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# Editorial: Rural STEMM education research: bridging between uniqueness and universality: rural-focused and rural-reimagined approaches

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## Editorial on the Research Topic

[Rural STEMM education research: bridging between uniqueness and universality: rural-focused and rural-reimagined approaches](#)

This *Frontiers in Education* Research Topic, “*Rural STEMM education research: bridging between uniqueness and universality: rural-focused and rural-reimagined approaches*,” addresses a core challenge in the field: how can we design and study education rooted in local rural communities and environments that also informs broader practice and theory? This theme invited work that revealed what is distinct about education in specific rural settings while producing insights that resonate across contexts (Coladarci, 2007; Harmon and Johnson, 2025; MacSuga-Gage et al., 2022; Saw, 2025). The 14 articles collected in this Research Topic examine rural STEMM education’s distinct assets, challenges, needs, and opportunities while grounded in a broader research field. Together, they demonstrate how rural contexts shape STEMM teaching, learning, and research, and how ideas born in small schools and tight-knit rural communities have broader implications. The papers in this Research Topic are organized by five themes: *Place-Based and Contextually Relevant Pedagogies*, *Teacher Leadership*, *Professional Development*, and *Attitudes, Technology Integration, Student Motivation, and Community Engagement and Partnerships*.

## Theme 1: Place-based and contextually relevant pedagogies

Kizys et al. highlighted the potential of place-based education (PBE) to enhance STEM education in challenging rural places and emphasized the need for long-term professional development to equip teachers with the skills necessary to integrate STEM content and career development effectively. The researchers documented experiences of three teams of educators in integrating project-based learning (PBL) units and PBE principles in rural middle schools to foster meaningful learning experiences and enhance career awareness among students. Jones revealed how K-8 teachers in sustained deep rural (SDR) places

of the Northern Rocky Mountain region implement STEM education. Despite challenges of extreme rurality characterized by geographic isolation, small school populations, and limited access to resources, SDR educators employed three key strategies to integrate STEM education: (1) managing STEM instruction across multiple grade levels, (2) integrating STEM through multi-subject connections, and (3) utilizing local environmental and community resources for hands-on, experiential learning.

[Mercier et al.](#) examined a place-based STEM project with rural elementary and middle-grade students, showing how contextualized learning fostered shifts in identity affiliations as problem-solvers, advocates, and community members. Their findings illustrated how PBE can cultivate agency, environmental stewardship, and a sense of STEM competence through authentic engagement with local issues. [Iturbe-Sarunic et al.](#) advanced rural science education through water education in Chile's Los Lagos Region, using design-based research in four rural communities to characterize local rural knowledge (LRK) and co-design a contextually relevant teaching and learning sequence (TLS). The TLS employed a place-based inquiry for modeling approach in which students use sensor technology to collect and analyze real-time data on their local water, integrating LRK with national science standards. Their findings underscored the importance of community involvement, participatory design, and place-based learning with technology in rural science education.

## Theme 2: Teacher leadership, professional development, and attitudes

[Meador et al.](#) explored informal STEM learning by examining the experiences of teachers who facilitated competitive educational robotics programs in rural schools. These researchers highlighted how participation in these programs contributed to the teachers' development as STEM leaders. This research offers practical implications for how rural schools can support the growth of STEM teacher leaders through integrated and innovative educational approaches. [Crawford and Starrett](#) validated a social validity survey of STEM professional development (PD) resources across rural and non-rural educators. Results indicated measurement invariance across contexts while also revealing rural educators' stronger valuation of feasibility and appropriateness. The study highlighted the importance of tailoring PD initiatives to rural realities while preserving universal dimensions of quality and relevance. [Pedonti et al.](#) introduced a new framework and tool to assess early childhood educators' dispositions toward science learning in outdoor environments. Analysis of a sample of rural and non-rural educators showed that teachers' expectations and values for outdoor recreation relate to perceived science teaching costs, which in turn are indirectly linked to science beliefs, instructional practices, and support for outdoor learning. Rural-residing educators in the study reported lower perceived costs and higher engagement in outdoor activities, suggesting that rural communities offer contextual strengths to support high-quality science education in early childhood.

## Theme 3: Technology integration

[Tang and Qian](#) examined how rural high school students' perceived authenticity of learning and their career interests in engineering could be enhanced by hands-on making processes driven by 3D printing. Study findings underscored the potential of rural-focused approaches, when combined with universally applicable technology like 3D printing, for supporting rural students' learning and action-oriented outcomes in STEM education. [Kim and Wargo](#) widened the lens to rural educational leaders navigating the integration of artificial intelligence into K–12 STEM education. Rural education leaders see the promise of personalization and efficiency but must confront broadband access challenges, infrastructure gaps, and ethical concerns. Together, these studies illustrate how rural STEM education is shaped across levels of community, classroom, and leadership, not as a story of deficit, but one of adaptation, innovation, and resilience.

## Theme 4: Student motivation

[Jackson et al.](#) highlighted how motivational processes differ for rural students with and without Individualized Education Plans (IEPs), with teacher perceptions emerging as a critical factor in sustaining engagement. Findings challenge deficit perspectives by showing that rural students with IEPs hold strong expectations for success, even as systemic barriers prevent these beliefs from translating into STEM engagement. Focusing on the intersection of culture, rural geographic background, and the impacts of these factors on identity, [Puente et al.](#) examined the pláticas (conversations) of rural, Latinx undergraduate students to understand how these factors influence the pursuit of STEM degrees and careers. While participants recognized the appeal of career prestige and high earning potential, these students' motivations were more deeply rooted in a desire to “give back” to their rural communities, highlighting a culturally grounded commitment to service through STEM fields.

## Theme 5: Community engagement and partnerships

[Gutiérrez et al.](#) investigated the impact of family involvement in informal STEM learning through interactive, at-home activities designed to leverage rural communities' strong, close-knit relationship characteristics. Using the Learning Dimensions of Making & Tinkering framework, their case study revealed that rural families engaged with STEM content in social, emotional, creative, and self-expressive ways. The findings of this study underscore the value of family experiences in fostering rich discussions and deepening understanding of STEM concepts. Addressing access to authentic, high-quality STEM learning for rural students, [Rivera et al.](#) analyzed university–K–12 partnership programs designed to bring STEM content into rural schools. The authors' findings identified key components of successful partnerships and emphasized the pivotal role of teachers in driving program

TABLE 1 Rural-focused and rural-reimagined research approaches.

|                             | Rural-focused                                                                                                      | Rural-reimagined                                                                                                                        |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Definition                  | Centers people, places, and issues in rural areas; rurality is the focal construct.                                | Reconceptualizes/recontextualizes established theories and methods to include rural relevance.                                          |
| Guiding questions           | What phenomena emerge when rurality is central? Which rural subtype and local characteristics are key?             | How should “geography-blind” theories be adapted to rural contexts? Which constructs need reconceptualizing to reflect rural relevance? |
| Primary use/implications    | Critique/extend theory to center rurality; generate constructs born in rural contexts; highlight rural uniqueness. | Bridge universal theories with rural relevance; connect rural insights to wider field; broaden applicability and practice.              |
| Example constructs/theories | Rural identity, rural cultural wealth, rural critical policy analysis, etc.                                        | Place-based education, situated expectancy-value beliefs, social cognitive career theory, etc.                                          |

success, particularly through the cultural capital they contribute to the collaboration between higher education institutions and rural communities. McBride’s community case study of Wyoming’s rural technical STEM pathways demonstrated how relationship-centered approaches enable students to navigate educational “deserts” defined by geographic isolation and cultural diversity. Rural technical STEM educators served as cultural brokers, bridging local knowledge with broader academic systems and offering supports that extend beyond academics to address mental health, family, and community needs.

## Rural-focused and rural-reimagined research approaches

Collectively, this Research Topic highlights both the uniqueness and universality of rural STEM education. Rural places differ widely, yet work focused on a single community can produce important lessons with implications for many others. Theories or methods built to be universal can be adopted or adapted to make sense of local phenomena in different rural contexts. We introduce *rural-focused* and *rural-reimagined* research approaches as a metatheory, a fundamental set of ideas about how rural phenomena could be understood and studied (Bates, 2005; see Table 1). Rural-focused research approaches center people, places, and issues in rural areas (e.g., rural identity, Agger et al., 2018, rural cultural wealth, Crumb et al., 2023, rural critical policy analysis, Brenner, 2022), whereas rural-reimagined research approaches reconceptualize or recontextualize traditional theories and methods to include rural relevance in the studies (e.g., place-based education in Starrett et al., 2021 and situated expectancy-value beliefs in Starrett et al., 2022; social cognitive career theory in Meador, 2018, and Saw and Agger, 2021). This distinction is adapted by analogy from research on race in education psychology, where race-focused work addresses constructs with race at the center, while race-reimagined work reconceptualizes constructs to include racially influenced, sociocultural perspectives (DeCuir-Gunby and Schutz, 2014, 2024).

Both rural-focused and rural-reimagined approaches can serve as metatheoretical lenses for rural educational researchers to critique and extend theories to center rurality in their research inquiry. They are also useful for understanding the significance

of the STEM educational research articles collected in this Research Topic. Studies that employed rural-focused theories or constructs include Iturbe-Sarunic et al. (local rural knowledge), Jones (sustained deep rurality), McBride (rural intersectionality theory), Meador et al. (rural teacher leadership framework and rural robotics teacher identity), and Mercier et al. (rural place-based education). Studies that utilized a rural-reimagined approach to expand geography-blind theories or constructs with rural relevance include Crawford and Starrett (social validity theory), Jackson et al. and Pedonti et al. (situated expectancy-value theory), Kim and Wargo (diffusion of innovation theory), Kizys et al. (project-based learning), and Puente et al. (giving back framework).

## Recommendations for future research

This Research Topic presents rural-focused and rural-reimagined studies that enrich theories and constructs and bridge gaps between uniqueness and universality in rural STEM education research and beyond. It also points to what researchers in the field could pursue next. First, future work should treat rurality as central to study design. Each study on STEM education should specify the rural subtype (e.g., rural-fringe, SDR) and describe unique rural features (e.g., culture, ecology, labor markets; Grant et al., 2024; Thier et al., 2020). Second, researchers may consider employing rural-focused and rural-reimagined approaches to develop, integrate, refine, and expand theories and constructs that are useful for understanding and studying rural STEM education (National Academies of Sciences, Engineering, and Medicine, 2025). Third, future studies should continue to explore how rurality intersects with other social identities or statuses (e.g., gender, race/ethnicity, social class, language) and other contextual factors (e.g., cultures, economies, ecologies) in shaping STEM teaching, learning, and research (McNamee et al., 2025; Sansone, 2023). Finally, future STEM education research would benefit from co-design and collaboration with teachers, youth, families, and community partners to ensure that research questions, theoretical frameworks, and methodological approaches are locally grounded (Harmon, 2017; Saw and Culbertson, 2025). Together, these steps will advance rural STEM education research and generate evidence and insights that strengthen the understanding, application, and impact of STEM education in rural communities and beyond.

## Author contributions

AS: Writing – review & editing, Writing – original draft. GS: Writing – review & editing, Writing – original draft. AM: Writing – review & editing, Writing – original draft. HH: Writing – review & editing, Writing – original draft.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

## References

- Agger, C., Meece, J., and Byun, S.-y. (2018). The influences of family and place on rural adolescents' educational aspirations and post-secondary enrollment. *J. Youth Adolesc.* 47, 2554–2568. doi: 10.1007/s10964-018-0893-7
- Bates, M. J. (2005). "An introduction to metatheories, theories, and models," in *Theories of Information Behavior: A Researcher's Guide*, eds. K. Fisher, S. Erdelez, and L. McKechnie (Medford, NJ: Information Today), 1–24.
- Brenner, J. (2022). "Toward a rural critical policy analysis," in *The Bloomsbury Handbook of Rural Education in the United States*, eds. A. P. Azano, K. Eppley, and C. Biddle (London: Bloomsbury Academic), 30–42. doi: 10.5040/9781350172036.0010
- Coladarci, T. (2007). Improving the yield of rural education research: an editor's swan song. *J. Res. Rural Educ.* 22, 1–9. Available online at: <https://jrre.psu.edu/sites/default/files/2019-08/22-3.pdf>
- Crumb, L., Chambers, C., Azano, A., Hands, A., Cuthrell, K., and Avent, M. (2023). Rural cultural wealth: dismantling deficit ideologies of rurality. *J. Multicult. Educ.* 17, 125–138. doi: 10.1108/JME-06-2022-0076
- DeCuir-Gunby, J. T., and Schutz, P. A. (2014). Researching race within educational psychology contexts. *Educ. Psychol.* 49, 244–260. doi: 10.1080/00461520.2014.957828
- DeCuir-Gunby, J. T., and Schutz, P. A. (2024). The evolution of race-focused and race-reimagined approaches in educational psychology: future directions for the field. *Educ. Psychol. Rev.* 36:30. doi: 10.1007/s10648-024-09873-2
- Grant, P. D., Longhurst, J. M., and Thier, M. (2024). Rural definition triangulation: improving the credibility and transferability of rural education research in the United States. *J. Res. Rural Educ.* 40:2016985. doi: 10.3102/2016985
- Harmon, H., and Johnson, J. (2025). "Introduction to the handbook on rural and remote education," in *Handbook on Rural and Remote Education*, eds. J. Johnson and H. Harmon (Cheltenham: Edward Elgar), 1–11. doi: 10.4337/9781035307722.00005
- Harmon, H. L. (2017). Collaboration: a partnership solution in rural education. *Rural Educ.* 38, 1–5. doi: 10.35608/ruraled.v38i1.230
- MacSuga-Gage, A. S., Kern, L., and Gage, N. A. (2022). Riding fences. *Rural Special Educ. Quart.* 41, 59–60. doi: 10.1177/87568705221098206
- McNamee, T. C., Willis, J. F. E., and Davis, R. (2025). "Towards a critical rural education line of inquiry: rural spaces as multi-identity contexts," in *Handbook on Rural and Remote Education*, eds. J. Johnson and H. Harmon (Cheltenham: Edward Elgar), 417–431. doi: 10.4337/9781035307722.00035
- Meador, A. (2018). *Environmental Variables for STEM Degree Interest and Goal Persistence: Examining the Experiences of Minority Students in the Rural Context* (Doctoral dissertation). Texas Tech University. TTU Electronic Theses and Dissertations. Available online at: <https://hdl.handle.net/2346/82716> (Accessed October 14, 2025).
- National Academies of Sciences, Engineering, and Medicine (2025). *K–12 STEM Education and Workforce Development in Rural Areas*. Washington, DC: National Academies Press.
- Sansone, V. A. (2023). Applying intersectionality to address racial and spatial postsecondary disparities—rural Latino youth. *Teach. Coll. Rec.* 125, 59–75. doi: 10.1177/01614681231181802
- Saw, G. K. (2025). Place-sustaining education in rural areas: book review of "handbook on rural and remote education." *J. Res. Rural Educ.* 41, 1–5. doi: 10.26209/JRRE4105
- Saw, G. K., and Agger, C. A. (2021). STEM pathways of rural and small-town students: opportunities to learn, aspirations, preparation, and college enrollment. *Educ. Res.* 50, 595–606. doi: 10.3102/0013189X211027528
- Saw, G. K., and Culbertson, R. (2025). Place-sustaining partnerships for rural education and workforce development. *Rural Educ.* 46, 1–5. doi: 10.55533/2643-9662.1606
- Starrett, A., Irvin, M. J., Lotter, C., and Yow, J. A. (2022). Understanding the relationship of science and mathematics place-based workforce development on adolescents' motivation and rural aspirations. *Am. Educ. Res. J.* 59, 1090–1121. doi: 10.3102/00028312221099009
- Starrett, A., Yow, J., Lotter, C., Irvin, M. J., and Adams, P. (2021). Teachers connecting with rural students and places: a mixed methods analysis. *Teach. Teach. Educ.* 97:103231. doi: 10.1016/j.tate.2020.103231
- Thier, M., Beach, P., Martinez, J., C. R., and Hollenbeck, K. (2020). Take care when cutting: five approaches to disaggregating school data as rural and remote. *Theory Pract. Rural Educ.* 10, 63–84. doi: 10.3776/tpre.2020.v10n2p63-84

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