed, high-quality, up-to-date, and contextually relevant experiences to this audience during secondary instruction that will ignite or reinforce interest in science, mathematics, and engineering study and professions. Research has found that activities of this type can impact student interest in STEM [16] and help to overcome the current challenge of attracting females to STEM [17].

Research Questions and Methodology

The research questions for the study were: (1) How and to what extent does the programming impact teacher participant confidence in respect to understanding and conducting research? (2) Do impacts vary based on participant background or prior experience? (3) What value do school administrators see in the training provided? The first question was addressed through the administration of pre- and post-participation surveys and follow-up interviews six months after program completion. Information about participant background and experience was gathered to address the second question. Short, in-person interviews were completed with school and district administrators to address the third question.

The pre-participation survey consisted of: (1) a question regarding highest degree achieved, (2) a question about personal confidence in learning new skills, (3) 17 questions about topic areas related to research and collaboration, (4) one request for information about how the participant learned about the project, (5) a question about the amount of time the participant anticipated investing in summer activity, (6) an open-ended question about what the participant hoped to learn, and (7) a final open-ended question about the participant's greatest concern regarding the project. The post-participation survey repeated most of the queries from the first survey to facilitate understanding of program impact and gathered an overall rating of the summer program, information about time invested during the programming and included a query about ways to improve the programming plus a request for additional comments.

Follow-up interviews were completed in a semi-structured manner with primary questions asked of every informant but with possible additional queries to clarify or expand on initial responses. There were eight questions.

1. What advantage did you derive from learning about data-driven considerations of renewable energy?
2. What practical help has learning about designing and conducting research been to you since completing your RET experience, especially with respect to teaching?
3. What advantage do you see for a middle or secondary school teacher in having an understanding of how research results are chronicled and disseminated?
4. How did your RET experience impact your understanding and practice of working on collaborative teams?
5. How did the knowledge you gained regarding the development of research questions impact you in the last year?

6. How did you call upon your experience in the RET project when designing new instructional elements?
7. Were you able to implement any instructional changes/innovations based on your RET experience? If so, how successful do you feel they were?
8. Have there been any long-term impacts for you or your school from your participation in the RET?

School and district administrators were asked to comment on why they wished for their teachers to attend the summer program and what benefits they saw for the teacher, the teacher's school, and for the district from teachers having attended the programming.

Descriptive and comparative statistical analysis was employed with quantitative data. The constant comparative method [18] was employed to arrive at themes for the qualitative data. Triangulation was employed when multiple forms of data had been gathered in respect to the same topic.

Project Results

The project team conducted pre- and post-participation surveys to collect feedback from the teacher participants. An annual follow-up phone interview was conducted to collect additional feedback from the teachers. In addition, feedback from school administrators, such as principals and superintendents, was collected to get their perception of the summer research programs. Five-point Likert scales used on the surveys were converted to numeric values by assigning the value of one (1) to the lowest point on the scale and adding one point for each step up the scale up to five (5).

Analysis of pre- and post-participation survey results from the 6-week program participants indicated the participants in both years the opportunity has been offered considered the programming to be Very Good to Excellent, a five-point Likert scale from poor to excellent was used, and that opinion was consistent across gender, ethnicity, level of secondary education in which the informant taught, and area of instructional specialization. Pre-participation survey data indicated the participants entering the summer program were most confident in areas of general skill for adult professionals like ability to learn, to collaborate and communicate, and to work independently. Comparison of pre- and post-participation survey responses showed an increase in confidence for all 17 queried constructs for both years. Five of the increases were statistically significant in 2023 while 16 were in 2024 (Table 2). Thus, the project appears to produce the desired outcome for teacher participants, increased confidence in respect to understanding research, how it is conducted and preparing and completing presentations about research findings, and, in some categories, at significant levels although this must be verified through continued replication.

Researchers have found STEM teachers experience difficulty incorporating technology and engineering in STEM education programming [19] and that they regularly encounter barriers such as inadequate preparation, insufficient training and professional development opportunities to keep their discipline-specific and technical skills up-to-date, and a lack of hands-on training modules in the curriculum for their students [20]. Analysis of the follow-up annual phone interview data from conversations with the participating teachers confirmed these patterns. Intriguingly, there was considerable overlap between what the teachers hoped to learn during the summer, what researchers indicate are common barriers to incorporating technology and engineering content in courses, and what they reported as being the most valuable element of the NSF program, with six primary themes. These were as follows.

- New materials/information to include in teaching.
- Advanced curriculum development skills.
- Learning research processes.
- Learning how to present research findings.
- Learning about the skills students need to succeed in research and engineering.
- Learning about specific science topics.

Table 2: Significant Findings in the 6-week Program

2023	2024
Significant at < .001 - Planning a research project ($p < .001$).	*Significant at < .001* - Making formal research presentations ($p < .001$). - Working collaboratively with other participants ($p < .001$). - Working collaboratively with graduate students ($p < .001$). - Submitting a paper for publication ($p < .001$).
Significant at < .01 but > .001 - Asking for help when you don't understand something ($p = .002$). - Dealing with unanticipated delays in conducting research ($p = .004$).	*Significant at < .01 but > .001* - Formulating a research question ($p = .001$). - "Fitting in" with a new group ($p = .001$). - Conducting a literature review ($p = .001$). - Learning new skills ($p = .001$). - Making technical presentations ($p = .002$). - Asking for help when you don't understand something ($p = .002$). - Working collaboratively with faculty mentors ($p = .004$). - Dealing with unanticipated delays in conducting research ($p = .004$).
Significant at < .05 but > .01 - Conducting research ($p = .034$). - Formulating a research question ($p = .035$).	*Significant at < .05 but > .01* - Working independently to find answers to questions ($p = .022$). - Conducting research ($p = .038$). - Managing your time while working on a research project ($p = .049$).

Analysis of the pre- and post-participation survey results from the two-and-a-half-week USDA program demonstrated the teachers participating also considered that program to be Very Good to Excellent, measured on a five-point Likert scale with a range from poor to excellent, and that opinion was consistent across gender, level of education in which the informant taught, and area of instructional specialization. Results for increase in confidence are strongly positive based on ratings submitted using a five-point Likert scale (Table 3). The ratings were reduced to numeric values by assigning the value of one (1) to the lowest point on the scale and adding one point for each step up the scale up to five (5). The means for all 17 topics considered were above the “some increase” level with all but one approaching or exceeding the “good increase” level. The means were also tightly grouped with the largest gap between scores occurring for the penultimate and last topics. The last topic, submitting a paper for publication, was not an activity directly incorporated into the project. Thus, having it occur at the bottom of the rank ordering is understandable. Comparative analysis of pre- and post-participation finding was not possible as the pre-participation survey asked for ratings of confidence while the post-participation survey asked for ratings of increases in confidence (i.e., two different constructs were measured). The positive findings from the first year will need to be replicated with a second and even third group of teachers before they can be considered consistent and reliable outcomes of the project. However, the first 2.5-week cohort had increases in confidence for all topics queried above “some increase,” a value of 3 on the five-point scale, with all but that one approaching or exceeding “a good increase,” a value of 4 on the scale (Table 3).

Table 3: Rank Ordered List of Increase in Confidence Following USDA Project Participation

Working collaboratively with other participants. ($\mu = 4.29$)	Conducting research. ($\mu = 3.93$)
“Fitting in” with a new group. ($\mu = 4.14$)	Managing your time while working on a research project. ($\mu = 3.93$)
Working collaboratively with graduate students. ($\mu = 4.14$)	Dealing with unanticipated delays in conducting research. ($\mu = 3.86$)
Learning new skills. ($\mu = 4.14$)	Planning a research project. ($\mu = 3.79$)
Working independently to find answers to questions. ($\mu = 4.14$)	Asking for help when you don’t understand something. ($\mu = 3.79$)
Communicating with project faculty. ($\mu = 4.07$)	Formulating a research question. ($\mu = 3.71$)
Working collaboratively with faculty mentors. ($\mu = 4.00$)	Making formal research presentations. ($\mu = 3.64$)
Making technical presentations. ($\mu = 3.93$)	Conducting a literature review. ($\mu = 3.64$)
	Submitting a paper for publication. ($\mu = 3.43$)

Similar to the six-week program, the 2.5-week opportunity addressed challenges the teachers encountered, as expressed in topics about which they hoped to learn, and later ratings of the most valuable elements of the undertaking. The result was five overlapping themes. They were as follows.

- New materials/information to include in teaching.
- Advanced curriculum development skills.
- Learning research processes.
- Learning how to present research findings.
- Learning about new information/skills/patterns

The existence of the same themes in the listing for the six-week and 2.5-week projects also confirms the presence of these interests and challenges across the schools and districts involved.

Brief interviews with some school administrators, including an assistant principal, a district STEM director, a principal, an assistant superintendent, and a superintendent of a school district, were also conducted. Each was asked to explain what they saw as benefits for the schools and districts in having teachers participate in the programs. Their comments are summarized below.

- All of the informants noted the potential of the program for establishing and strengthening connections between the schools, the districts, and the University.
- All of the informants also stated that the programs provided opportunities and resources that the schools and district could not and would not be able to afford. The teachers were provided with guided, hands-on experience with graduate students and faculty mentors involved in every step of the process. That level of support and rigor could not be achieved within the professional development budgets of the schools or districts, a challenge noted in [20].
- Four of the five informants felt the curricular content the teachers developed in the program was a direct benefit to the schools. These materials were developed in areas with local significance and will be utilized in the schools to supplement science instruction, hopefully engaging K-12 students in science that they can recognize has local connections and impact. Advantageous patterns are described in [16], [17].
- A fourth point made was that the programs provided the teacher participants with science career insight they would not otherwise have developed.
- The STEM director touched on topics the other informants did not. These were the project-based patterns in the programs, which is also an emphasis in the sciences in the local schools and the multidisciplinary nature of the undertaking reinforcing integrating instruction across the curriculum like involvement of math, science, computing, and writing skills.

Thus, the administrative informants not only confirmed the presence of challenges in the local schools that were identified and described by researchers in [19], [20], they recognized the value of the process for reinforcing desired collaborations, providing unavailable opportunities and resources, creating materials with advantageous characteristics [16], [17], and as providing helpful professional development.

In the 6-week program, the actual time commitment reported by the teachers, 20 to 40 hours per week with 75% over 30 hours a week, was appropriate for a program that seeks to provide a short-term, intensive introduction to research for which the attendees receive a stipend. In the USDA program, the actual time commitment reported by the teachers ranged from 10 to 40 hours per week with 78.6% over 25 hours a week. In both cases, the time commitment reported was realistic and manageable, especially given the level of impact reported by the participants and advantages recognized by school and district administrators.

Through the interviews of teacher participants as well as administrators, it became clear that both the NSF and USDA summer programs provided regional teachers with the STEM content knowledge, curriculum development skills, and materials needed to engage students in relevant STEM activities. Furthermore, regional administrators recognized among the program strengthens connections with the local University, an avenue that can help students see STEM higher education as an obtainable pathway.

Lessons Learned and Continuous Improvements

Post-participation survey responses included several key comments associated with improving the program. It was suggested that the facilitators:

- Increase clarity regarding project processes and procedures by sharing more concise details about expectations at the beginning of the program.
- Increase the number of meetings. Although the faculty and graduate students were available, some teacher participants wished to increase the number of meetings with mentors to get more guidance and set up more check-ins regarding research activity.
- Increase the volume of preparatory processes. Most of the teacher participants preferred more research skill training and were willing to dedicate more time to attend the training before the program started. The majority of teachers noted a preference for detailed training on using data analysis tools, such as Excel, with hands-on practice.

The project team was aware of the confusion of the expectations during the 6-week program in Summer 2023 and made necessary changes in Summer 2024 by announcing the detailed expectations, including the required deliverables and deadlines, on the first day of the program and repeating them during each group meeting. The project team thinks one of the possible reasons behind the first comment is that most teacher participants were not familiar with the required time and effort in writing the project reports, making the posters, and preparing for the oral or poster presentations.

Due to both programs being relatively short, it is critical to keep a consistent and clear meeting schedule for the teachers and mentors. Several mentors had to travel for conferences during the program period, while one mentor's graduate student was not available due to unexpected issues. These circumstances were not welcomed by the participants who, in both programs, preferred in-person meetings over discussions via emails or virtual meetings. In parallel, participants suggested having a daily check-in time or daily meeting time scheduled at the beginning of the program that would remain consistent.

The project team was surprised by the third comment. Considering the busy schedule of most teachers during the school year, neither programs had pre-program training besides two introductory webinars. However, the project team plans to provide recorded training videos as optional training materials to teachers before the program starts in the future.

In addition to the above comments, some teachers in the USDA program suggested increasing the USDA program to 3 weeks or longer. The teachers appear to have enjoyed the program, they benefitted as described above, and wanted more time to complete the research projects. The project team may modify the scope of some project elements to better accommodate the two-and-a-half-week time window.

Since both programs focus on recruiting teachers from local school districts, email with flyers seemed to be an effective way to reach out to potential teacher candidates based on the pre-participation survey results. The project team actively contacted STEM coordinators in the region, school principals, and school district offices to promote both programs. Participant comments indicate the timing of the recruitment process may be as important as the recruitment methods. Based on the feedback from teachers during meetings, early in the spring semester, from January to February, is a great time to promote programming of this type as that is when most teachers are considering their summer plans.

It should be noted that the implementation of the learning modules during the school year requires close collaboration between the teachers and mentors. The mentors should maintain consistent communication after the summer program to ensure that the teachers will teach the assigned classes and have the necessary supplies to implement the modules. The project team expects to establish a strong Community of Practice (CoP) through both programs. In addition to regular email communication, Microsoft Teams is used to facilitate the CoP, where members can connect and share ideas, information, and stories with persons with whom they might not ordinarily interact. It is expected that the collaborative work of the CoP will enable the free flow of information, shared knowledge, and ongoing and engaging dialogue among all members. The products of the programs (i.e., research work, curricular modules, and other artifacts and materials) are being shared among all members, creating bonds encompassing trust, mutual respect, and camaraderie.

Conclusion

Two summer research programs for teachers in middle, junior high, and high school were enacted in the patterns described above. They involved the provision of research training and experience in a manner that involved other HIPs besides research engagement, collaborative assignments, mentoring, a learning community, and a capstone project. The projects completed involved planning, conducting, and presenting findings from a research undertaking and using learning from that process to create new curricular material for use with the participants' students in the coming school year. Evidence gathered indicates that the process increased teacher confidence in multiple areas related to understanding, conducting, and presenting research findings while meeting the interests and needs of the teachers expressed prior to participation. The programming also addressed needs and filled gaps recognized by school and district-level administrators. That both a six-week and 2.5-week program could produce results of this type is informative as short programs would be easier to enact for colleges and universities across the United States.

Replication of the process is necessary to determine whether the outcomes reported herein result consistently for participants. The two years of data for the six-week project appear to indicate that is the case, but similar outcomes from additional offerings would strengthen that argument and could provide further support for the notion that shorter-term offerings are also effective.

The potential of the project for impact on STEM interest of students in secondary education settings is supported by evidence in the literature and testimony from past participants regarding use of the curricular materials they developed. That over 50% of the teachers trained identified as female and over 60% with groups underrepresented in STEM fields means the efforts described above advanced the number of female and non-majority role models in science, technology, and mathematics classrooms. These are general findings rather than precise measures of the long-term impact on the students who engage with the teachers trained but are also indicators of positive potential.

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