Tile Farm
Math Made Beautiful

TILE FARM ACADEMY:

ESSA Tier 4 Evidence Rationale

(Demonstrates a Rationale)

Date: January 2026 **Product scope**: Tile Farm Academy

Purpose of this document

This document describes how Tile Farm Academy aligns with **ESSA Tier 4 evidence ("Demonstrates a Rationale")**. Under the Every Student Succeeds Act (ESSA), Tier 4 evidence includes (a) a well-specified logic model grounded in high-quality research suggesting an intervention is likely to improve relevant outcomes and (b) ongoing efforts to examine the effects of the intervention (U.S. Department of Education, 2023). This rationale is intended to support district decision-making and evidence-building efforts by describing Tile Farm Academy's intended outcomes, research-aligned design principles, theory of action, and current evaluation activities.

Overview of Tile Farm Academy

Tile Farm Academy is a visual, creative, and conceptually focused mathematics platform designed to support sense-making, reasoning, discourse, spatial thinking, and durable learning. It integrates adaptive practice, structured mathematical discussion, and open-ended creative tasks within a unified learning environment.

Tile Farm Academy is intentionally designed as a **low-floor, high-ceiling** learning environment, enabling the same core experiences to support a wide range of learners and instructional contexts, including core instruction, intervention, enrichment, STEAM learning, and teacher preparation.

Intended outcomes

Tile Farm Academy is designed to support the following student and teacher outcomes:

1. **Development of number sense and flexible strategy use**, including understanding numerical relationships and using diverse strategies to solve problems
2. **Mathematical reasoning, justification, and discourse**, including explaining and comparing strategies
3. **Spatial skill development**, including visualization, composition, decomposition, and transformation
4. **Application of mathematical knowledge in creative and design-oriented contexts**, supporting transfer and problem solving
5. **Improved student and teacher attitudes toward mathematics**, including engagement, confidence, persistence, and positive mathematical identity

These outcomes are intended to support heterogeneous classrooms and diverse learner populations.

Populations and settings

Tile Farm Academy is designed to support learners across a wide range of populations and settings, including:

- Mixed-ability classrooms
- Multilingual learners
- Students with unfinished learning
- Students with disabilities
- Students performing above grade level

Tile Farm Academy has been used across **PreK–12** settings, as well as in pre-service teacher education and postsecondary design-oriented mathematics contexts. Differences in outcomes across contexts reflect differences in implementation and emphasis, not differences in underlying learning science.

Research-aligned design principles

1. **Conceptual understanding and mathematical proficiency**
   Tile Farm Academy is designed to support multiple strands of mathematical proficiency, including conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Research emphasizes that durable fluency develops when students reason about numbers and relationships rather than memorizing procedures in isolation (Kilpatrick et al., 2001; National Council of Teachers of Mathematics [NCTM], 2014).

2. **Representations as thinking tools**
   Tile Farm Academy emphasizes the creation, interpretation, and connection of visual representations as central tools for mathematical thinking. Research-based guidance highlights the importance of using and connecting representations to support conceptual understanding, reasoning, and communication (NCTM, 2014). Visual representations can reduce cognitive load and make mathematical relationships visible, particularly for young learners and multilingual students (Moschkovich, 2015).

3. **Mathematical discourse and multilingual access**
   Tile Farm Academy supports mathematical discourse

through tasks that allow students to communicate using multiple modalities, including visual, verbal, and gestural representations. Research on multilingual learners emphasizes that mathematical meaning-making is not limited to formal academic language and is often expressed through representations, diagrams, and informal talk (Moschkovich, 2015). Opportunities to explain and compare strategies support deeper understanding and language development simultaneously (NCTM, 2014).

4 **Spatial reasoning as a core mathematical competency**
Spatial reasoning is treated as a core component of mathematical thinking in Tile Farm Academy. Research demonstrates robust relationships between spatial skills and mathematics achievement and provides evidence that spatial skills are malleable and responsive to instruction (Hawes et al., 2022). Meta-analytic findings indicate that spatial training can lead to improvements in mathematical performance, particularly when instruction involves active construction and transformation tasks (Hawes et al., 2022).

5 **Mastery learning and spaced practice**
Tile Farm Academy's Daily Digits component incorporates mastery learning and spaced practice to support durable learning. Research on mastery learning demonstrates positive effects on student achievement when learners are given sufficient time and feedback to reach understanding before progressing (Bloom, 1968). In addition, extensive evidence from cognitive science shows that distributed (spaced) practice and retrieval practice significantly improve long-term retention compared to massed practice or repeated review (Cepeda et al., 2006; Roediger & Karpicke, 2006; Dunlosky et al., 2013).

6 **Creative application and engagement**
Tile Farm Academy includes constraint-based creative tasks that require students to apply mathematical ideas in novel contexts. Research suggests that open-ended and inquiry-based tasks support deeper conceptual understanding, transfer, and sustained engagement when students are encouraged to explore multiple strategies and representations (NCTM, 2014). Such experiences also contribute to positive mathematical identity and persistence.

7 **Attitudes toward mathematics (students and teachers)**
Tile Farm Academy is designed to support positive dispositions toward mathematics for both students and teachers. Research indicates that math anxiety is associated with avoidance behaviors and lower performance and can emerge early in schooling (Ashcraft, 2002). Studies also suggest that teacher attitudes toward mathematics can influence classroom practices and student outcomes, highlighting the importance of supporting teacher confidence and enjoyment of mathematics (Beilock et al., 2010).

Logic model (theory of action)

The logic model below reflects established research on mathematical learning, spatial cognition, mastery learning, and effective instructional practices (Bloom, 1968; Kilpatrick et al., 2001; NCTM, 2014; Hawes et al., 2022).

Inputs
- Visual, manipulable, and language-flexible mathematical tasks
- Structured discourse routines (Tile Talk)
- Adaptive practice with mastery progression and spaced repetition (Daily Digits)
- Creative, constraint-based challenges (Studio experiences)
- Teacher supports and professional learning resources

Learning mechanisms
- Representational reasoning supports conceptual understanding and communication
- Discourse promotes sense-making and language development
- Spatial reasoning strengthens mathematical and STEM-related thinking
- Mastery learning and spaced practice support durable retention
- Creative engagement supports motivation and persistence

Expected outcomes
- **Short-term**: increased engagement, strategy use, and teacher confidence
- **Intermediate**: improved reasoning, discourse quality, and spatial skills
- **Long-term**: improved mathematical proficiency, fluency, and positive dispositions

Ongoing efforts to examine effects

Tile Farm Academy is currently engaged in multiple evaluation efforts consistent with ESSA Tier 4 expectations (U.S. Department of Education, 2023), including:

- An efficacy study in a large public school district
- An efficacy study in a predominantly multilingual learner charter school
- A study examining the impact of Tile Farm Academy on **pre-service teachers' attitudes toward mathematics** at Purdue University

Additional evaluation activities include usage-based analyses, pre/post outcome comparisons where available, and measures of implementation fidelity. These efforts are intended to strengthen the evidence base over time and support progression toward higher ESSA evidence tiers.

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About Tile Farm

Tile Farm is committed to redefining mathematics education through intuitive, visually engaging tools that inspire creativity and deepen understanding. Developed by a team of educators, mathematicians, and designers, Tile Farm aims to make math accessible and enjoyable for learners of all ages.

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For more information about Tile Farm, please contact us.

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