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Appalachian
STATE UNIVERSITY

Office of Rural Promise

GREAT STEM: A PRACTICAL PROFESSIONAL LEARNING MODEL FOR GRADES 9–12 RURAL STEM EDUCATORS

GREAT STEM
Empowering Teacher Learning

Teachers from Western NC high schools participate in collaborative brainstorming during the 2026 GREAT STEM summer convening.

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Learning in the Professions

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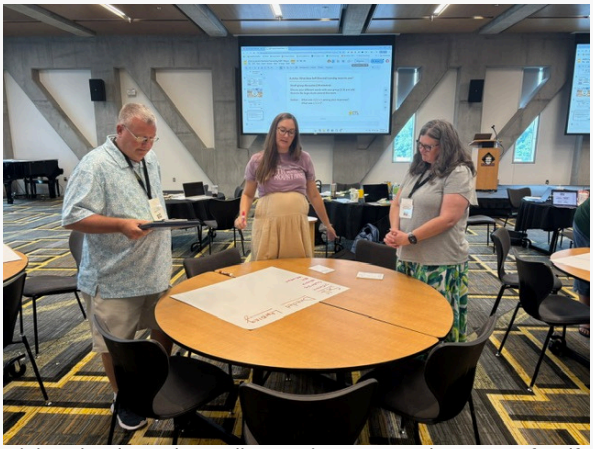
GREAT STEM teachers collaborate at their tables during the 2025 summer convening in Boone, NC.

INTRODUCTION

Rural school districts are expected to prepare high school students for careers shaped by science, technology, engineering, and mathematics (STEM), including technology-driven and advanced manufacturing fields (National Academies of Sciences, Engineering, and Medicine, 2025). When students in rural communities lack access to meaningful STEM learning opportunities, they may have fewer chances to develop the knowledge and skills necessary for a changing workforce (National Academies of Sciences, Engineering, and Medicine, 2025). These expectations come at a time when rural districts continue to face teacher shortages, higher turnover, and greater difficulty filling instructional positions than suburban and urban districts (Ingersoll & Tran, 2023). Geographic isolation and limited resources also restrict access to sustained, high-quality professional learning tailored to local needs (National Academies of Sciences, Engineering, and Medicine, 2025).

For many high school STEM educators in rural Appalachian regions, professional development can feel disconnected from classroom realities (National Academies of Sciences, Engineering, and Medicine, 2025). Sessions are often generic, compliance-driven, or difficult to access because of travel time, substitute shortages, and scheduling constraints. As a result, professional learning does not always support the kind of instructional growth teachers and students need.

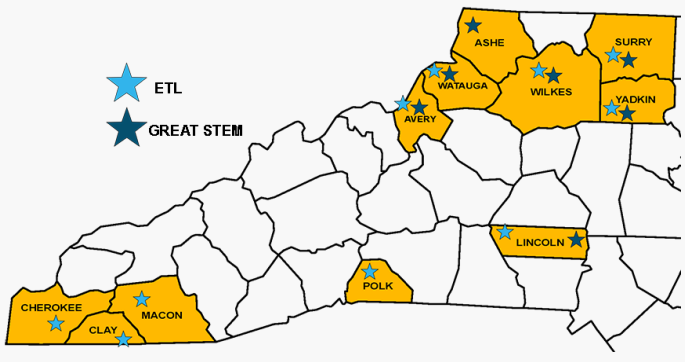

High school teachers discuss important elements of self-directed learning during the 2025 summer convening in Boone, NC.

GREAT STEM: A PRACTICAL PROFESSIONAL LEARNING MODEL FOR GRADES 9–12 RURAL STEM EDUCATORS

The GREAT STEM initiative was created to address these challenges. It is supported by a three-year, $1 million grant from the National Science Foundation through the Robert Noyce Teacher Scholarship Program (Award #2150926) and is led by Appalachian State University's Office of Rural Promise in partnership with North Carolina State University. GREAT STEM is a professional learning model designed specifically for grades 9–12 STEM educators in rural settings. It emphasizes teacher choice, structured support, and evidence of classroom practice to strengthen instruction, support teacher growth, and improve student learning.

GREAT STEM is grounded in the belief that teachers are professionals. Educators identify their own learning needs, apply strategies in their classrooms, and demonstrate growth through real instructional evidence rather than seat time. This white paper explains the challenges GREAT STEM addresses, describes how the model works, summarizes evidence of its effectiveness, and offers a clear, practical plan for districts and higher education partners interested in adopting a similar approach.

A competency-based professional learning model, GREAT STEM strengthens STEM instruction and teacher retention in rural schools through microcredentials, coaching, and classroom-based evidence of practice.



KEY FINDINGS

GREAT STEM participants brainstorm about elements of self-directed learning at the 2025 summer convening in Boone, NC.

"I LOVED it. I was allowed the freedom to actually find a PD that would enhance my learning , knowledge and classroom. It was rigorous, but in a productive way."

Findings from the GREAT STEM initiative indicate that teacher-directed, competency-based professional learning can strengthen STEM instruction in rural schools.

Across multiple cohorts of grades 9–12 STEM educators in Western North Carolina:

- 92% of participating teachers reported high satisfaction with the professional learning experience,
- 92% reported positive impacts on student engagement and project-based learning,
- Teachers reported increased confidence, agency, and ownership of professional growth, and
- Teachers reported that their classroom instruction showed increased inquiry-based learning and stronger connections to workforce pathways.

PROBLEM STATEMENT: THE CHALLENGE FACING RURAL HIGH SCHOOLS

Rural high schools face ongoing challenges related to STEM instruction and teacher retention. Districts in Western North Carolina and similar rural regions continue to report shortages of qualified teachers, particularly in mathematics, science, and career and technical education (CTE) (Berry et al., 2019; Podolsky et al., 2019). Statewide data indicate persistent vacancies in these areas, reflecting broader challenges in recruiting and retaining educators in high-need subject areas (North Carolina Department of Public Instruction, 2024).

Beginning teachers, including many who enter the profession through residency or alternative licensure pathways, leave the profession at higher rates than their more experienced peers, contributing to ongoing staffing instability in many districts (North Carolina Department of Public Instruction, 2024; Public Schools First NC, 2026). In addition, teachers in STEM fields are often positioned in high-need roles that can involve heavier instructional demands, accountability pressures, and more limited access to instructional resources and support, particularly in rural contexts (Berry et al., 2019; Hyler & Carver-Thomas, 2019).

Traditional professional development does little to address these issues. Many workshops require travel, time away from classrooms, or substitute coverage that rural districts often cannot afford or sustain. Even when teachers attend, sessions are often disconnected from their content areas or from outcomes such as project-based learning, computational thinking, or real-world STEM applications. Teachers often describe professional development as disconnected from their content, classroom contexts, and day-to-day instructional work, making it difficult to use in practice (Darling-Hammond et al., 2017; Garet et al., 2001; Wei et al., 2009). When professional learning is not coherent, sustained, or relevant, it is less likely to strengthen instruction, and uneven access to high-quality learning opportunities can contribute to inequities for students (Darling-Hammond et al., 2017; Desimone & Garet, 2015). In response, district and higher education leaders have placed greater emphasis on flexible professional learning, grounded in practice, locally relevant, and connected to both classroom instruction and workforce preparation, particularly in rural STEM contexts (National Academies of Sciences, Engineering, and Medicine, 2025; U.S. Department of Education, 2022).

SOLUTION:
THE GREAT STEM APPROACH

How the Model Works

GREAT STEM is a teacher-directed professional learning model designed for grades 9–12 STEM educators, including mathematics, science, and career and technical education teachers. The model emphasizes flexibility, relevance, and evidence of practice.

Key elements of the model include:

- **Professional learning needs assessment**
  - Teachers initiate the program by completing a structured, standards-aligned self-assessment (our program's needs assessment). This tool helps teachers reflect on their current practice and identify strengths and areas for growth across key domains: instructional techniques, content mastery, leadership skills, and strategies for student engagement.
- **Self-Directed Learning Plans**
  - Based on their assessment, teachers create individualized learning plans that identify one or two instructional goals for the year. These plans focus professional learning on what teachers and students need most.
- **Navigator coaching**
  - Each teacher works with a Navigator who provides non-evaluative coaching support. Navigators help teachers clarify goals, select learning pathways, plan classroom implementation, and reflect on progress. Coaching is separate from formal evaluation and designed to support growth.
- **Micro-credentials**
  - Teachers earn competency-based micro-credentials in areas such as computational thinking, project-based learning, formative assessment, inquiry-based instruction, and instructional leadership. Each micro-credential requires classroom implementation and submission of evidence reviewed using clear criteria. Successful completion results in a digital badge.
- **Reflection and evidence of practice**
  - Teachers reflect on their instruction using written reflection and, when helpful, short classroom videos, audio recordings, or student work samples. Reflection helps teachers connect professional learning to student outcomes and instructional improvement.
- **Recognition and incentives**
  - Where possible, teachers receive stipends or continuing education credit. These incentives recognize professional learning as meaningful work and support participation and completion.

Because the model is modular and flexible, it can be adapted to fit rural districts and higher education partnerships that operate with limited time, funding, and staffing (Darling-Hammond et al., 2017; National Academies of Sciences, Engineering, and Medicine, 2025).

PROGRAM OUTCOMES

Across multiple cohorts of grades 9–12 STEM educators in western North Carolina, the GREAT STEM initiative has shown promising results. Findings draw on internal program evaluation data, including teacher feedback, submitted artifacts, and classroom implementation.

Ninety-two percent of participating teachers reported high satisfaction with the professional learning experience, describing it as relevant, accessible, and closely connected to their instructional needs. Ninety-two percent also reported positive impacts on student engagement and project-based learning.

Teachers described increased use of inquiry-based instruction, stronger connections to real-world and workforce contexts, and more student-centered learning opportunities. Participants also reported increased confidence, agency, and ownership of their professional growth.

Together, these findings indicate that teacher-directed, competency-based professional learning can strengthen instruction while supporting teacher growth and retention in rural STEM contexts.

SUPPORTING EVIDENCE THAT THE MODEL WORKS

Research has shown that professional learning is most effective when it is closely connected to classroom practice, gives teachers meaningful choice, and includes time for reflection and collaboration (Darling-Hammond, 2005). Professional learning models that allow teachers to focus on their own instructional goals are more likely to feel relevant and lead to meaningful changes in practice than one-size-fits-all workshops (Garrison, 1997).

Competency-based approaches, including micro-credentials, build on these principles by emphasizing classroom implementation and evidence of practice. Rather than measuring professional learning through attendance alone, competency-based systems ask teachers to apply strategies in their classrooms and demonstrate their impact through artifacts such as lesson plans, student work, and reflective analysis. Requiring evidence of practice may strengthen the transfer of professional learning into classroom instruction (Brown & Mhichíl, 2019; Digital Promise, 2016; Sawchuk, 2016).

Teacher motivation and professional confidence are also central to sustained instructional improvement. Teachers who experience strong self-efficacy are more willing to experiment with new strategies, persist through instructional challenges, and maintain long-term commitment to the profession (Bandura, 1994; Eccles & Wigfield, 2002). Professional learning environments that support autonomy, reflection, and visible growth contribute not only to improved instruction but also to teacher retention.

These issues are particularly important in rural districts, where geographic isolation, staffing shortages, and limited access to specialized professional learning can restrict opportunities for sustained instructional development. Research on rural education and partnership-based improvement highlights the need for flexible, locally relevant professional learning models that can build instructional capacity while respecting the realities of rural schools and communities (Farrell et al., 2021; Lavalley, 2018; Nelson et al., 2024).

Recent scholarship examining the evolving landscape of STEM micro-credentials provides additional support for competency-based professional learning models. In a national analysis of STEM micro-credential initiatives, West et al. (2026) describe the GREAT STEM model as an example of how teacher-directed learning, coaching support, and evidence of classroom practice can create flexible and equitable pathways for professional growth, particularly for educators working in rural districts where traditional professional development opportunities are limited.

ACTION PLAN FOR DISTRICTS AND HIGHER EDUCATION PARTNERS

The following action plan outlines how districts and institutions of higher education can implement a similar model using existing staff, structures, and funding.

- **Phase 1: Assess Needs and Identify Participants (Month 1)**
  - Designate a program lead, such as a STEM coordinator, instructional coach, CTE director, or faculty member.
  - Select a pilot group of 10 to 15 grades 9–12 STEM educators.
  - Use a brief assessment based on existing evaluation or professional growth tools.
  - Support teachers in creating self-directed learning plans with one or two instructional goals.
  - Cost: minimal
  - Primary investment: coordination time

- **Phase 2: Launch Initial Micro-Credentials (Months 2–6)**
  - Launch three to five micro-credentials aligned to district and workforce priorities.
  - Accept evidence teachers already produce, such as lesson plans, student work, and short reflections.
  - Use trained district staff or faculty to review submissions using shared rubrics.
  - Cost: low
  - Primary investment: planning and assessment time

- **Phase 3: Provide Ongoing Coaching Support (Months 2–6)**
  - Assign one Navigator to support 10 to 15 teachers.
  - Hold one thirty-minute coaching check-in per teacher each month.
  - Keep coaching non-evaluative and focused on classroom practice.
  - Cost: low to moderate
  - Primary investment: reassigned coaching time

- **Phase 4: Recognize and Incentivize Participation (Months 3–6)**
  - Offer modest stipends, continuing education credit, or public recognition.
  - Allow micro-credentials to count toward professional growth plans or licensure renewal.
  - Cost: low
  - Primary investment: reallocation of professional development funds

- **Phase 5: Evaluate Implementation and Impact (Month 6)**
  - Track participation, completion rates, and teacher satisfaction.
  - Collect brief reflections on instructional change and student engagement.
  - Use simple tools such as surveys and short observation notes.
  - Cost: minimal
  - Primary investment: review and reflection time

- **Phase 6: Scale and Sustain the Model (Months 7–12)**
  - Expand micro-credential offerings based on pilot results.
  - Train additional Navigators from within the district or higher education partner.
  - Blend funding sources such as Title II, CTE funds, grants, and continuing education budgets.
  - Embed the model into existing professional learning structures.
  - Cost: variable
  - Primary investment: leadership alignment and long-term planning.

CONCLUSION

Rural districts cannot rely on traditional professional development models to build long-term STEM capacity. Professional learning must be flexible, practice-centered, and responsive to the realities of rural schools. The GREAT STEM initiative shows how teacher choice, coaching support, and competency-based micro-credentials can strengthen instruction while supporting teacher retention. With strategic partnerships and modest coordination, this model offers a practical and scalable approach to expanding high-quality STEM learning opportunities for rural students.

For partnership opportunities, pilot implementation, or technical assistance, districts may contact the Appalachian State Learning in the Professions team for additional information and planning support.

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