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REAL Mathematics Digital Design Companion:

Applying Equity Principles to Math EdTech Development and Procurement

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The ***REAL Mathematics Digital Design Companion*** was created to support education technology developers, district and state leaders, educators, and educational researchers in ensuring that mathematics technology tools—including emerging artificial intelligence (AI) systems—align with the essential characteristics of Culturally Responsive and Sustaining Education (CRSE). The *Digital Design Companion* is grounded in the *REAL Mathematics Practical Measurement Toolkit*, a resource developed to help educators translate CRSE principles into classroom practices that are observable and improvable.

While many educators value CRSE, operationalizing and measuring its principles in practice remains a persistent challenge. The *Toolkit* addresses this through practical measurement tools—including lesson planning guides, student surveys, and observation protocols—designed to help educators gather meaningful data, improve their practice, and ultimately make mathematics teaching and learning more relevant, engaging, and connected to students' lives. The *Digital Design Companion* extends the *Toolkit*'s work by translating the same domains into the context of technology design and digital learning systems, providing a lens for examining how edtech tools support equitable mathematics learning through their product features, user experience design, data practices, and implementation supports.

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Audience and Intended Use

The *Digital Design Companion* is a tool intended for multiple audiences involved in the development, selection, and implementation of mathematics education technology tools. The tool is not meant to be used in evaluation for compliance but rather to be used for continuous improvement and responsible design, enabling interest holders to ask meaningful questions about how technology influences mathematics teaching and learning. Audiences include the following:

- **Education Technology Developers and Product Design Teams.** Developers can use the tool to guide the design and refinement of digital learning tools. By examining features, AI systems, and user experience elements through a CRSE lens, developers can build products that support CRSE, student agency, and meaningful engagement in mathematics.
- **District and State Leaders.** Leaders responsible for edtech procurement and implementation can use the tool to review and evaluate mathematics edtech products before adoption. The tool describes indicators that highlight what to look for in digital tools—including how AI-driven personalization, data monitoring systems, and instructional supports affect equity and access in mathematics learning.
- **Educators, Instructional Leaders, and Researchers.** Educators, instructional leaders, and researchers can use the tool as a reflective framework for understanding how technology shapes the mathematics learning environment. The *Digital Design Companion* provides guidance for examining whether digital tools reinforce high expectations; support multiple pathways for learning; and reflect students' identities, languages, and experiences.

Why This Companion Tool Is Needed Now

The rapid expansion of digital learning tools and AI-enabled systems in mathematics education presents both opportunities and risks. Digital tools can broaden students' access to learning supports, representations, and feedback. However, they can also unintentionally reinforce narrow definitions of success, replicate bias in training data or algorithms, lower expectations and rigor, and reduce opportunities for student agency and culturally meaningful learning experiences. Developers can use the companion tool to avoid these pitfalls and ensure their products are accessible for all students and aligned with best educational practice. In turn, as schools increasingly adopt AI-enabled mathematics tools, educators and leaders can use the companion tool to ensure that these systems support—not undermine—equitable learning. The *REAL Mathematics Digital Design Companion* provides a framework for examining how technology tools shape instructional experiences and for ensuring that the technology's design aligns with the goals of CRSE.

Research and Evidence Base

The companion tool is informed by a substantial body of research on CRSE (see the *REAL Mathematics Practical Measurement Toolkit* for more on the research base), which emphasizes the importance of connecting instruction to students' identities, experiences, languages, and communities. The tool is also informed by extensive experience supporting teachers, education leaders, and edtech developers in applying CRSE to their work.

CRSE approaches draw on related traditions, including culturally relevant pedagogy, culturally responsive teaching, and culturally sustaining pedagogies. Research in these areas demonstrates that culturally responsive learning environments strengthen students' sense of belonging, support academic achievement, and affirm the cultural and linguistic assets students bring to the classroom.

The tool is also grounded in research that identifies five essential characteristics of culturally responsive and sustaining mathematics instruction and curricula:

- **Affirms Racial and Cultural Identities**
- **Cultivates Agency and Belonging**
- **Integrates Socially Responsible, Real-World Contexts**
- **Centers Community Knowledge**
- **Promotes Critical Mathematical Thinking and Learning**

These characteristics serve as the conceptual foundation for the REAL Mathematics framework and for the indicators in this companion tool.

Using the Companion Tool

The *REAL Mathematics Digital Design Companion* is organized around key domains that reflect how digital tools influence mathematics learning. For each domain, the tool provides guiding questions and indicators that help interest holders examine whether a technology product supports equitable and culturally responsive mathematics instruction.

The tool can be particularly useful for reviewing AI-enabled edtech. Across all domains, tools should demonstrate the following:

Transparency: Clear explanations of where and how AI is used

Human Oversight: Educator authority over AI-generated content and recommendations

Bias Auditing: Ongoing evaluation of AI outputs across racial, linguistic, gender, and ability groups

Data Minimization: Data collection limited to only what is necessary; student privacy protected

Avoidance of Surveillance Framing: AI that supports learning rather than monitoring or behavioral control of students

Explainability: AI-generated feedback, hints, or pathways that are understandable to students and educators

By translating classroom-focused CRSE principles into the context of technology design, user experience, data systems, and implementation, this companion tool aims to help users ensure that mathematics edtech tools promote rigorous learning, meaningful engagement, and equitable opportunities for all students.

Domains adapted from the *REAL Mathematics Practical Measurement Toolkit* (pages 22–23)

1 Framing the Experience: Identity, Relevance, and Language, including AI Framing

Intent: *Does the lesson affirm identities, connect math to students' lives, and include linguistic diversity, and does AI reinforce rather than distort this commitment?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Contextual problem libraries that reflect diverse communities, family structures, and lived realities (not just generic or dominant-culture defaults) AI-generated examples trained and reviewed to avoid cultural stereotyping Options for students or educators to select, adapt, or contribute contexts Multilingual AI supports embedded in core functionality (not hidden add-ons) AI personalization that expands access to culturally relevant contexts—rather than narrowing exposure	Transparent labeling of AI-generated content Clear explanation of why AI suggests certain contexts or supports Onboarding and task launches (orientation and starting new tasks) that explain why the math matters in relevant terms Language that avoids deficit framing (e.g., not "low-performing profile") Visuals, names, and narratives that reflect racial, cultural, and linguistic diversity authentically in both human- and AI-generated content	Ability to determine which contexts students engage with most Disaggregated analysis of AI-generated prompts, hints, and feedback Monitoring for differential framing by race, language, gender, and perceived ability Review of which AI-suggested contexts students engage with most	Guidance for educators on reviewing and adapting contexts and AI-generated materials based on student communities Clear signals to district decision-makers that AI must support cultural relevance as a design priority rather than being optional

2 Learning Goals and Outcomes: High Expectations With Multiple Pathways and With AI Personalization Safeguards

Intent: *Are goals rigorous, culturally relevant, and open to multiple demonstrations of learning, and does AI personalization maintain high expectations?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Tasks (may be AI-supported) that allow multiple solution pathways (not answer-only tutoring) Prompts that encourage explanation, reasoning, and revision Options for students to explain thinking using words, visuals, audio, or symbols Generative AI that supports representation (visuals, audio, symbolic) without replacing student thinking Built-in reflection prompts tied to learning goals Guardrails preventing AI from lowering task complexity based on early performance	Growth-oriented AI progress indicators that emphasize growth, reasoning, and persistence—not just speed or correctness Clear messaging that struggle is productive Clear student-facing explanations of how AI suggestions are generated	Analysis of whether AI pathways differ by student subgroup Evidence of learning beyond correctness (e.g., evidence of revision, strategy shifts, explanation depth) Ability to determine patterns of growth over time, not just completion rates Monitoring for unintended tracking effects created by algorithmic personalization	Alignment guidance ensuring that AI does not narrow rigor Procurement materials that define success beyond test-aligned metrics and require documentation of AI training data and bias testing

Domains adapted from the ***REAL Mathematics Practical Measurement Toolkit*** (pages 22–23)

3 Instructional Strategies: Agency, Voice, and Social Responsibility in AI-Mediated Environments

Intent: *Do activities build belonging and voice, and does AI amplify rather than suppress student agency?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Choice-based tasks (students select topics, data sets, or representations) AI tools that support student-generated questions Open-ended investigations connected to real-world or community issues AI tools that allow critique of data, algorithms, and real-world uses of math Collaborative tools that allow students to build ideas together Collaborative spaces where AI assists but does not dominate discussion AI feedback delivered after student thinking is surfaced	Interaction patterns that foreground student reasoning before providing automated feedback and that allow students to question or revise AI feedback Design that prioritizes human dialogue over automation Space for student-generated questions, not only system-generated prompts Design that values explanation and sense-making over speed Prompts that encourage reflection on how AI systems use data	Participation metrics (who contributes, how often, in what ways; who defers to AI) Indicators of whether students revise, reflect, or extend their thinking after AI feedback Ability to determine patterns of students' overreliance on AI-generated answers	Professional learning on facilitating AI-supported discourse Messaging to decision-makers that positions math and AI as tools for understanding power and systems

Domains adapted from the ***REAL Mathematics Practical Measurement Toolkit*** (pages 22–23)

4 **Assessment and Reflection:** Responsive, Meaningful Feedback, With AI Feedback Governance

Intent: *Are assessments culturally responsive, and is AI feedback equitable and interpretable?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Embedded formative assessment tied to authentic tasks Transparent scoring models for AI-assisted grading Reflection prompts that ask students how their experiences, language, or culture supported their learning AI-generated feedback prioritizing reasoning over correctness	Assessment experiences that feel like part of learning—not interruptions Clear explanation of how AI evaluates work Student-facing feedback that affirms effort, identity, growth, and persistence Opportunities to contest or revise AI judgments	Assessment data that surface patterns of understanding across groups Disaggregated performance comparisons between AI-assisted and non-AI modes Bias audits of AI scoring patterns Tools that help educators see how students approach and experience tasks, not just the results that students produce Monitoring for linguistic bias in natural language evaluation	Clear guidance that assessments are for learning and improvement, not labeling District-facing explanations of how data should (and should not) be used Explicit guardrails against automating high-stakes decision-making

Domains adapted from the ***REAL Mathematics Practical Measurement Toolkit*** (pages 22–23)

5 Instructional Materials: Representation and Narrative Power in Human- and AI-Generated Content

Intent: *Are materials bias-free, inclusive, and representative of diverse voices and ways of knowing, and does AI-generated content maintain representation standards?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Diverse authorship and perspectives embedded in content AI content generation trained and reviewed for inclusive representation Continuous audits of AI-created examples and narratives Avoidance of tokenism in automated content generation Tasks that challenge dominant narratives about who does math and how Opportunities for students to see peers, families, and communities as knowledge sources	Avoidance of tokenism (representation embedded throughout, not isolated) Consistent affirmation of multiple ways of being good at math Transparency about when examples are AI-generated	Platform-wide representation audits (of both human- and AI-generated content) Feedback loops for identifying and reporting bias, assumptions, and other harmful AI outputs	Transparent documentation of design choices around representation Public documentation of AI training safeguards Procurement criteria addressing AI bias mitigation explicitly Procurement materials that address equity explicitly, not implicitly

Domains adapted from the *REAL Mathematics Practical Measurement Toolkit* (pages 22–23)

6 Scaffolding and Supports: Safety, Belonging, and Access, With AI Responsiveness

Intent: *Do supports, including AI supports, respond to cultural, linguistic, and emotional needs without stigmatizing?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Scaffolds that support access without simplifying the math AI scaffolds that maintain rigor Language supports, visuals, and prior-knowledge bridges tied to lived experience Language supports powered by AI translation and simplification tools Peer-support structures (collaboration, shared strategies) AI suggestions framed as options, not prescriptions	Help-seeking normalized AI support framed as empowerment—not remediation	Insight into which supports are used—and by whom Analysis of correlation between AI supports and deep engagement Monitoring for stigmatizing patterns (e.g., oversuggesting support to certain groups)	Educator guidance on interpreting AI support analytics Messaging that rejects deficit-based interpretations of AI usage

Domains adapted from the *REAL Mathematics Practical Measurement Toolkit* (pages 22–23)

7 Collaboration With Families and Communities

Intent: *Are families and communities partners in relevance and meaning?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Family-facing views or summaries that explain learning goals in accessible language Family-facing explanations of AI functionality Plain language summaries of how student data inform AI personalization Opportunities for community data, stories, or applications to inform tasks Opportunities for community feedback on AI-generated content	Language and visuals that invite families in rather than gatekeep Accessible explanations of AI decision-making Respectful acknowledgment of community knowledge	Signals showing whether family engagement tools and/or AI explanation tools are accessed Feedback channels for community input and for reporting bias or concerns	Procurement criteria requiring AI transparency statements Clear expectations for how schools can meaningfully involve families Procurement criteria that value community connection Clear district expectations around responsible AI communication

8 Reflection and Continuous Improvement—AI Learning and Governance

Intent: *Does the product evolve responsibly, and are AI systems continuously audited?*

Features and AI systems	User experience (UX)	Data and monitoring	Implementation
Built-in reflection tools for educators and teams Iteration pathways rather than static curricula Mechanisms for updating content and AI models based on student experience and bias findings Clear documentation of model updates Human review cycles for AI-generated content	Transparency about what the tool or system is learning and how it is changing Reflection framed as growth—not surveillance	Practical dashboards highlighting actionable AI insights Trends that support improvement cycles rather than compliance Ongoing bias testing across student groups	Alignment with district continuous improvement models Governance plans defining roles for oversight of AI systems Clear messaging that AI supports learning and equity—not automation of inequity