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RESEARCH REPORT

STEM Research Experiences for Teachers: A Feasibility Study of The Sustainable Energy for Empowering Rural Communities Program

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Abstract

Evaluating teacher STEM education programs is an essential but sometimes overlooked step in enhancing STEM education for students in the United States. The current study evaluated a novel STEM education program for rural teachers in sustainable energy engineering (SEER) to address basic program feasibility and teacher perceptions of the experience. A quantitative approach examined teacher (n=10) report of program engagement, utility, learning for the classroom, research for the classroom, and engineering principles. A qualitative approach gathered teacher responses about their experiences in the SEER program, including program activities, feelings, challenges, and benefits. Findings reveal that teachers were generally engaged and enthusiastic about the utility of the program, including its relevance for teaching in the classroom and growth of knowledge of engineering principles. Teachers also reported that they were excited but initially anxious about their ability to engage in STEM research. Towards the end, teachers reported enhanced confidence in their abilities, as well as broadened STEM networks and new curriculum for the classroom. Results provide support for the SEER program's ability to provide quality rural STEM teacher education.

Keywords: *STEM, teacher education, rural schools*

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Introduction

Interest in Science, Technology, Engineering and Mathematics (STEM) education has surged over the past few decades as global leaders have recognized the increased importance of educating the future labor force for tomorrow's challenges (Chai et al., 2021; Li et al., 2020). Although interest in improving STEM education for students in the United States has risen, there has been comparatively less attention focused on evidence-based STEM teacher education (Li et al., 2022; Jong et al., 2021). This oversight is unfortunate, as specialized education and training, evaluated empirically, is needed for STEM teachers to be successful in the classroom (Al Salami et al., 2017; Lo, 2021). Indeed, it is likely that multiple otherwise promising STEM reforms and innovations to-date have failed as a direct result of the insufficient focus on teacher education and preparation (Jong et al., 2021; Milner-Bolotin, 2018). When it comes to quality STEM teacher education, there are notable challenges that need to be addressed.

First, STEM itself is an interdisciplinary field, but many teachers do not receive training for integrated STEM but rather for the individual subject areas, such as mathematics, technology, etc. (Honey et al., 2014; Lo, 2021). Indeed, one recent study of teacher perceptions of barriers indicated that a lack of understanding of how to teach integrated STEM was the single biggest obstacle (Shernoff et al., 2017). Relatedly, an additional challenge with STEM teacher education is the perceived confidence and ability of teachers to translate that education into the classroom. Teachers often report concerns about how to implement STEM education, especially with respect to needed materials and appropriate pedagogy (Margot & Kettler, 2019; Lo, 2021). Of note, Du et al. (2019) examined STEM teaching quality, perceptions of STEM teaching ability, and teacher-identified STEM supports needed following teacher participation in a three-year professional development program. This study found that participating in the STEM professional development program resulted in enhanced STEM teacher effectiveness and knowledge, as well as identification of additional challenges, including the need for material resources and further technical training (Du et al., 2019). Similarly, Estapa and Tank (2017) reported that teachers in their applied STEM teacher education program, which paired teachers with engineers, struggled to translate learned knowledge into the classroom. A need for support around lesson planning and enactment was identified (Estapa & Tank, 2017).

STEM teacher education programs designed to address these issues must be evaluated to ensure that STEM teacher education and preparation adequately keep pace with the demand for STEM education (Lynch et al., 2019; Milner-Bolotin, 2018). To that end, many novel programs for STEM professional development have been piloted in the United States but only a fraction of these programs have been evaluated for their ability to prepare teachers to 1) teach STEM as an integrated topic and 2) implement STEM education in the classroom (Cavlazoglu & Stuessy, 2017; Lo, 2021). To date, no single STEM teacher education program has emerged as the gold standard in the United States, perhaps due to the absence of rigorous evaluation data but also likely due to

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the necessary tailoring of program features to meet specific school, district, or regional needs (Lynch et al., 2019; Milner-Bolotin, 2018). Indeed, the benefit of tailored STEM teacher education programs is that they can more flexibly address unique educational characteristics and contexts than their more rigid programmatic counterparts (Bentley & Cason, 2019; Matsko & Hammerness, 2014). Tailored STEM teacher education for rural schools is one such context in need of special consideration.

Rural STEM Educators

Rural STEM educators face distinct challenges in comparison with their suburban and metropolitan counterparts (Cain et al., 2024; Crain & Webber, 2021). For example, rural STEM educators may have comparatively fewer instructional resources, and their schools may have less overall capacity for teaching STEM (Saw & Agger, 2021; Showalter et al., 2017). These limitations may be further confounded by geographic isolation, preventing rural STEM educators from collaboration with peers at other institutions or availing themselves of nearby external resources (Jenks et al., 2015; Schafft, 2016). Additionally, there may be fewer accessible professional development opportunities for rural STEM educators than their counterparts (Downes & Roberts, 2018; Lavalley, 2018). These barriers faced by rural STEM educators, among others, warrant consideration with respect to the tailoring of STEM teacher education programs. In addition to challenges, rural STEM educators also have other specific characteristics which may be considered potential assets to leverage in the creation of tailored STEM teacher education programs.

Although rural education research has traditionally focused on challenges or perceived deficits, examining rural characteristics which may function as strengths for STEM educators is also important (Biddle & Azano, 2016; Sherfinski et al., 2020). For example, rural STEM educators may demonstrate resourcefulness and ingenuity in their teaching, abilities perhaps cultivated in educational conditions of inadequate support or resources (Chambers et al., 2019; Crumb et al., 2023). Rural STEM educators often live in the same communities where they teach, making them knowledgeable about both their students' rural background and any local STEM opportunities for their students (Lakin et al., 2021; Rivera et al., 2019). Relatedly, many rural communities have strong ties to local ecology, sustainability efforts, and STEM-related industries, such as wind, natural gas, and biomass, helping to facilitate career pathways for STEM students (Avery, 2013; Weber et al., 2014). Taken together, these characteristics of rural STEM education and educators helped to inform the novel professional development program Research Experiences for Teachers: Sustainable Energy Engineering for Empowering Rural Communities (RET: SEER; Nanny, 2016).

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Oklahoma's Rural Educational Context

With 52% of Oklahoma public-school children residing in rural communities, significantly higher than the national average of 29% (State-by-State results, 2023), Oklahoma's rural student population is notably diverse, ranking second nationally in diversity. Over 70% of the state's school districts reside within one of the 39 sovereign Tribal Nations, with American Indian students comprising 13.5% of the student population (Oklahoma State Department of Education Diverse Learner Team, 2020). This rural concentration, combined with the state's geographical diversity encompassing 12 defined ecoregions, underscores the need for autonomous, place-based STEM professional development opportunities for rural teachers (Staff, 2021).

The National Rural Education Association's research priority of Teacher and Leader Preparation, Recruitment, and Retention (2022) aligns closely with Oklahoma's rural context. While some studies have investigated teacher certification and new policies to address teaching vacancies, there is a pressing need for more research on effective programs to enhance retention, particularly as rural schools face challenges in recruiting and retaining STEM educators. Recent reports highlight the severity of this issue in Oklahoma, where rural districts struggle significantly to staff secondary science and math positions with highly qualified teachers. Lazarev et al. (2017) and Watson (2022) note that more than half of the state's districts have reported resorting to emergency measures to fill open teaching positions, underscoring the critical need for innovative solutions to address this persistent problem in rural STEM education.

Oklahoma's teacher shortage revealed over 500 teacher vacancies in 2016, escalating to 1,019 in 2022 (Lazarev et al., 2017; Oklahoma Education Facts, 2022). To address this issue, Oklahoma has implemented emergency teacher certification measures and lifted restrictions on adjunct teaching hours in K-12 schools (Camper, 2022). However, these measures have raised concerns about the potential "de-professionalization" of teaching, as evidenced by the low retention rate of only 19% of emergency-certified teachers remaining in the profession for three years (Wallis, 2023). Emergency teacher certifications for the 2023/2024 school year topped 5,000 compared to 40 in 2013 (Stockett, 2024) and is a growing issue for schools in the state.

Oklahoma's STEM industry pipeline is transitioning from fossil fuel to renewable energy production. The state ranks third in the nation for total renewable energy production between wind, solar, hydro, geothermal and biodiesel, with the preponderance of these production locales situated within rural communities (Renewable Energy, 2019). The state now accounts for 45% of electricity production from renewable energy sources (Energy Information Administration, 2022) accentuating the critical need for professional development opportunities for rural STEM educators such as the Research Experience for Teachers. Such initiatives are essential to ensure quality STEM instruction, long-term retention of qualified educators, and the development of skills and knowledge necessary for rural residents to capitalize on emerging renewable energy opportunities in their communities.

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Evaluating RET: SEER

The National Science Foundation (NSF) funds Research Experiences for Teachers programs with the express purpose of facilitating long-term collaborations among higher education institutions, school districts, and industry (RET; https://www.nsf.gov/). Previous STEM RET programs, including those targeting rural teachers, have proved beneficial in enhancing teacher report of STEM basic and applied knowledge, as well as strategies for translating this learning into the classroom and perceived teacher efficacy for STEM teaching (Bowen et al., 20221; Lux et al., 2024). SEER is an RET program designed specifically for rural teachers in Oklahoma. As part of this program, rural Oklahoma teachers participated in an authentic six-week summer research experience, learning hands-on skills from mentoring University of Oklahoma faculty conducting sustainable energy engineering-related research. Additionally, SEER includes training in STEM pedagogy with support for teacher creation of new STEM-related lesson plans and classroom applications. During the week, participating teachers alternated between dedicated laboratory time with PhD faculty working on one or more aspects of sustainable energy engineering and STEM pedagogy-focused instruction and lesson plan creation. At the end of the summer experience, teachers taught their lessons to other participants. The lesson plans and videos are housed in the Institute for Math & Science Education website. Additionally, teachers also prepared a research presentation or poster to present to their research professors and/or graduate students.

In order to assess the usefulness of this unique program, the current evaluation study employed a mixed methods analysis. Mixed methods refer to the general combination of both quantitative and qualitative data to address questions of interest (Cevik et al., 2024; Clark & Creswell, 2008). The benefit of collecting quantitative data for the SEER program is that individual's responses are easy comparable and can be directly examined using descriptive statistics, including variable means and standard deviations. The benefit of also collecting the qualitative data is that teachers can share more depth and detail about feelings and experiences during the program, with the potential to shed light on barriers or concerns previously not anticipated by program facilitators.

The Present Study

The aims of this study were two-fold. The first aim was to address basic feasibility questions concerning the ability of the program to engage and educate teachers, and in turn, teachers' commitment to translate that learning into their classrooms. To this end, we used a quantitative approach to examine participating teachers' self-reported engagement in the program and their perception of the program's utility, alongside teachers' reported intentions and perceived abilities to translate their experiences into secondary education teaching. The second aim was to gather free-response data about teachers' experiences during the program, including how they felt about activities, how they dealt with challenges, and how well they felt

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the program aligned with their goals and/or what benefits they felt the program provided. For this aim, we utilized a qualitative approach to gain more insight into the teacher's experiences during the summer program, including activities they participated in each week, their affective responses, perceived challenges, and their personal and professional goals for their time in the program.

Method

Participants

Data were derived from a subsample of STEM teachers participating in the Sustainable Energy for Empowering Rural Communities program in the summer of 2024 (N=10, Mage = 45, SD = 8.86 years; 57% women). These teachers reported an average of 11.42 years of teaching experience (SD = 5.99). The majority (57%) reported having earned a bachelor's degree, and the remaining 43% reported some graduate-level education, including a master's degree or some doctoral-level education. Reported annual income varied, as 28.6% reported earning less than $60,000, 14.3% reported earning between $60,000-89,999, 28.6% reported earning between $90,000-119,999, and 14.3% reported earning more than $120,000. Two teachers declined to report income and race/ethnicity. While most teachers self-reported as White (50%), 7.1% identified as American Indian or Alaska Native, 14.3% identified as Asian or Asian American, and 14.2% identified as multi-racial.

Procedure

On the first morning of the SEER program, trained evaluation personal provided informed consent for teachers, highlighting that participating in assessment of the SEER program was not a requirement of SEER program. Data collection utilized SurveyMonkey (https://www.surveymonkey.com) and took place at the end of each of the six weeks of the program in summer 2024, with weekly follow-ups distributed via email to teachers participating in the assessment. Assessments took approximately 5-10 minutes to complete. No compensation was provided for assessment participation. East Central University institutional review boards approved all study procedures (IRB #24-32).

Measures

After week 1, teachers completed a short demographic questionnaire and open-ended questions about that week's program activities, experiences and challenges. Teachers answered these same open-ended questions again for weeks 2-6. After week 3 (midpoint) and week 6 (end), teachers also completed additional questionnaires on program engagement, utility, applying learning, research, and engineering principles in the classroom.

Teacher Program Engagement: Teachers completed a 12-item measure of perceived engagement in the Sustainable Energy for Empowering Rural Communities program created for program feasibility assessment. Instructions prompted teachers to indicate "how true each

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statement is from your perspective" using a 7-point Likert-type scale ranging from 1 (not at all true) to 7 (very much true). Example items include "I intentionally get involved in what is going on at RET" and "When I am doing RET activities, I feel interested." Internal consistency was high (α =.96 at midpoint and .96 at endpoint, respectively).

Teacher Program Utility: Teachers completed an 18-item measure of perceived program utility in the Sustainable Energy for Empowering Rural Communities program created for program feasibility assessment. Instructions prompted teachers to indicate "how true each statement is from your perspective" using a 7-point Likert-type scale ranging from 1 (not at all true) to 7 (very much true). Example items include "I see how the ideas I have learned and reviewed here are valuable to me as a teacher" and "I recognize how these skills will be valuable in my teaching." Internal consistency was high (α =.99 at midpoint and .99 at endpoint, respectively).

Teacher Learning for the Classroom: Teachers completed a 25-item measure of perceived classroom applicability for the Sustainable Energy for Empowering Rural Communities program created for program feasibility assessment. Instructions prompted teachers to indicate "how true each statement is from your perspective" using a 7-point Likert-type scale ranging from 1 (not at all true) to 7 (very much true). Example items include "I see these skills as feasible to use in my teaching" and "These ideas fit well with what I do in my classroom." Internal consistency was high (α =.98 at midpoint and .98 at endpoint, respectively).

Teacher Research for the Classroom: Teachers completed a 6-item measure of perceived classroom research application for the Sustainable Energy for Empowering Rural Communities program created for program feasibility assessment. Instructions prompted teachers to indicate "how true each statement is from your perspective" using a 7-point Likert-type scale ranging from 1 (not at all true) to 7 (very much true). Example items include "RET is increasing/has increased my confidence in integrating research into my classroom" and "The RET program is helping me/helped me see the value of implementation of integrating research into my classroom." Internal consistency was high (α =.98 at midpoint and .98 at endpoint, respectively).

Teacher Engineering Principles for the Classroom: Teachers completed a 6-item measure of perceived engineering principles classroom application for the Sustainable Energy for Empowering Rural Communities program created for program feasibility assessment. Instructions prompted teachers to indicate "how true each statement is from your perspective" using a 7-point Likert-type scale ranging from 1 (not at all true) to 7 (very much true). Example items include "Because of this experience I have greater ability to integrate engineering principles into my teaching" and "I am seeing/I saw how to implement engineering principles into my classroom teaching." Internal consistency was high (α =.95 at midpoint and .95 at endpoint, respectively).

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Plan of Analysis

A parallel mixed methods approach was utilized to address the dual aims of the study (Clark & Creswell, 2008). For aim 1, descriptive statistics and basic bivariate analyses were performed in IBM SPSS Statistics (V. 27; IBM, 2024) using study-specific measures for teacher program engagement, teacher program utility, teacher learning for the classroom, teacher research for the classroom, and teacher engineering principles for the classroom. Because of the small sample size, no inferential tests were performed. For aim 2, qualitative analyses were performed utilizing modified Qualitative Content Analysis (Roller, 2019) to identify prominent themes within teachers' reported program activities, experiences and challenges. The lead investigator generated the coding framework using a combination of inductive and deductive approaches. All themes were coded manually. In the first stage of analysis, recurrent themes were identified related to teachers' activities, emotional experiences, and challenges/response to challenges. These themes were then refined for the main analysis, including grouping together similar content.

Results

Aim 1: Descriptive Statistics and Bivariate Analyses

Table 1 includes means and standard deviations for all study measures at week 3 and week 6, as well as bivariate correlations between these measures. Means across measures were high at both week 3 and week 6 ($M>5.37$, 5= More true than not). All study measures were positively correlated within each time point ($\beta>.68$, $ps<.05$), including teacher program engagement, teacher program utility, learning for the classroom, research for the classroom, and engineering principles for the classroom. There were no statistically significant stability correlations for measures between time points, likely a reflection of the small sample and variability across time. These midpoint and end point results indicate that teachers felt generally positive about the experience and specifically about their engagement in the program as well as the program's ability to inform their STEM teaching in the classroom.

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Table 1.
Descriptive Statistics and Correlations for Study Variables at Week 3 and Week 6 (n=10)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. Week 3 Teacher program engagement	6.20	0.98	—	.79**	.73*	.68*	.70*	.07	.22	.20	-.08	.07
2. Week 3 Teacher program utility	5.70	1.33		—	.79**	.88**	.92**	.29	.50	.44	-.01	.27
3. Week 3 Teacher learning for classroom	5.68	1.01			—	.89**	.91**	-.30	-.03	.04	-.44	-.30
4. Week 3 Teacher research for classroom	5.38	1.22				—	.92**	-.10	.19	.32	-.15	-.08
5. Week 3 Teacher engineering principles for classroom	5.65	1.17					—	-.06	.16	.14	-.32	-.09
6. Week 6 Teacher program engagement	6.53	0.70						—	.84**	.74*	.72*	.87**
7. Week 6 Teacher program utility	6.39	0.93							—	.82**	.75*	.94**
8. Week 6 Teacher learning for classroom	6.18	0.83								—	.76*	.73*
9. Week 6 Teacher research for classroom	6.25	0.76									—	.87**
10. Week 6 Teacher engineering principles for classroom	6.33	0.92										—

$^{*}p < .05$. $^{**}p < .01$

Aim 2: Qualitative Analyses

With respect to weekly activities, most teachers reported that they were engaged in hands-on learning and experiments with their PhD mentors, including “create[d] a Winogradsky column,” “set up a reactor to separate the hydrogen from the methane,” and “creat[ed] and test[ed] fiber/carbon reinforced concrete and plastics.” The most common emotion that teachers reported experiencing during the initial week activities was excitement (n=6); however, this excitement was frequently coupled with some worry or trepidation, especially about individual ability (n=4). For example, one teacher states that they initially experienced feelings of “optimism and validation peppered with moments of confusion and doubt.” Similarly, another teacher reported experiencing “a mix of excitement and apprehension.” A third teacher explains that their feelings of insecurity stemmed from a “complete and utter lack of knowledge and experience with the subject matter.” A fourth teacher echoes similar concerns, stating that “I felt that some of it [the science] was way above my science education level.” However, these initial feelings after the first week gave way to reports of increased confidence and ability in the following weeks. By week 4 teachers no longer report any feelings of anxiety. Instead, they now reported finding

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pleasure in their scientific activities (n=4) and pride in their accomplishments (n=6). For example, one teacher relates that they felt "happy and excited to see [their] hard work pay[ing] off." Another explains that they felt "very much more confidant… in my lab and pedagogy work. Finding our stride…" Importantly, several teachers (n=4) reported feeling like a "[real] scientist," because of their experiences, highlighting just how much they perceived their knowledge, and skills grew during the SEER program.

Teachers also reported that their experiences were not without challenges. Teachers commonly relayed after the first week that the perceived gap between their science education and expectations in the lab was a notable obstacle (n=8). As an example, one teacher related that they "faced challenges understanding complex lab safety protocols and grasping technical aspects of the project." Similarly, a second teacher echoed that "I didn't understand a lot of terminology discussed in the lab. I had to take notes and go back and look up specific terminology and processes." Later in the program teachers moved on to highlight specific research project challenges (n=6) such as "using [the] glove box," "maintaining consistency and being careful when dealing with chemicals…," and running out of "polytungstate chemical." A few teachers noted that working with specific individuals was challenging (n=2).

With respect to goals for their SEER program experience, teachers most reported that they wanted to inform their teaching with current STEM research (n=7). One teacher reported "For my RET experience, I aim to integrate new STEM research into my curriculum, develop engaging, inquiry-based lessons, and enhance my teaching through collaboration with researchers and educators." Another teacher echoed "I am looking for lessons and activities to take back to my classroom." Yet a third stated that "Mostly I just want to be at the cusp of current research and better convey the excitement new discovery generates to my students." When asked to reflect at the end of the SEER program experience on their earlier goals, teachers generally responded positively. Three specific components emerged, including increased contacts and connections (n=3; e.g. "I added people to my network."), enhanced confidence in STEM teaching (n=3; "Confidence in my abilities."), and new/improved curriculum (n=5, "Creat[ed] new curriculum to help students understand the engineering process."). Taken together, the qualitative data demonstrated that teachers had enthusiasm and excitement for the SEER program, often mixed with apprehension about their perceived inexperience, that ultimately gave way to increased confidence, knowledge and applicable skills for the classroom by the end of the summer program.

Discussion

This study utilized a mixed methods approach to evaluate the feasibility of SEER, a novel research experience for rural teachers utilizing a sustainable energy engineering program. The first aim used a quantitative lens to address foundational feasibility questions about the program's ability to engage and educate teachers, as well as teachers' commitment to translate

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that learning into their classrooms. These results indicate that participating teachers felt positively about the program, including high levels of engagement and perceived utility. Teachers also indicated that the SEER program was relevant and informative of their learning for the classroom context, applying research in the classroom, and for using engineering principles in the classroom. These findings help demonstrate that the SEER program is a practically useful one for rural STEM teachers, lighting that teachers see the utility generally and its specific application to teaching STEM and STEM-focused research in the classroom. Findings from this program resonant with those findings from other RET STEM programs targeting rural educators. Indeed, the basic model of intensive summer STEM education training for teachers seems a sound one for enhancing teacher readiness to teach STEM in the classroom (Bowen et al., 2021; Lux et al., 2024). Replicating these findings in the specific area of rural Oklahoma helps to establish the usefulness of such programs across varied rural contexts.

The second aim of the study was to gather qualitative data about teachers' experiences during the program, including emotions related to weekly activities, perceived challenges, and program benefit. These findings indicate that teachers were excited about the program, although they also experienced some apprehension about not feeling fully prepared for the advanced research aspects of the program. The excitement reported by teachers parallels the teacher enthusiasm and engagement in the SEER program supported by the quantitative measures. The concomitant apprehension, however, along with the specific identified gap between perceived skills and needed research abilities, is a unique contribution of the qualitative data, highlighting the value of this approach. Other work examining barriers to STEM education has previously identified anxiety as a cause of STEM avoidance (Christensen & Osgood, 2023). Indeed, teachers may feel unprepared by their earlier education to teach STEM, or in this case, engage in STEM research. That apprehension quickly ebbed and was replaced by growing self-efficacy, likely reflecting the benefits of the SEER program. Enhanced self-efficacy for teaching STEM, likely related to enhanced knowledge and experience, has been reported in similar rural-focused STEM RET programs (Bowen et al., 2021; Lux et al., 2024). In particular, the immersive nature of such summer programs may help participating teachers build confidence rapidly. This increased confidence is also specifically cited by multiple teachers as a key benefit of the program, alongside building STEM connections and curriculum. Such benefits, identified by the teachers participating in the program, underscore the value of the SEER program for preparing rural STEM educations to teach the next generation of STEM students. That these rural teachers specifically identified connections and growing their STEM contacts as a program benefit is important to note, as it highlights the ability of SEER to address rural education challenges related to isolation and limited resources.

The benefit of the mixed methods approach to this evaluation lies in the dual ability of this data to address basic feasibility questions about implementing the SEER program for teachers as well as to uncover unexpected challenges and experiential aspects of teachers' participation in

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the program. To that end, results from aim 1 helped to establish the general utility of the program, demonstrating that teachers found it useful for strengthening their ability to teach research-based STEM in the classroom. While this information is essential and replicates similar findings from other STEM RET programs (Bowen et al., 2021; Lux et al., 2024), it does not shed much light on the unique challenges and characteristics of the program as experienced by teachers. Results from aim 2 help to address these questions. Understanding that teachers found the scientific content of the program initially daunting before developing a sense of mastery may further help to make sense of the variability in aim 1 measures, as it is possible that this qualitative change in teachers was not well assessed with the basic feasibility questionnaires. Indeed, understanding how immersive teacher STEM education programs may help shift the teachers' sense of content mastery and educational identity represent important next steps for future evaluation. In the future, novel RET programs may wish to incorporate psychological skills training, such as emotion regulation or mindfulness techniques (Wimmer et al., 2019), to combat anxiety and facilitate teacher success in the summer program and ultimately the classroom beyond.

Limitations and Future Directions

This evaluation study has multiple strengths, including examination of program participation at multiple time points, as well as the utilization of a mixed methods approach to address study aims. No evaluation study is without limitations, however. It is important to note that these data only gather teachers' perception of the program and their self-report of future transferability of learning into the classroom setting. Future research should follow up with teachers during the school year to examine the actual application process and classroom learning. Additionally, the measures used in this study were specifically designed to address the SEER program. While the advantage of creating measures for this evaluation is that questions could be tailored specifically to the STEM-related teacher education constructs of interest, the question remains concerning the broader psychometric properties of these new tools. Future work, if continuing to utilize these measures, should also examine convergent validity with similar measures and divergent validity with different measures, among other considerations. Lastly, it should also be noted that these measures did not demonstrate stability correlations from the midpoint to the endpoint. Future work should also examine the measures' reliability over time in a larger sample.

Conclusions

By evaluating the rural STEM teacher education program SEER, this study helped to illuminate the perceived usefulness of the program and teachers' report of their experiences as program participants. Such data help to establish the basic feasibility of the SEER program, including uncovering specific challenges indicated by teachers during their summer

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participation. More broadly, evaluating STEM teacher education programs such as SEER help to ensure that resources invested in advancing STEM education are directed towards evidence-based efforts likely to succeed.

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