# Digital Divide and Conquer: Collaborative Tools for Inclusive Ohio Math Classrooms

**Erik Kormos**
Ashland University

**Abstract**

The digital divide remains a significant barrier to equitable mathematics education in Ohio, affecting students' access to essential instructional technology tools. This article examines the integration of collaborative instructional technology tools in K-12 mathematics instruction as a strategy to bridge this divide. By exploring platforms such as Google Workspace for Education, Desmos, Padlet, and innovative tools like Tilt Brush, the manuscript highlights practical strategies for fostering collaboration and engagement in the mathematics classroom. Both traditional and innovative approaches to technology integration are discussed, along with potential partnerships within Ohio that support for educators and students. Ultimately, the article emphasizes the importance of creating inclusive learning environments that empower all students, enabling them to develop critical mathematical skills and a sense of belonging in an increasingly digital world.

**Keywords:** Collaborative Learning, Educational Technology, Digital Divide

## 1 Introduction: Bridging the Digital Divide in Mathematics Education

In the rapidly evolving landscape of education, instructional technology has emerged as a pivotal force shaping teaching and learning practices, particularly within mathematics education. Collaborative instructional technology tools significantly improve student engagement, facilitate effective communication, and enhance critical problem-solving skills essential for success in today's technology-driven workforce (Vazzana, 2024). However, a persistent digital divide, characterized by unequal access to modern instructional technology and essential resources, remains a significant barrier, disproportionately affecting mathematics instruction in underserved communities (Cullen et al., 2020).

This digital divide profoundly impacts students' opportunities to engage meaningfully with mathematics. According to the National Center for Education Statistics (NCES, 2021), disparities in technology access significantly affect students' mathematics achievement and overall educational success (see Figure 1). For instance, a 2021 survey by the Ohio Department of Education across over 500 public school districts revealed substantial inequities: although 83% of students have internet connectivity and 92% have access to devices like laptops or tablets, these figures mask deeper disparities. In major urban districts, up to 25% of students—approximately 46,000 children—lack reliable internet access at home. Rural districts face unique challenges, with up to 55% of students lacking essential devices such as laptops or desktops, and 25% of students in certain counties relying solely on smartphones for educational purposes (Kormos & Crawford, 2023). Additionally, these gaps are racialized, with districts having large Hispanic populations reporting even lower connectivity rates—20% of these students unaccounted for in terms of internet access compared to 12% in predominantly white districts (Ohio Department of Education, 2021).

The implications of this divide extend beyond technological access, encompassing broader academic and workforce challenges. Students lacking exposure to collaborative instructional tools encounter significant barriers in developing essential academic skills, leaving them ill-equipped for the digital job market. Mathematics education, increasingly delivered through interactive digital platforms, reinforces mathematical concepts while simultaneously cultivating indispensable skills for career success (Vinnervik, 2022). Furthermore, reports have highlighted the troubling decline in student proficiency in mathematics, particularly in Ohio, where the percentage of eighth graders not proficient surged from 62% to 71% between 2019 and 2022 (Annie E. Casey Foundation, 2024). Chronic absenteeism also nearly doubled, affecting 30% of students and hindering academic recovery, with wealthier districts recovering more effectively than less affluent counterparts (Behrens, 2024).

Addressing these disparities requires a multifaceted approach emphasizing not only access to technology but also robust professional development for educators. Teachers must be equipped with ongoing training sessions, workshops, and collaborative support to effectively integrate instructional technologies into their teaching practices, fostering enhanced student engagement and improved outcomes in mathematics (Cullen et al., 2020). The implementation of collaborative instructional technologies also addresses academic proficiency and emotional well-being, supporting diverse learning styles and promoting peer interactions that deepen mathematical understanding.

Consequently, effectively addressing this digital divide through practical applications of collaborative instructional technologies is critical to providing equitable learning opportunities and ensuring all students thrive academically and professionally.


**Figure 1**
*The Digital Divide: Ohio K–12 technology access statistics.*

## 2 Collaborative Instructional Technology Tools in Mathematics Education

Building on the challenges outlined in the previous section, the integration of collaborative instructional technology tools offers a promising solution to bridging the digital divide. In this section, we will explore various technology platforms that facilitate cooperative learning and discuss their potential to improve both engagement and outcomes in mathematics classrooms.

Collaborative instructional technology tools play a vital role in enhancing mathematics education by fostering communication, teamwork, and critical thinking among students. These tools not only bridge the digital divide but also create an engaging and inclusive learning environment that encourages all students to participate in mathematical discourse (Urban-Woldron, 2013). In Ohio, where diverse educational needs exist across urban and rural settings, leveraging collaborative instructional technology can significantly improve mathematics instruction and learning outcomes.

One notable tool is Google Workspace for Education, which includes applications like Google Docs, Sheets, and Slides, providing an expansive platform for collaboration in the mathematics classroom. These tools enable students to work together on projects in real-time, fostering both community and collective problem-solving (Amalia et al., 2017; Orhani, 2021). For instance, educators can use Google Sheets to create shared data sets that students can analyze, manipulate, and discuss as part of group activities. In a specific example, a mathematics class could work with weather data, such as monthly temperature and rainfall figures from a local weather station like the Ohio Department of Natural Resources' State Climatologist's Office. Educators could share this data with the students in Google Sheets, where they would analyze trends over time, calculate averages, determine correlations between temperature and rainfall, and create visual representations such as graphs or charts.

During the activity, students might discuss how different weather patterns could influence various real-world situations, such as crop growth, water usage, or even energy consumption. For example, one group might notice that certain months with higher rainfall have lower temperatures, and they could hypothesize how this impacts local farming practices. Another group might explore the potential implications for energy use, considering how temperature fluctuations affect heating and cooling needs.

In this activity, the teacher begins by introducing the weather dataset, which includes monthly temperature and rainfall data. Students are then divided into small groups, with each group assigned specific tasks, such as calculating averages, identifying outliers, and creating visual representations like bar or line graphs using Google Sheets. Once the groups have completed their analysis, they present their findings to the class and engage in a guided discussion about the relationships between temperature, rainfall, and other environmental factors. The teacher facilitates the discussion, prompting students to consider the broader implications of their data, such as how weather patterns affect local farming, energy usage, or daily life. Finally, students reflect on how the data analysis helped them better understand mathematical concepts like averages, percentages, and correlations, and discuss the relevance of these concepts in real-world scenarios.

The outcome of this activity would be twofold: students would improve their understanding of key mathematical concepts, such as data analysis and statistical reasoning, while also learning how mathematics applies to real-world scenarios. This collaborative, data-driven approach helps students recognize the value of mathematics in everyday life, all while fostering teamwork, critical thinking, and problem-solving skills.

Additionally, teachers can integrate Google Docs for collaborative note-taking during lessons, where students work together to create comprehensive study guides or document their problem-solving processes step-by-step. In a geometry lesson, educators can leverage the Chrome app Mote to enhance student understanding of key vocabulary. For instance, as students learn terms like angle bisector or congruence, the teacher can provide audio notes using Mote, explaining the definitions and their application to real-world geometric problems. Students can also record their own audio reflections or ask questions about the terms, further solidifying their understanding. As they work through problems in groups, students may listen to the audio notes to clarify their understanding, revisiting complex vocabulary whenever needed. Students might ask questions like, "How do I know if two angles are congruent?" or "What is the difference between acute and obtuse angles?" These questions can guide further discussion and help the teacher provide additional feedback or clarification. This approach allows students to engage with feedback in a more dynamic and accessible way, ensuring that vocabulary becomes an integral part of their problem-solving process and overall learning experience (Weathers, n.d.).

Google Slides, on the other hand, can be used for group presentations on mathematical concepts, where students contribute slides on different methods for solving the same problem, promoting diverse approaches to solutions. The ability to leave audio commentary via Mote within Slides further enhances this collaborative experience, enabling teachers to guide student presentations with real-time feedback or supplementary explanations. This method of learning builds not only mathematical reasoning and communication skills but also fosters peer feedback and revision, deepening students' understanding of concepts while reinforcing the importance of teamwork and shared learning (Cullen et al., 2020).

Another effective platform is Desmos, an interactive graphing calculator that supports collaborative exploration of mathematical ideas. For example, in a lesson on quadratic functions, students could use Desmos to graph different quadratic equations and analyze how changes to the coefficients impact the shape and position of the graph. Students could work in pairs or small groups to compare their graphs, discussing the relationships between the variables and how adjustments to the equation influence the curve. This collaborative activity encourages students to visualize complex mathematical relationships and deepen their understanding of concepts such as the vertex, axis of symmetry, and the effect of different coefficients on the graph's shape. Teachers and peers can provide immediate feedback on the students' graphs, prompting further discussion and refining understanding. By allowing students to work together on mathematical tasks, Desmos enhances both individual and collective learning experiences, fostering a deeper comprehension of functions and geometry (Vazzana, 2024; Moldavan et al., 2022).

Lastly, tools like Padlet offer a dynamic platform for collaboration, allowing students to share ideas, ask questions, and present their mathematical work in an interactive, visual environment. For example, in a lesson on solving systems of equations, a teacher could prompt students to work on different methods, such as substitution, elimination, or graphing, and then post their solutions and reasoning on a shared Padlet board. Students can visualize their work by posting equations, graphs, and step-by-step solutions, allowing peers to review and provide feedback on each method. This encourages a collaborative environment where students can compare different approaches, ask questions about alternative methods, and deepen their understanding of the concept. Teachers could also guide discussions by asking students to reflect on the strategies used by their peers, promoting critical thinking and engagement as they build on each other's work (Kleinsmith, 2017; Dahal et al., 2020).

Research supports the effectiveness of collaborative instructional technology tools in mathematics education. Studies have shown that technology-enhanced collaborative learning environments improve student engagement, motivation, and performance in mathematics (Clark, 2015; Herold, 2017; Moldovan, 2022). In Ohio, where disparities in access to instructional technology exist, the implementation of these tools can help bridge gaps in learning opportunities and foster an equitable educational landscape. By promoting teamwork, communication, and critical thinking, these tools not only engage students but also prepare them for future academic and career success. Educators must continue to explore and integrate these technologies into their teaching practices to ensure that all students can benefit from rich, collaborative learning experiences in mathematics.

To provide educators with a clear framework for implementing these tools effectively, the following table (Table 1) summarizes the key collaborative instructional technology tools and strategies discussed in this paper. This visual representation serves as a practical guide, illustrating how each tool can be utilized to foster student engagement, teamwork, and critical thinking. By aligning these tools with specific classroom applications, educators can better understand how to incorporate them into their instruction, ensuring an equitable and impactful learning experience for all students.

**Table 1.** *Collaborative Technology Tools and Strategies for Mathematics Instruction*

| Tool/Strategy | Purpose | Implementation Example | Skill Development |
|---|---|---|---|
| Google Workspace for Education | Facilitates collaboration and real-time editing. | Students use Google Sheets to analyze shared datasets and create graphs collaboratively. | Data analysis, teamwork, mathematical reasoning. |
| Desmos | Interactive graphing and problem-solving. | Teachers assign graphing activities for students to explore functions and transformations collaboratively. | Graph interpretation, critical thinking. |
| Padlet | Collaborative idea-sharing and peer feedback. | Students post solutions, share math resources, and discuss problem-solving strategies on virtual boards. | Communication, collaboration, growth mindset. |
| Mote (Chrome Extension) | Enhances personalized feedback and interaction. | Teachers leave audio comments on Google Docs and Slides with constructive feedback on students' math work. | Reflection, communication, self-improvement. |
| Classcraft (Gamification) | Makes learning engaging through game mechanics. | Students earn points and rewards for completing collaborative math challenges and assisting peers. | Motivation, problem-solving, teamwork. |
| Tilt Brush (VR Tool) | Visualizes abstract math concepts in an immersive 3D space. | Students design and manipulate 3D geometric structures to explore spatial relationships and volume. | Spatial reasoning, creativity, geometry comprehension. |
| Microsoft Teams | Facilitates peer teaching and group discussions. | Students form small groups to teach one another math concepts via Teams breakout rooms. | Communication, leadership, peer learning. |
| Virtual Field Trips | Applies math in real-world contexts using tools like Google Earth or VR platforms. | Students calculate distances, analyze maps, and solve location-based math problems as a team. | Real-world application, geography-math integration. |

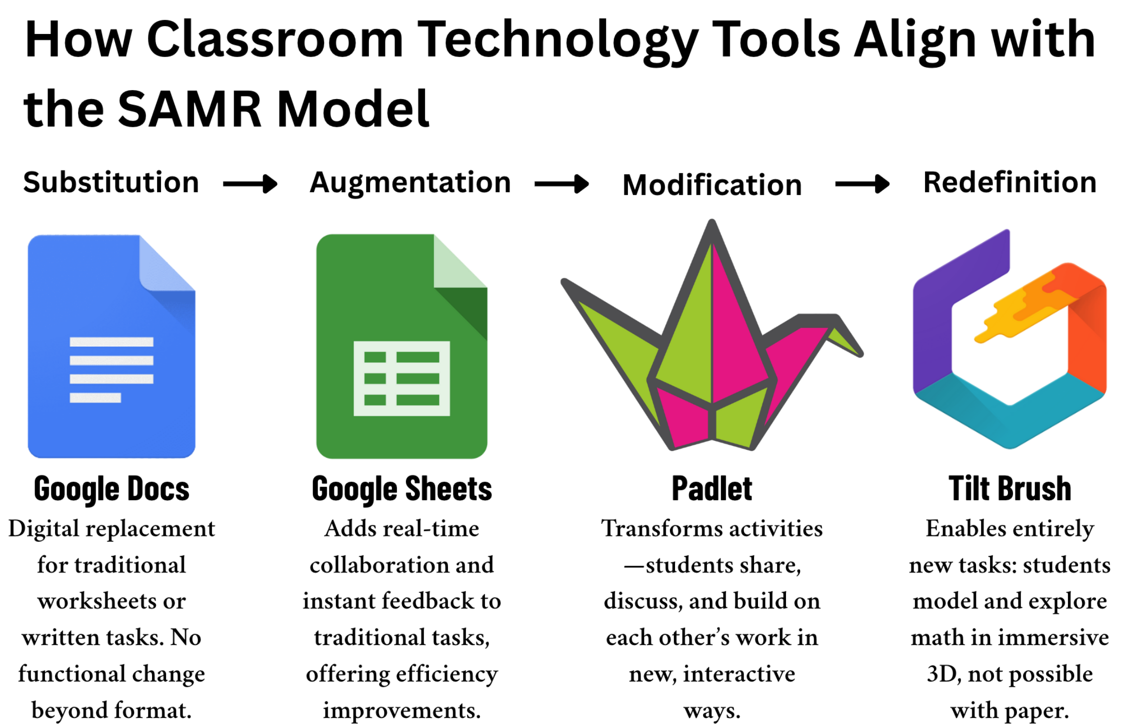
While these tools provide a foundation for creating an interactive classroom environment, their effectiveness depends on purposeful integration into mathematics education practices. The next section explores specific strategies for embedding these tools into instructional frameworks like SAMR and TPACK, offering practical approaches to maximize their impact on student learning outcomes.

## 3 Effective Strategies for Integrating Collaborative Instructional Technology Tools

Integrating collaborative instructional technology tools into teaching requires thoughtful planning and alignment with instructional technology frameworks to ensure their effectiveness. By applying frameworks like SAMR and TPACK, educators can thoughtfully blend traditional approaches with innovative strategies to enhance student engagement and learning outcomes, creating a bridge between abstract mathematical concepts and practical understanding.

**Figure 2**

*How classroom technology tools can be mapped onto the four levels of the SAMR model, illustrating progression from simple substitution to redefinition of learning activities.*




One effective strategy is the flipped classroom model, which aligns well with the SAMR framework. Initially, the flipped classroom may represent a Substitution level of SAMR, where instructional videos replace in-person lectures. However, it can progress to Redefinition, where in-class time is transformed into collaborative problem-solving opportunities that would not be possible without technology (Hilton, 2016). For instance, mathematics educators can use platforms like Edpuzzle to assign algebraic concept lessons, embedding questions to assess understanding before students enter the classroom (Bhagat et al., 2016). By freeing up class time for collaborative work, students can apply their knowledge in small groups to solve complex problems, fostering a deeper understanding and promoting peer collaboration (Kormos, 2024). This model aligns with the ISTE Standards for Educators, particularly the Facilitator standard, which emphasizes creating active learning environments that maximize the use of technology and fosters a culture where students take ownership of learning goals and outcomes (Crompton, 2023).

Project-Based Learning (PBL) is another powerful strategy, particularly when viewed through the lens of the TPACK framework. PBL allows educators to combine their technological, pedagogical, and content knowledge to design meaningful, real-world math tasks (Chaidam

& Poonputta, 2022; Demir & Onal, 2021). For example, educators can use Google Sheets for data analysis or GeoGebra for geometric modeling, enabling students to investigate real-life problems like community transportation patterns. Tools like GeoGebra serve as a conduit for bridging theoretical math concepts and practical application, allowing students to visualize geometric shapes and analyze data collaboratively (Amalia et al., 2017). PBL aligns with the ISTE Standard for Educators for Collaborator, encouraging students to work together, leverage digital tools, and communicate their findings (Crompton, 2023). This approach also demonstrates how technology integration in mathematics education can move beyond mere content delivery to creating authentic learning experiences.

Peer teaching, supported by collaborative platforms such as Microsoft Teams or Google Meet, is an example of how SAMR can transform traditional methods into more engaging, tech-enhanced experiences. At the Augmentation level of SAMR, these platforms improve the way students interact with content and each other by offering real-time collaboration features like screen sharing and digital whiteboards. This method shifts the learning environment from passive reception of knowledge to an interactive, student-led process (Caukin & Trail, 2019). When students use these tools to teach and explain topics such as algebraic equations, they take ownership of their learning while developing critical communication skills (Wea et al., 2021). This strategy fosters an active, collaborative learning environment in line with the ISTE Standard for Educators for Facilitators who encourage students to take responsibility for their learning outcomes.

Incorporating virtual reality (VR) tools like Tilt Brush introduces an innovative way to teach mathematical concepts through 3D visualization, which represents the Redefinition level of the SAMR framework. In this immersive environment, students can manipulate and construct geometric figures, exploring concepts such as angles and spatial reasoning in ways that go beyond the limitations of traditional tools (Lei et al., 2018). By engaging with VR, students experience a hands-on approach to geometry that enhances their creativity while improving their understanding of abstract mathematical principles. This integration of VR also aligns with the TPACK framework, where educators apply their knowledge of technology, pedagogy, and content to create interactive learning experiences that engage students in a more meaningful way (Hill & Uribe-Florez, 2020).

To effectively integrate collaborative instructional technology tools, educators require ongoing professional development (PD) that is both comprehensive and context-specific. PD initiatives should not only introduce teachers to the technical functionalities of tools like Google Workspace, Desmos, or Tilt Brush but also provide training on how to align these tools with instructional frameworks such as SAMR and TPACK. For example, workshops or webinars can demonstrate how to design lessons that use Google Docs for collaborative note-taking or Tilt Brush for 3D geometric modeling, ensuring that the tools are leveraged to meet pedagogical goals (So & Lu, 2019).

Further, peer coaching and Professional Learning Communities (PLCs) have been shown to enhance teachers' confidence and skill in integrating technology. These collaborative environments allow educators to share best practices, co-develop lesson plans, and receive feedback from colleagues, fostering a culture of continuous learning (Caukin & Trail, 2019). Additionally, personalized coaching sessions tailored to individual teachers' needs can help bridge gaps in technology proficiency, ensuring equitable access to PD across diverse educational settings (Lei et al., 2018).

Integrating ISTE-aligned PD opportunities, such as certifications in digital learning or micro-credentialing programs, equips educators with the skills to implement collaborative tools effectively. These programs emphasize real-world application, enabling teachers to create authentic, student-centered learning experiences (Crompton, 2023).

## 4 Initiatives to Bridge the Digital Divide in Rural and Urban Communities

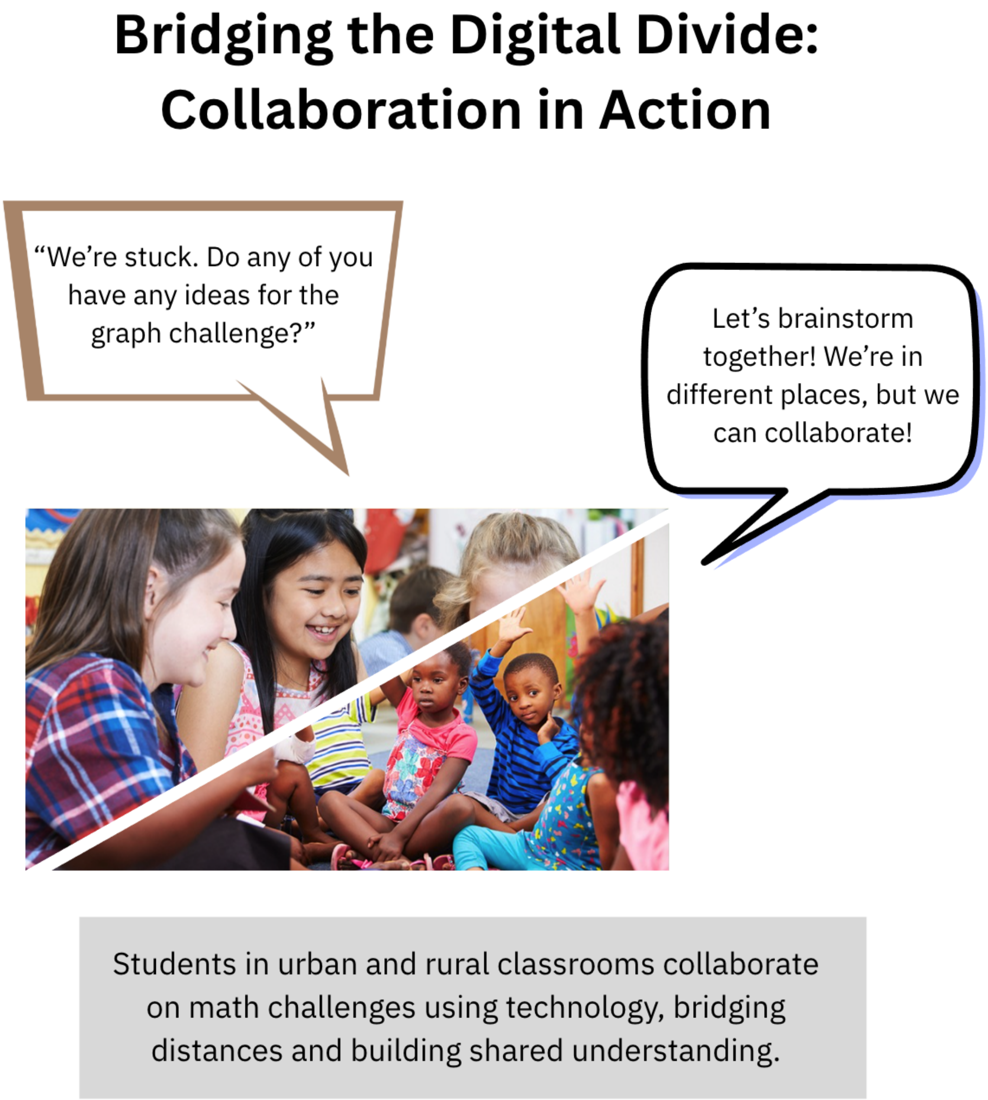
Collaborative efforts play a crucial role in bridging the digital divide, particularly in the context of Ohio's diverse educational landscape. By leveraging partnerships among schools, community organizations, and local businesses, educators can create an inclusive environment that fosters equitable access to instructional technology for all students (Lofthouse & Thomas, 2017). This section will highlight concrete examples, such as teacher work samples, student results, and collaborative initiatives, to illustrate how instructional technologies in K-12 mathematics education can bridge gaps in access and opportunity, particularly in rural and underserved areas.

For example, one successful implementation involves a lesson plan using Google Workspace to enhance mathematical discourse while leveraging real-world data sets. In a study conducted by Akcil et al. (2021), students worked in small groups to analyze data related to water quality in local streams. By using collaborative tools, such as Google Sheets, students worked together to analyze the data, compare environmental factors, and explore the relationship between water quality and waste management systems. The objectives included improving problem-solving skills, fostering teamwork, and using data to make connections between math concepts and real-world issues. Through the collaborative environment, students gained insights from one another and developed a deeper understanding of the material. Additionally, working with community resources, such as local environmental agencies or wastewater management experts, further strengthened the connection between the mathematical concepts and the broader community.

Ohio offers numerous local organizations that can partner with schools to enhance such community-based learning initiatives. For instance, schools in rural and small-town districts can collaborate with organizations like the Ohio Environmental Council or the Great Lakes Environmental Festival to access resources on local water quality and waste management initiatives. In cities such as Cleveland or Cincinnati, community groups like The Nature Conservancy in Ohio and Green Umbrella focus on environmental conservation, providing educational opportunities for students to explore real-world issues while learning math and science. These partnerships can provide students with real-world data, field trips, or expert guest speakers, further enhancing their understanding of environmental issues and their connection to mathematics.

Ohio's educational landscape is marked by a significant number of both rural and urban school districts. According to the Ohio Department of Education and Workforce (n.d.), Ohio has 124 rural school districts with high student poverty and small student populations (Typology 1), serving over 170,000 students. Additionally, there are 107 rural school districts with average student poverty and very small student populations (Typology 2), serving 110,000 students. These areas often face challenges related to limited access to resources, including instructional technology. In contrast, Ohio has 47 urban school districts with high student poverty and average student populations (Typology 7), which serve approximately 210,000 students. Another 8 urban districts with very high student poverty and very large student populations (Typology 8) serve 200,000 students. Given the disparities in access to technology and resources, these districts can particularly benefit from partnerships with local organizations, such as Ohio EPA (Environmental Protection Agency) or Local Waste Management Districts, to ensure students gain access to technology and real-world learning experiences.

**Figure 3**
*Technology initiatives connect students across urban and rural communities, supporting real-time collaboration and shared problem-solving in mathematics learning.*




By utilizing tools like Google Workspace and fostering partnerships with local organizations, schools in both rural and urban districts can bridge the digital divide. In rural and small-town districts, partnerships with local environmental agencies and conservation organizations help provide hands-on experiences with environmental data, further enriching students' learning experiences. Urban districts can benefit from collaborations with organizations like The Cleveland Foundation or United Way of Greater Cincinnati, which can provide students with the resources and mentorship they need to access technology and build connections with real-world problems.

Collaborative efforts that leverage these local partnerships can offer students from these diverse backgrounds opportunities to access technology, build mathematical understanding, and engage with their communities in meaningful ways. These efforts help bridge the digital divide by fostering equitable access to both technology and learning opportunities, creating a stronger connection between classroom learning and real-world applications in local communities.

Data from classrooms that have implemented collaborative technologies reveal significant improvements in student performance and engagement. For instance, a 2022 study in an urban school reported a 20% increase in student scores on math assessments after integrating tools like Google Classroom for project-based learning (Moldovan et al., 2022). Students expressed enthusiasm about using technology to collaborate with their peers, leading to deeper understanding and retention of mathematical concepts. Feedback from students indicated that working in groups helped them feel more confident in their abilities and encouraged them to participate actively in discussions.

A recent initiative at the Cleveland Public Library, the opening of Studio 525, exemplifies how community partnerships can enhance access to technologies for K-12 students. Studio 525 serves as a teen tech hub, offering a range of technologically driven activities such as video game setups, virtual reality experiences, AI exploration, robotics, and arts and crafts (Justice, 2024). This innovative space not only includes a safe environment for youth to explore technology but also promotes STREAM (science, technology, reading, art, and math) programming. The studio provides local youth and families the opportunity to engage with the various tech features, showcasing creativity and curiosity. The studio aims to collaborate with educators to inspire, educate, and empower the next generation of innovators and creators. By fostering a collaborative and interactive atmosphere, Studio 525 encourages students to develop their technological skills while reinforcing the relevance of math in everyday life (Cleveland Public Library, n.d.).

Addressing equity is vital in both urban and rural settings. Collaborative efforts in urban areas, like those with local libraries, offer safe spaces for students to access instructional technology outside of school hours. Meanwhile, partnerships in rural areas, such as those between schools and local businesses, create innovative opportunities for applying math concepts to real-world situations (Lotter et al., 2020). These partnerships help ensure that all students, regardless of their socioeconomic background, have access to the resources they need to succeed.

As math educators, it is important to recognize collaborative instructional technologies are instrumental in creating equitable learning environments for K-12 students in Ohio. By providing concrete examples of teacher work samples, student results, and successful classroom projects, this section illustrates the effectiveness of these strategies in bridging the digital divide. Educators are encouraged to consider these approaches as they seek to enhance their own practices and foster inclusive mathematical discourse in their classrooms. To further illustrate the potential of collaborative technology, it is crucial to recognize how these efforts not only enhance learning within the classroom but also extend beyond it. By working with local organizations and businesses, educational initiatives can provide students with the necessary tools to succeed in real-world scenarios. The following conclusion reinforces the importance of these collaborative strategies and the need for a sustained focus on equity in both urban and rural educational settings.

## 5 Conclusion: Ensuring Equitable Access to Instructional Technology in Math Education

Addressing the digital divide is a multifaceted challenge that requires both innovative solutions and collaborative efforts. This conclusion summarizes the strategies for closing the gap in access to instructional technology, emphasizing the importance of fostering inclusive, supportive, and technology-driven learning environments for all students.

The digital divide poses significant challenges to equitable mathematics education, particularly in Ohio, where diverse socioeconomic backgrounds can impact students' access to instructional technology. However, through the strategic integration of collaborative instructional technology tools, educators can create inclusive learning environments that foster engagement and enhance mathematical understanding. By utilizing innovative technologies, teachers can design interactive and meaningful learning experiences that promote collaboration and critical thinking skills.

In addressing the digital divide, it is essential to implement a variety of strategies that encompass both traditional approaches, such as instructional technology access initiatives and community partnerships, and innovative solutions like mobile technology labs and peer mentorship programs. These efforts not only improve access to instructional technology but also cultivate a sense of belonging and support among students. By fostering a growth mindset, educators can encourage students to embrace challenges and view instructional technology as a vital tool for academic success (Urban-Woldron, 2013).

Ultimately, bridging the digital divide in mathematics education is not solely about providing access to instructional technology; it is about creating a supportive and inclusive environment where all students can thrive. By leveraging collaborative instructional technology tools and fostering a culture of collaboration and support, math educators can inspire curiosity and inquiry in their students. As we move towards an increasingly digital future, it is crucial that educators remain committed to ensuring equitable access to resources, empowering every student to succeed in mathematics and beyond.

## References


Akcil, U., Uzunboylu, H., & Kinik, E. (2021). Integration of technology to learning-teaching processes and Google Workspace tools: A literature review. *Sustainability, 13*(9), 5018.

Amalia, E., Surya, E., & Syahputra, E. (2017). The effectiveness of using problem based learning (PBL) in mathematics problem solving ability for junior high school students. *International Journal of Advance Research and Innovative Ideas in Education, 3*(2), 3402–3406.

Annie E. Casey Foundation. (2024). 2024 Kids Count Ohio Data Profile. Children's Defense Fund-Ohio. https://assets.aecf.org/m/databook/2024-KCDB-profile-embargoed-OH.pdf

Behrens, C. (2024, June 18). Ohio students losing ground in math, reading after COVID, per study. *The Columbus Dispatch*. https://www.dispatch.com/story/news/education/2024/06/17/casey-foundation-study-shows-ohio-kids-losing-ground-in-math-reading/74086301007/

Bhagat, K. K., Chang, C. N., & Chang, C. Y. (2016). The impact of the flipped classroom on mathematics concept learning in high school. *Journal of Educational Technology & Society, 19*(3), 134–142.

Caukin, N., & Trail, L. (2019). SAMR: A tool for reflection for ed tech integration. *International Journal of the Whole Child, 4*(1), 47–54.

Chaidam, O., & Poonputta, A. (2022). Learning achievement improvement of 1st Grade students by using Problem-Based Learning (PBL) on TPACK model. *Journal of Education and Learning, 11*(2), 43–48.

Clark, K. R. (2015). The effects of the flipped model of instruction on student engagement and performance in the secondary mathematics classroom. *Journal of Educators Online, 12*(1), 91–115.

Cleveland Public Library. (n.d.). Studio 525. Cleveland Public Library. https://cpl.org/studio525/

Crompton, H. (2023). Evidence of the ISTE Standards for Educators leading to learning gains. *Journal of Digital Learning in Teacher Education, 39*(4), 201–219.

Cullen, C. J., Hertel, J. T., & Nickels, M. (2020, April). The roles of technology in mathematics education. In *The Educational Forum* (Vol. 84, No. 2, pp. 166–178). Routledge.

Dahal, N., Luitel, B. C., Pant, B. P., Shrestha, I. M., & Manandhar, N. K. (2020, September). Emerging ICT tools, techniques and methodologies for online collaborative teaching and learning mathematics. In *Mathematics Education Forum Chitwan* (Vol. 5, No. 5, pp. 17–21).

Demir, C. G., & Önal, N. (2021). The effect of technology-assisted and project-based learning approaches on students' attitudes towards mathematics and their academic achievement. *Education and Information Technologies, 26*(3), 3375–3397.

Herold, B. (2017). Poor students face digital divide in how teachers learn to use tech. *The Education Digest, 83*(3), 16.

Hill, J. E., & Uribe-Florez, L. (2020). Understanding secondary school teachers' TPACK and technology implementation in mathematics classrooms. *International Journal of Technology in Education, 3*(1), 1–13.

Hilton, J. T. (2016). A case study of the application of SAMR and TPACK for reflection on technology integration into two social studies classrooms. *The Social Studies, 107*(2), 68–73.

Justice, C. (2024, February). New teen tech hub 'Studio 525' opens inside Cleveland Public Library. *News 5 Cleveland*. https://www.news5cleveland.com/news/local-news/cleveland-metro/new-teen-tech-hub-studio-525-opens-inside-cleveland-public-library

Kleinsmith, C. L. (2017). The effects of using Padlet on the academic performance and engagement of students in a fifth grade basic skills mathematics classroom. Rowan University.

Kormos, E. (2024). Bridging the gap: Exploring urban high-needs teachers' perceptions of online teaching readiness and the digital divide. *Education and Urban Society*, 00131245241261088.

Kormos, E., & Crawford, A. (2023). From Blackboard to keyboard: An analysis of the challenges math teachers face in the digital divide and classroom. *Journal of Computers in Mathematics and Science Teaching, 42*(3), 227–245.

Lei, X., Zhang, A., Wang, B., & Rau, P. L. P. (2018). Can virtual reality help children learn mathematics better? The application of VR headset in children's discipline education. In *Cross-Cultural Design. Applications in Cultural Heritage, Creativity and Social Development: 10th International Conference, CCD 2018, Held as Part of HCI International 2018, Las Vegas, NV, USA, July 15–20, 2018, Proceedings, Part II 10* (pp. 60–69). Springer International Publishing.

Lofthouse, R., & Thomas, U. (2017). Concerning collaboration: Teachers' perspectives on working in partnerships to develop teaching practices. *Professional Development in Education, 43*(1), 36.

Lotter, C., Yow, J. A., Lee, M., Zeis, J. G., & Irvin, M. J. (2020). Rural teacher leadership in science and mathematics. *School Science and Mathematics, 120*(1), 29–44.

Moldavan, A. M., Capraro, R. M., & Capraro, M. M. (2022). Navigating (and disrupting) the digital divide: Urban teachers' perspectives on secondary mathematics instruction during COVID-19. *The Urban Review, 54*(2), 277–302.

National Center for Education Statistics (NCES). (2021). Report on the Condition of Education 2021. U.S. Department of Education. https://nces.ed.gov/pubs2021/2021144.pdf

Ohio Department of Education and Workforce. (2021). Data Insights: Ohio Students' Internet Connectivity and Technology Access. https://education.ohio.gov/Topics/Research-Evaluation-and-Advanced-Analytics/Data-Insights/Data-Insights-Ohio-Students-Internet-Connectivit

Ohio Department of Education and Workforce. (n.d.). Typology of Ohio School Districts. https://education.ohio.gov/Topics/Data/Report-Card-Resources/Supplemental-Information/Typology-of-Ohio-School-Districts

Orhani, S. (2021). Students' perceptions of using Google Classroom in math. *Journal of Social Education and Interdisciplinary Science, 2*(1), 24–31.

Pew Research Center. (2021). The digital divide persists even as lower-income Americans make gains in tech adoption. https://www.pewresearch.org/short-reads/2021/06/22/digital-divide-persists-even-as-americans-with-lower-incomes-make-gains-in-tech-adoption/

So, S., & Lu, E. (2019, June). Virtual reality in visual arts education: A study on using Google Tilt Brush. In *EdMedia+ Innovate Learning* (pp. 1485–1490). Association for the Advancement of Computing in Education (AACE).

Urban-Woldron, H. (2013). Integration of digital tools into the mathematics classroom: A challenge for preparing and supporting the teacher. *International Journal for Technology in Mathematics Education, 20*(3).

Vazzana, M. F. (2024). The implementation of technology into the mathematics classroom: A student-centered approach. In *Transformative Leadership and Change Initiative Implementation for P-12 and Higher Education* (pp. 300–309). IGI Global.

Vinnervik, P. (2022). Implementing programming in school mathematics and technology: teachers' intrinsic and extrinsic challenges. *International Journal of Technology and Design Education, 32*(1), 213–242.

Wea, K. N., & Kuki, A. D. (2021, March). Students' perceptions of using Microsoft Teams application in online learning during the Covid-19 pandemic. In *Journal of Physics: Conference Series* (Vol. 1842, No. 1, p. 012016). IOP Publishing. https://www.mote.com/docs/Educational_impact_of_Mote__by_John_Weathers_PhD.pdf

Weathers, J. (n.d.). The educational impact of recorded audio feedback using the Mote app. Mote. https://www.mote.com/docs/Educational_impact_of_Mote__by_John_Weathers_PhD.pdf

**Erik Kormos** Erik Kormos, Ph.D., is an Associate Professor of Educational and Assistive Technologies at Ashland University. Since joining AU in 2019, he has taught undergraduate and graduate courses in educational technology, social studies methods, and communication. His research examines educator perceptions of technology, the digital divide, and assessment in online learning. In 2023, he was honored with Ashland's Academic Mentor Award for his exceptional support of students beyond the classroom.