How Policy and Pedagogy Influence STEM Teachers' GenAI Use

Findings From a 2025 Exploratory Study From the AmplifyGAIN Center

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Introduction

Generative artificial intelligence (GenAI) is reshaping what is possible in K–12 classrooms, especially in science, technology, engineering, and mathematics (STEM) classrooms. GenAI tools can help STEM teachers build higher quality lesson plans, personalize learning for diverse students, and generate feedback that is more targeted. At the same time, these tools introduce new risks: hallucinated content, overreliance on AI-generated materials, and widening gaps between schools that have the infrastructure to support thoughtful adoption and those that do not. GenAI is also fundamentally different from previous educational technologies. Even its creators do not fully understand when or why it produces inaccurate outputs (Sheshadri et al., 2025; Shojaee et al., 2025), making it less a tool for teachers to master and more an instrument they must learn to navigate.

U.S. STEM teachers are entering this landscape unevenly. In recent national surveys, roughly 60 percent of STEM teachers reported having tried GenAI for instructional tasks, but only about 20 percent used it regularly (Diliberti et al., 2024; Gallup Inc., 2025). Most use is concentrated in lesson planning and materials creation. Meanwhile, as of summer 2025, only 22 percent of surveyed science and math teachers had received formal, district-sponsored professional learning on AI, and just 5 percent reported that their school or district has a formal AI use policy (Esbenshade et al., 2025). Teachers cited insufficient time to learn, inadequate training, and unclear district guidelines as their top barriers to adoption. In short, without district-adopted tools, STEM teachers are experimenting largely on their own, often without clear guidance on which tools to use, how to use them well, or whether the district has any expectations about their use.

For GenAI to be an instructional technology that improves learning opportunities, experiences, and outcomes for students, it is vital for researchers, policymakers, and educators to understand how and why STEM teachers use GenAI and what conditions support or constrain that use.

The AmplifyGAIN Center was established to investigate exactly this topic. We at WestEd join the University of Washington in conducting research funded by the Institute of Education Sciences. As one of four national centers under the Accelerate, Transform, Scale Initiative (Grant R305C240012), the center pursues a mission of conducting research and providing national leadership on the use of GenAI to improve mathematics and science teaching and learning in K–12 schools.

This report presents findings from the AmplifyGAIN Center's Year 1 exploratory studies. A prior report (Esbenshade et al., 2025) describes emerging patterns in STEM teachers' GenAI adoption, use, and support as revealed in a national survey of STEM teachers. The current report focuses on the in-depth interview series that informed that survey's creation and addresses three research questions:

1. How do K–12 STEM teachers use GenAI for instructional tasks (e.g., lesson planning, assessment, instruction, professional learning, administration)?
2. How does their pedagogical orientation influence their GenAI learning and use?
3. How is their use of GenAI situated in the social and institutional contexts of their schools?

Framing GenAI Use as Contextual

We understand GenAI as an instrument. Many previous educational technologies, such as calculators, laptops, or smartboards, function as tools. That is, they are objects built by designers for anticipated uses, and they behave as functions in a mathematical sense. One input generates one output. GenAI is different. Drawing on Rabardel's (1995) distinction, Tapan Broutin (2023) describes GenAI as more like an instrument. The same input does not generate the same output; therefore, GenAI is composed of both the technology and the user's evolving schemes for working with it. As a teacher uses GenAI, the technology adapts to the teacher, and the teacher adapts to it. This reciprocal relationship makes GenAI use less predictable (Mishra et al., 2023) and more dependent on the teacher's orientation, context, and experience than has been the case for previous technologies.

The Contextual Factors That Influence GenAI Use

To account for the contexts in which teachers navigate GenAI, this study adopts an ecological perspective (Zhao & Frank, 2003) that situates teachers' technology use within their social and institutional environments and pedagogical orientations. This perspective stands in contrast to the bulk of empirical research on GenAI in education, which has primarily sourced teachers' adoption decisions to individual attitudes and beliefs about the technology's usefulness and risks (e.g., Al Darayseh, 2023; Bower et al., 2024; Chounta et al., 2022; Kaplan-Rakowski et al., 2023; Parviz, 2024; Woodruff et al., 2023). While attitudes and beliefs matter, an ecological lens reveals how school culture, leadership, peer networks, and institutional infrastructure shape the scope and direction of GenAI use in ways that individual-level variables alone cannot explain. This study organizes the ecological perspective around three dimensions: pedagogical orientation, social context, and institutional context.

Pedagogical Orientation

Teachers' beliefs about teaching and learning have long been found to shape how they use educational technologies. Windschitl and Sahl (2002) observed that teachers who designed for active learning used laptops to support student inquiry, while teachers who understood teaching as knowledge delivery used the same technology to reinforce direct instruction. In the GenAI context, Hsu and colleagues (2024) found that preservice teachers with student-centered orientations used GenAI for strategy generation and open-ended questioning, while more teacher-centered peers used it for explanations and assessments. Kim and Kim (2022) showed similar patterns: Constructivist teachers used AI to support student writing processes, while more traditional teachers focused on efficiency. We focused our analysis of pedagogical orientation on a teachers' characterization of their teaching as more teacher-centered—whereby the teacher is the focus of activity with, for example, greater didacticism—or as more student-centered with more of a focus on student discourse and exploration and development of scientific and mathematical practices.

Social Context

Teachers do not adopt technological tools in isolation but rather in their social context. Frank and colleagues (2004) found that informal peer support increased the likelihood of technology use by 40 percent. Penuel's (2006) synthesis identified strong professional communities as key to successful adoption. Ertmer and Ottenbreit-Leftwich (2010) showed the converse: Unsupportive environments hinder adoption even among willing teachers. We define the social context of GenAI adoption as the messages and symbols of the schooling community that influence how individuals understand the social acceptability of and social support for their adoption and use of new technologies.

The social context that influences how individuals adopt and implement technologies involves the messages and symbols of the network of interpersonal relationships in a teacher's professional community. In other words, it is how someone's peers, supervisors, and students influence technology adoption and use, and it depends on how communities of practice develop shared understandings of technology's role in education. The social context provides crucial support mechanisms, knowledge sharing opportunities, and normative influences that can accelerate, impede, or alter the course of technology integration.

Institutional Context

Recent surveys indicate that a lack of school guidance about AI use and a lack of professional development are significant barriers to adoption (Diliberti et al., 2024; RAND American Educator Panels, 2025). Woodruff and colleagues (2023), surveying more than 4,500 U.S. teachers, found that unclear policies and limited administrative support were major adoption barriers, even among interested teachers.

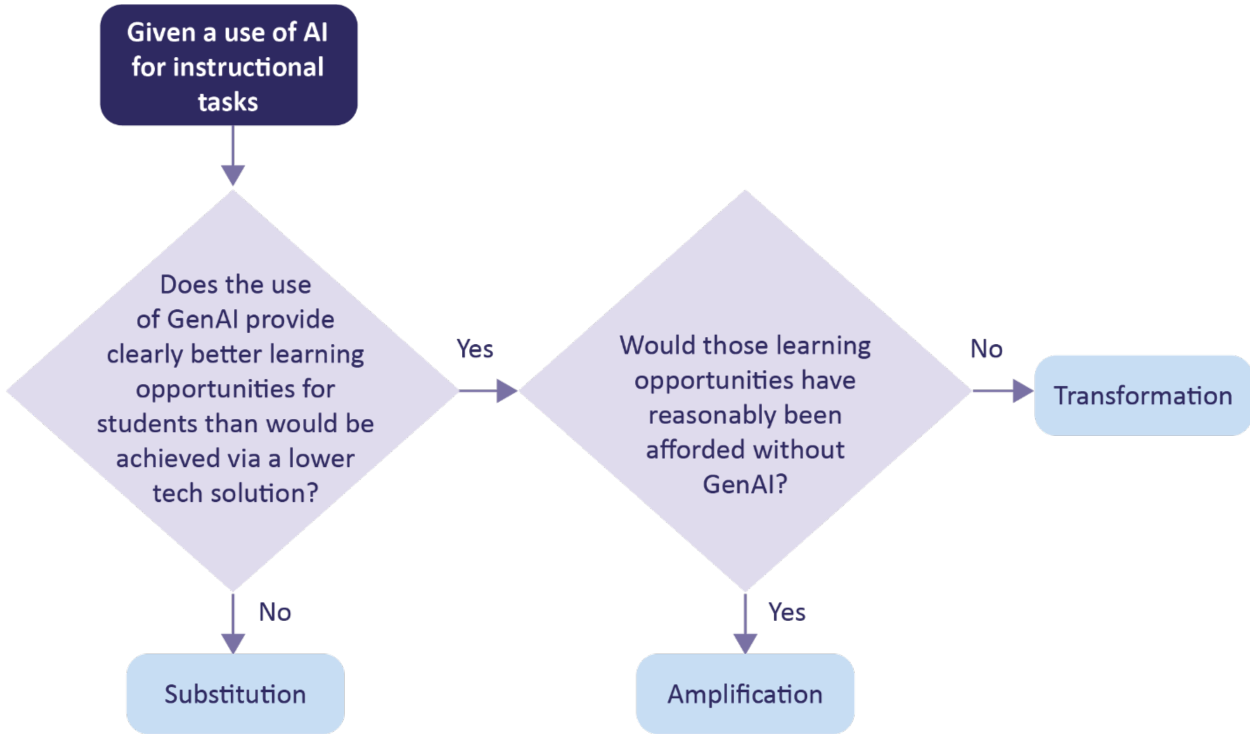
Institutional context refers to the organizational structures, policies, resources, and leadership factors that shape technology implementation. This includes school or district policies regarding technology use, available professional development, administrative support for innovation, resource allocation decisions, and established evaluation practices. The institutional context creates the formal and informal rules that govern how technologies can be used, establishes incentives or barriers for adoption, and determines the sustainability of technology initiatives through resource commitment and alignment with organizational goals.

Understanding GenAI Use Through Its Affordance of New Learning Opportunities

To categorize the nature of teachers' GenAI use, we adapted Puentedura's (2006) model for technology integration in which technology use is classified in terms of Substitution, Augmentation, Modification, or Redefinition (SAMR). Hamilton and colleagues (2016) recast Modification and Redefinition as "transformation" and critique SAMR for its emphasis on learning outcomes at the expense of educational processes and for its misapplication without regard to context.

To account for educational processes, we defined the key outcome of teachers' GenAI use as the provision of learning opportunities for students (Hiebert et al., 2025). Teachers' GenAI use is *substitutive* if it does not clearly provide better learning opportunities for students than would be achieved with lower tech solutions. Use is *transformative* if it does provide better learning opportunities and is the only technology that could reasonably do so. By "better," we mean learning opportunities that are more responsive to varied student learning needs and/or more consistent with ambitious STEM teaching. If it provides better learning opportunities but other technologies could achieve the same, then use is *amplified* but not transformative. See Figure 1.

Figure 1. Analytical Frameworks for SAMR Classification of GenAI Use Case



To address the second critique of Hamilton and colleagues, we situated this framework within the ecological perspective described above, analyzing each use case in light of the teacher's pedagogical orientation, social context, and institutional context.

Methods

We conducted a qualitative study to understand teachers' AI use in context. From a pool of 45 eligible teachers in the state of Washington who expressed interest, we assembled a subset of 24 to invite who varied by STEM subject, grade band, setting (urban or rural), and student demographics, including racial and socioeconomic composition, percentage of English Learner students, and percentage of students with disabilities. The 15 teachers who accepted our invitation included 6 science teachers, 4 math teachers, and 5 who taught both subjects. They spanned K–12 grade bands and the GenAI adoption spectrum from avoidance to regular use and represented schools ranging from small rural campuses with fewer than 10 staff to large urban high schools with more than 3,000 students.

Data Sources

We conducted 90-minute semistructured interviews (Bhattacharya, 2017) with each of the 15 teachers. We also conducted 60-minute interviews with one to three additional education professionals (principals, instructional coaches, technology directors, and teaching colleagues) at each teacher's school or district to develop a fuller picture of the social and institutional context of the teacher's GenAI use. In total, we conducted 40 interviews across the 15 schools.

Teacher interviews addressed two categories of questions. The first concerned GenAI use cases. We asked teachers to describe how they had experimented with or used GenAI for instructional tasks, whether other technologies or processes could have accomplished the same outcomes, and whether their use had impacted students' learning opportunities. The second category was contextual. We asked teachers to describe what they would have to see from another teacher to classify their teaching as "excellent." We asked them to describe the culture of the school with reference to how the adults in the school interacted and their norms in doing so, including specifically asking about how the adults talked about GenAI. We also asked about what policies and resources were made available to them for using GenAI and edtech more broadly.

Analytical Methods

We conducted, recorded, and transcribed all interviews on Zoom. Two researchers took notes during each interview on a common notes document organized by question. We analyzed transcripts and notes together after each interview using a constant comparison method (Glaser & Strauss, 1967) and iteratively refining our interview protocol as new themes emerged.

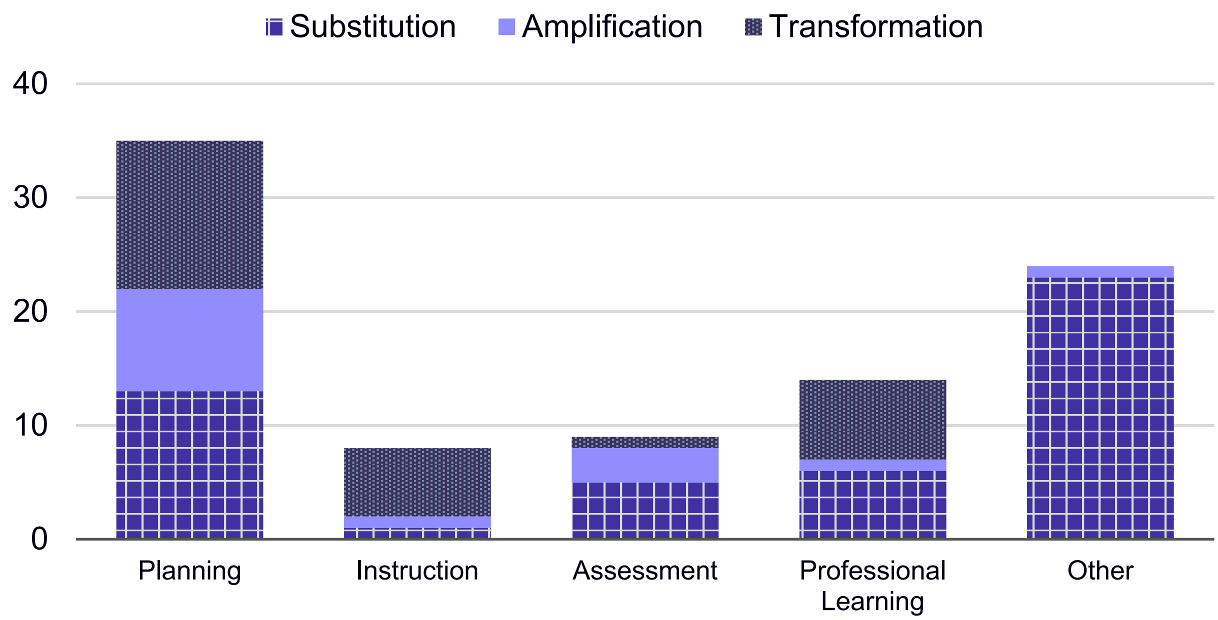
We identified 80 use cases across the 15 teachers. In collaborative analytical meetings, we first categorized each use case by instructional task: lesson planning, instruction, assessment, administration, or professional learning. Some use cases fit multiple categories. We then categorized each use case as substitutive, amplified, or transformative. Researchers wrote analytical notes substantiating their determinations, focusing on whether the use case provided new learning opportunities for students and whether GenAI had afforded those opportunities in ways other technologies could not. We also consolidated our notes on teachers' descriptions of high-quality STEM teaching, the social culture of their schools, and their administrations' policies, resources, and messaging about GenAI and innovation.

Findings

We identified 90 unique GenAI use cases across our 15 interview participants, with some use cases falling under multiple instructional use categories. The largest share involved lesson planning, followed by other administrative tasks, professional learning, assessment, and then instruction. Figure 2 shows the number of use cases identified as substitutive, amplified, or transformative within each of the instructional use categories. Overall, the greatest number of use cases were substitutive because teachers used GenAI in ways that did not provide new learning opportunities for students. Transformative use, whereby teachers used GenAI to create student learning opportunities that otherwise would not have been possible, was concentrated among a smaller number of teachers. What distinguished those teachers was their willingness to innovate, experiment, and collaborate both with AI and in the classroom, actions supported by their pedagogical beliefs and by school policies, messaging, and resources.

We found that teachers adopted and used GenAI to improve learning opportunities for students when the teachers held student-centered pedagogies and worked in schools that actively supported innovation and collaboration. Conversely, when teachers held more traditional pedagogical views or worked in isolated or underresourced settings, GenAI use tended to be substitutive or aimed at personal efficiency. Importantly, we also found instances of transformative use in some challenging contexts, such as when teachers used GenAI for their own professional learning.

Figure 2. Use Cases by Purpose and Category



We illustrate these patterns through four cases. Ms. Bennett is a teacher whose pedagogical orientation constrains transformative use of GenAI and whose school context offers limited support for transformative GenAI adoption. Ms. Wallace shares many of Ms. Bennett's contextual challenges but brings a different set of pedagogical commitments, and, as such, her story shows what orientation alone can and cannot accomplish. Mr. Flatly shows what becomes possible when a student-centered teacher works in a district that has invested deeply in building a collaborative culture and institutional infrastructure. Mr. Morgan shows that the same dynamic can play out in a small, underresourced school when leadership makes intentional choices around GenAI adoption, including outreach to and partnership with parents. Together, these four cases capture the central dynamic of our findings: that GenAI use is shaped not by the technology itself but by the intersection of teachers' beliefs about teaching and their social and institutional worlds.

Ms. Bennett: When Context and Orientation Align Against Adoption

Ms. Bennett taught middle school math and science in a small rural school with just four teachers. She had been teaching for more than 10 years. The nearest math or science colleague was over 30 miles away.

Ms. Bennett did not use AI and described herself as an AI avoider. She said she would be more likely to try GenAI if someone showed her something "easy and quick" that made her life easier. She wanted a flowchart or a specific list of what to put into GenAI and what she would get out. Without that, any investment on her part to learn the technology did not seem worthwhile. She understood GenAI as a tool for efficiency, but she was already efficient by using her previous lesson plans. As she put it,

> Why should I invest my time and energy in the summer or on Friday afternoons? … I've got each [lesson] in my Google Drive by subject. … I go to that period. It's easy, it's done. I can just hit print and boom!

Ms. Bennett understood AI primarily as a tool for teachers, not for teaching, and this orientation paralleled her teacher-centered approach to instruction. For example, she preferred to explain content to students before allowing them to explore, noting that when students explored first, they had "too many questions." She used a 5-E science method but reordered it, putting explanation before exploration. She took the same approach to learning new technologies. For example, during COVID-19, rather than experimenting with Google Classroom, she first went to YouTube and sought an explanation of Google Classroom. Just as she wanted content explained before students explored it, she wanted GenAI explained before she would explore it.

Ms. Bennett's school context also did not provide fertile ground for her exploration, innovation, or collaboration. Budget cuts had eliminated instructional coaches and tech support entirely. There was no AI policy, no professional learning about GenAI, and no messaging from leadership about its potential. Her principal was not involved as an instructional leader around technology. Ms. Bennett had full autonomy over her curriculum, which, in the absence of support, meant defaulting to what she already had. The social context was equally constraining. She did not have the ability to see another teacher's practice in her content area at her grade level because of the remoteness of her school. There was no daily grade-level content partner to experiment with, learn from, or be encouraged by.

Ms. Wallace: When Orientation Outpaces Context

Ms. Wallace taught high school science in a small rural school of about 350 students. She had been teaching for about 7 years. She was the only teacher of her subject at her grade level.

Ms. Wallace used GenAI in both substitutive and transformative ways. Her transformative use involved deploying GenAI for her own professional learning. Ms. Wallace had studied chemistry but was now teaching Earth science. She used GenAI to deepen her own pedagogical content knowledge to enable her to integrate her new conceptual understanding into her lesson planning. GenAI enabled a kind of just-in-time professional learning that directly strengthened her understanding so she could provide better learning opportunities to students.

Ms. Wallace's choice to use GenAI for her own professional growth rather than for efficiency reflected her pedagogical commitments. She described a high-quality science classroom as one in which "kids are asking questions and being okay with not having the answer but trying to figure it out together." She valued student inquiry, transfer, and exploration, and she saw herself as a facilitator of learning. Her pedagogical orientation shaped not just whether she adopted GenAI but also how she used it.

Ms. Wallace, like Ms. Bennett, was in a small school with few resources and little messaging for innovation or collaboration. Ms. Wallace described herself as the "lone innovator" at her school. Most of her colleagues were skeptical of AI or framed it primarily as a cheating tool. Her principal had recently attended a GenAI conference and found it "mind-blowing," but the school still had no AI policies, and professional learning funds were severely limited. Ms. Wallace wished for clearer boundaries, noting that the absence of policy constrained her willingness to explore student-facing uses. Absent the social and learning supports at school, she sought those supports elsewhere. She learned about GenAI on her own, primarily through social media and experimentation.

The case of Ms. Wallace suggests that a student-centered pedagogical orientation can drive a teacher toward transformative GenAI use even in a context that does not support adoption, but that transformative use is likely to require outside supports. The social narratives around GenAI also can constrain teachers such that they feel they cannot share their use or learning with others.

Mr. Flatly: When the Full Ecosystem Aligns

Mr. Flatly taught high school science and career and technical education (CTE) in a large urban high school of about 3,000 students. He had been teaching for 8 years and was the head of his school's science professional learning community (PLC).

Mr. Flatly did not see efficiency as GenAI's primary value. He called it a "creative thought partner" and used it to design new kinds of learning experiences. His most striking use case involved having students use GenAI to write lab procedures based on their own scientific questions and then run the experiments to see what happened. He closed the class with a discussion about whether or not the ChatGPT-created lab procedures helped student teams answer their research questions.

Mr. Flatly said that students "don't get a lot of experience in actually developing and creating labs and conducting labs generally." He continued:

> They're given a lab investigation. … It's more fun to not know what's going to happen, … more valuable and authentic to science is to actually do something that we don't know the answer to.

This example illustrates a transformative use. Instead of the teacher defining the questions and specifying lab procedure, students were asking their own questions, defining variables, designing procedures, and then assessing validity, facilitated by GenAI in a way that would have been unimaginable with prior technologies.

Mr. Flatly's use of GenAI as a creative partner rather than an efficiency tool was inseparable from his pedagogical orientation. He described himself as "a guide on the side rather than the sage on the stage" and said he loved learning alongside his students. He valued student exploration and uncertainty in the classroom. He regularly changed his lesson plans midclass to follow student thinking. His student-centered orientation to teaching was consistent with giving students GenAI for an authentic science experience and saying, "Let's try it and see what happens." Mr. Flatly's comfort with classroom uncertainty coupled with his appreciation for student metacognition was a pedagogical precondition for his transformative GenAI use.

Mr. Flatly's school and district provided an unusually rich ecosystem for GenAI experimentation. The district employed over 20 information technology (IT) professionals. The director of technology innovation worked with school leaders not just on tool adoption but on building AI literacy and framing GenAI as an instructional technology. The district had approved a suite of GenAI tools with robust data protection agreements and had developed sequenced rollouts that combined synchronous professional learning with asynchronous follow-up. At the school level, Mr. Flatly had five to six teachers of the same subject at each grade level and a large CTE department. The administration had structured regular PLC meetings during the school day. A special education teacher at the same school described a 5-year institutional investment in building a culture of collaboration that predated GenAI. Mr. Flatly described enjoying sharing his GenAI discoveries with colleagues, and the IT director estimated that more than half the teachers were regularly using GenAI for instruction.

Mr. Flatly's case shows what is possible when pedagogical orientation, social context, and institutional context are aligned. A student-centered teacher who saw GenAI as a thought partner rather than a shortcut, working in a school with genuine collaborative structures and a district that provided tools, training, and clear guidance constitute the ecosystem in which ambitious, student-facing transformative use emerged.

Mr. Morgan: How Leadership Can Complement Orientation Even With Resource Limitations

Mr. Morgan taught 5th grade math and science at a small-town elementary school of 300 students, 70 percent of whom were Hispanic and from low-income families. He was a 1st-year teacher who had previously worked as a mechanical engineer. His school had an involved parent community.

Of Mr. Morgan's 11 use cases, 8 were transformative. He used a natural language coding platform to build a website for students to access instructional resources outside of class—something his lack of coding experience would have made impossible in the absence of GenAI. He built custom chatbots for specific pedagogical purposes, including one that advised him on differentiating curricula for students with individualized education programs (IEPs). He used GenAI to adapt curricula to be more culturally relevant to his students. And he deployed GenAI directly with students during class. Students used GenAI on their school-supplied laptops to get personalized mathematical explanations. Mr. Morgan described students coming up to him "just glowing" after finally understanding decimal multiplication. He reflected: "It kind of gives that ability for students to really take charge of their own education in a really positive way."

Mr. Morgan's transformative use was rooted in his pedagogical commitments. He valued differentiation and cultural relevance. He described wanting to make learning connect to students' lives and identities, including integrating elements of their culture into his math instruction. He wanted his students to care about their education and to see its relevance, which undergirded his commitment to using GenAI to build more culturally responsive, personalized learning opportunities for his students

Mr. Morgan's school had chronic budget constraints and just two teachers per grade level. However, the school had secured a grant to provide laptops to every student. It had adopted MagicSchool, a pedagogically oriented GenAI platform, in 5th grade classrooms. The principal actively encouraged Mr. Morgan to experiment and to lead professional development sessions for other teachers, and the school had developed a clear student AI use policy. Mr. Morgan described parents as enthusiastic about the school's GenAI adoption. He described the principal as someone who fostered a culture of teacher leadership and innovation, framing the school's limited resources not as a reason to play it safe but rather as a reason to adapt. The collaborative structures were modest because of the small pool of teachers, but Mr. Morgan said they were consistent and focused on instructional improvement.

Mr. Morgan's case may be the most important for policymakers because it showed that transformative GenAI use did not require a large district, a 20-person IT department, or abundant funding. It required a teacher with a student-centered orientation and a leader who framed GenAI as an instructional tool, encouraged experimentation, endorsed tools with clear guidelines, and even provided modest collaborative structures. This small, rural school got the fundamentals right—policies, resources, messaging, and a culture of innovation—and a 1st-year teacher produced some of the most transformative use we observed in the entire study.

Implications

This study examined how K–12 STEM teachers in the United States use GenAI for instructional tasks and how their use is shaped by pedagogical orientation and the social and institutional contexts of their schools. These findings have implications for those crafting and supporting AI policies in schools in the hopes of catalyzing GenAI as a force for improving STEM teaching and learning.

Policies, Resources, and Messaging Should Work Together to Support Transformative GenAI Adoption

Our findings show that institutional context operates through three interrelated channels: policies, resources, and messaging. Schools in which all three were aligned—where clear policies gave teachers confidence, endorsed tools gave them a starting point, and leadership messaging connected GenAI to instructional goals—demonstrated the most transformative use. Where any channel was missing, teachers were left to navigate on their own and GenAI use tended to default toward substitution or avoidance.

GenAI Policies Should Be Clear but Flexible

District leaders should develop GenAI use policies that are clear enough to provide guidance about use but flexible enough to encourage experimentation. Educators' responses in our study suggest that policies should include the following:

- **GenAI Ethics:** Teachers had significant questions about the impact of GenAI on teaching and learning and raised ethical considerations. Technology directors expressed concern that without use policies, including data protection policies, teachers may use GenAI for student data in ways that violate the Family Educational Rights and Privacy Act (FERPA). As such, district and school policies should include principles of GenAI ethics and data protection that teachers can use as bedrock for navigating GenAI dilemmas in teaching and learning and for adhering to FERPA regulations.
- **GenAI as a Situated Tool:** Teachers in our study were clear that they wanted GenAI tools and GenAI learning to be consistent with the improvement efforts they were already being asked to implement. So, GenAI use policies should be situated in a district's guiding principles of teaching and learning, with clearly articulated connections to district and school improvement plans.
- **GenAI Use Policies:** Teachers also called for a clear understanding of how they are allowed and encouraged to use GenAI both in and out of the classroom and how their students were allowed and/or encouraged to use it. District and school policies should clearly articulate appropriate and inappropriate use by both teachers and students with examples and a framework for teachers and students to navigate marginal use cases.

Teachers Need Common GenAI Tools That Fit Into the Initiatives for Which They Are Already Accountable

District leaders need to plan both for the adoption of common GenAI tools and for the time and money that teachers and school leaders need to learn new GenAI tools and the way they fit into improvement plans.

- **GenAI Tool Adoption:** The teachers in our study regularly expressed a desire for the adoption of common tools. Not only does such adoption concretize any use policies that schools and districts create but it also allows teachers to know that they can go to each other for help. Teachers contrasted uniform tools with the current lack of uniformity, stating that they did not know who they could go to if other teachers are using different tools.
- **Time and Money for GenAI Professional Learning:** Schools and districts also need to support content-focused and curriculum-connected professional learning about how teachers can use GenAI to accomplish instructional improvement goals. The most transformative use cases in our study surfaced in environments with robust PLCs and structures for teachers to not only attend GenAI professional learning but also lead sessions and share how they were innovating. These structures require time and money as a key investment of resources into GenAI for instructional improvement.

Schools and Districts Should Craft Their AI Narratives to Promote Innovation

Districts and schools should be intentional about their GenAI messaging. The teachers in our study who were in schools where the social messaging closely associated using AI with *cheating* were the teachers who were avoiding GenAI or using it only lightly. On the other hand, when schools' social messaging associated GenAI with *innovation*, teachers were more experimental and open about how their use supported their learning, leading to more transformative use. Through intentional messaging, districts can steer the social acceptability of GenAI use and experimentation toward narratives about innovation and away from narratives about cheating. We believe this is most effectively done with policies and resources that align with innovation narratives.

Teachers Need Content-Specific, Collaborative, Ongoing Professional Learning

Where policy, resources, and messaging intersect most is in professional learning. Based on our interviews, effective AI professional learning looks less like a vendor demo and more like sustained GenAI-focused PLCs (Nucci et al., 2026). Districts should design GenAI professional learning to do the following:

- **Ground GenAI in Existing Initiatives:** Teachers who were hesitant to learn GenAI cited not having time for "one more thing." Districts can catalyze adoption by framing GenAI learning as a way for teachers to work toward already established district and school initiatives.
- **Prioritize Immediate, Hands-On Application:** Replace demos with protected time to apply GenAI to real lessons, assessments, and data sets—ideally organized by discipline.

- **Attend to the Adoption Gradient:** Teachers recommended showing GenAI avoiders how it could help them be more efficient and alleviate some of their "pain points." Teachers also said that once reluctant teachers have bought into the possibilities, the professional learning design should then pivot them toward GenAI for instructional improvement and more student-centered and agentic learning opportunities.
- **Build in Peer Collaboration:** Teachers asked for mixed-experience groups, teacher-led sharing spaces, and down-the-hall support to have structures for the GenAI learning to extend well after the professional learning sessions were over.
- **Play the Long Game:** One-off workshops tend not to produce instructional change; sustained, PLC-aligned learning across the year does (Hill & Papay, 2022). Teachers in our study asked for collaborative, content-focused GenAI professional learning in regularly recurring sessions over time such that they could learn incrementally, try out techniques, experiment, innovate, and then reconvene to share and learn.

GenAI Is Unlikely to Be Used to Improve Instruction Without Cultivating a Student-Centered Orientation to Instruction

Throughout our study, the teachers who were the most innovative in their use of GenAI were also the most exploratory in their learning about the technology. They were not afraid to be wrong, to start again, to revise, and to share their learning with others. These same qualities can be found in classrooms with ambitious mathematics and science instruction. High-quality STEM teaching involves experimentation, collaboration, and creativity—the same qualities required to use GenAI transformationally to make better learning opportunities for students.

GenAI has the potential to enable student-centered instruction to flourish. It can help math teachers craft better tasks that are more expansive, more relevant, and more tied to vital concepts. It can help math and science teachers ask better questions that get students involved in discourse with each other. It can be used as a means to help students get in the driver's seat of their own learning as we saw in Mr. Flatly's case. However, the work that many districts and schools are engaging in to help teachers move toward student-centered education must continue. GenAI can enhance current practices. That means that teacher-centered practices can become more so. Suboptimal learning experiences can be delivered more efficiently; furthermore, GenAI can help student-centered teachers grow even more effective and empowering for students. So, any GenAI professional learning opportunities that schools and districts design and deliver should be embedded in a common vision of high-quality STEM instruction and in current instructional improvement initiatives.

Rural Teachers Require Special Consideration

The challenges to GenAI adoption for improving instruction were substantial for the rural teachers in our study. Geographic isolation from subject-area peers, budget cuts that eliminated coaching and tech support, limited professional learning funds, and the absence of institutional infrastructure for innovation made it difficult for the teachers in our study to understand GenAI as an acceptable technology and a tool for improving teaching. They had fewer opportunities to collaborate and experiment with others, and therefore their own learning opportunities were limited. A rural science teacher whose nearest colleague in the same subject is 30 miles away faces a fundamentally different adoption landscape than an urban teacher with five same-subject peers down the hall and a 20-person IT department.

Policymakers should consider how GenAI professional learning can be designed for both rural school leaders and teachers in ways that help them develop virtual networks. For school leaders, virtual networks can help them better understand GenAI as an instructional technology tied to a vision of high-quality STEM instruction. School leader networks can also help school leaders discuss useful policies, resources, and messaging that can support instructional improvement. For teachers, a robust GenAI rural network can provide them with new learning opportunities. Teachers can learn together, gaining not just AI literacy but also AI engineering skills that can help them deploy GenAI to approach ambitious math and science practices—building better tasks, providing greater student agency, and planning for and facilitating more robust discourse while providing more useful and timely feedback for students. Without intentional investment, GenAI adoption risks widening the already significant gap between well-resourced and underresourced schools.

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