Instructionally Embedded Assessments to Meet Instructional and Summative Uses: Evidence from a Pilot Study

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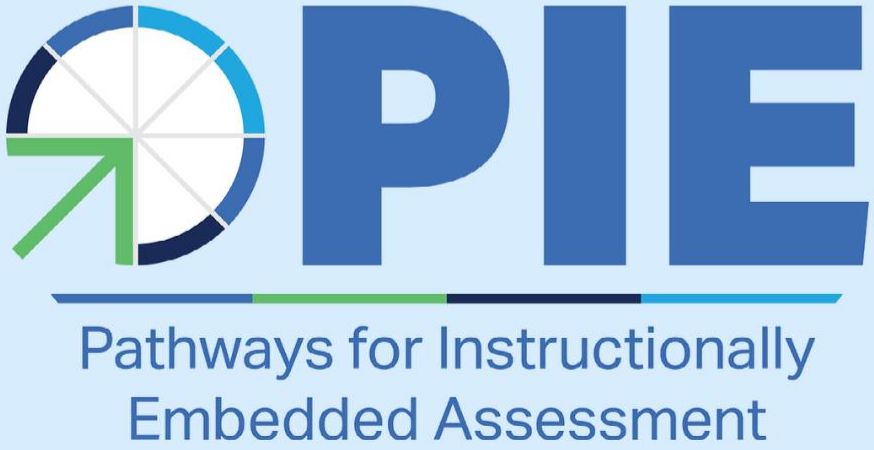


Missouri Department of Elementary & Secondary Education

KU Achievement & Assessment Institute
The University of Kansas

Accessible Teaching, Learning, & Assessment Systems

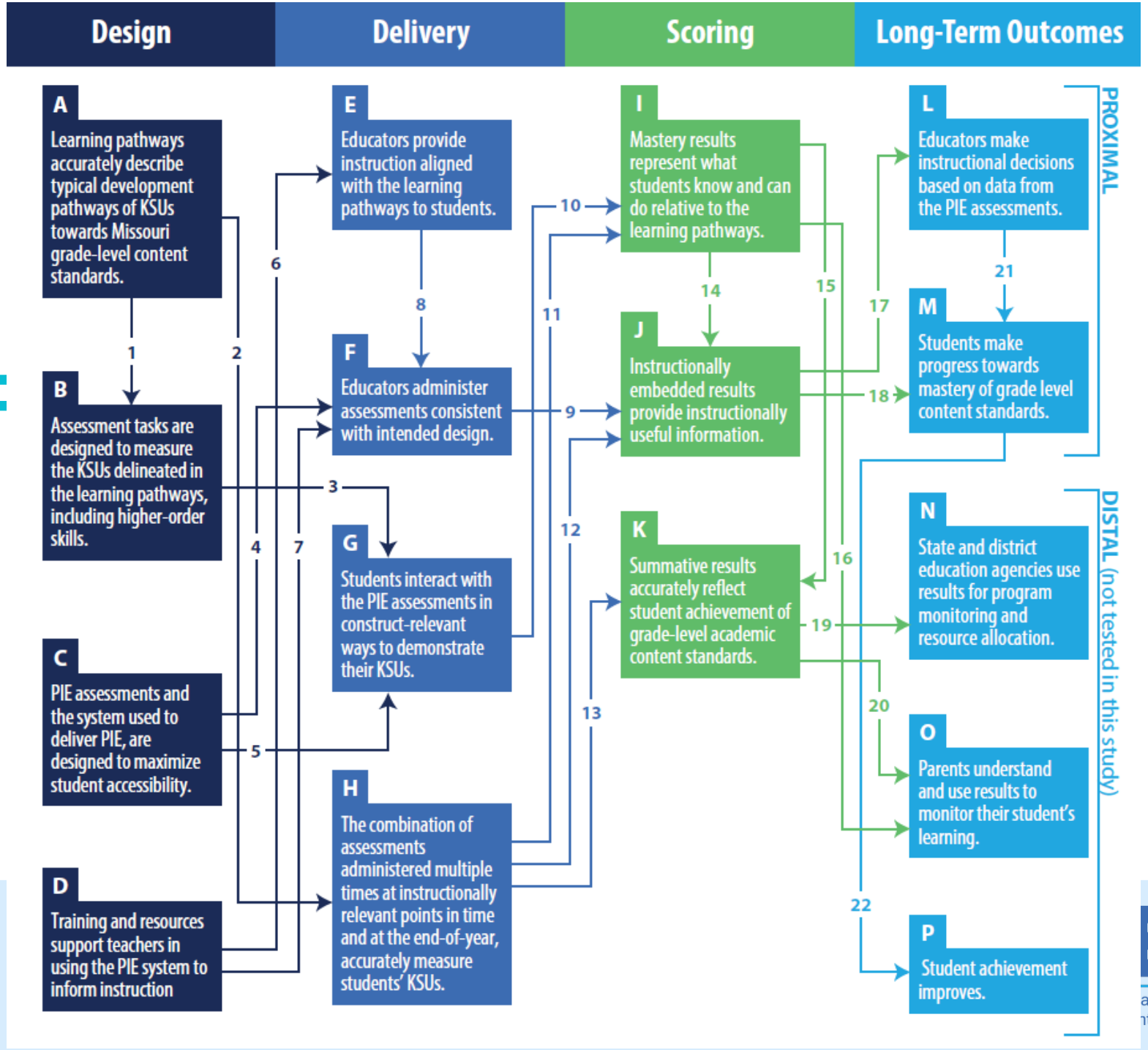
Pathways for Instructionally Embedded Assessment (PIE)

- A four-year Competitive Grants for State Assessments funded project aimed at designing, developing and testing a prototype through-year assessment model that delivers short, instructionally embedded assessments.
- The system was pilot tested in 5th grade mathematics classrooms with:
  - a primary focus on supporting teachers' use of assessment results to inform classroom instruction, and
  - a secondary focus on evaluating potential future uses of PIE assessment results for summative reporting purposes (e.g., for use within accountability models).

Guiding Principles

- Theory of Action
  - Instructionally useful mastery results (Claims I and J)
  - Summative results that reflect achievement on standards (Claim K)
- Embed assessments as part of instruction, and then use that information such that end-of-year assessments can be shorter and less burdensome
  - Still meeting stakeholder needs (e.g., accountability systems, consistent with the *Standards* and peer review criteria)

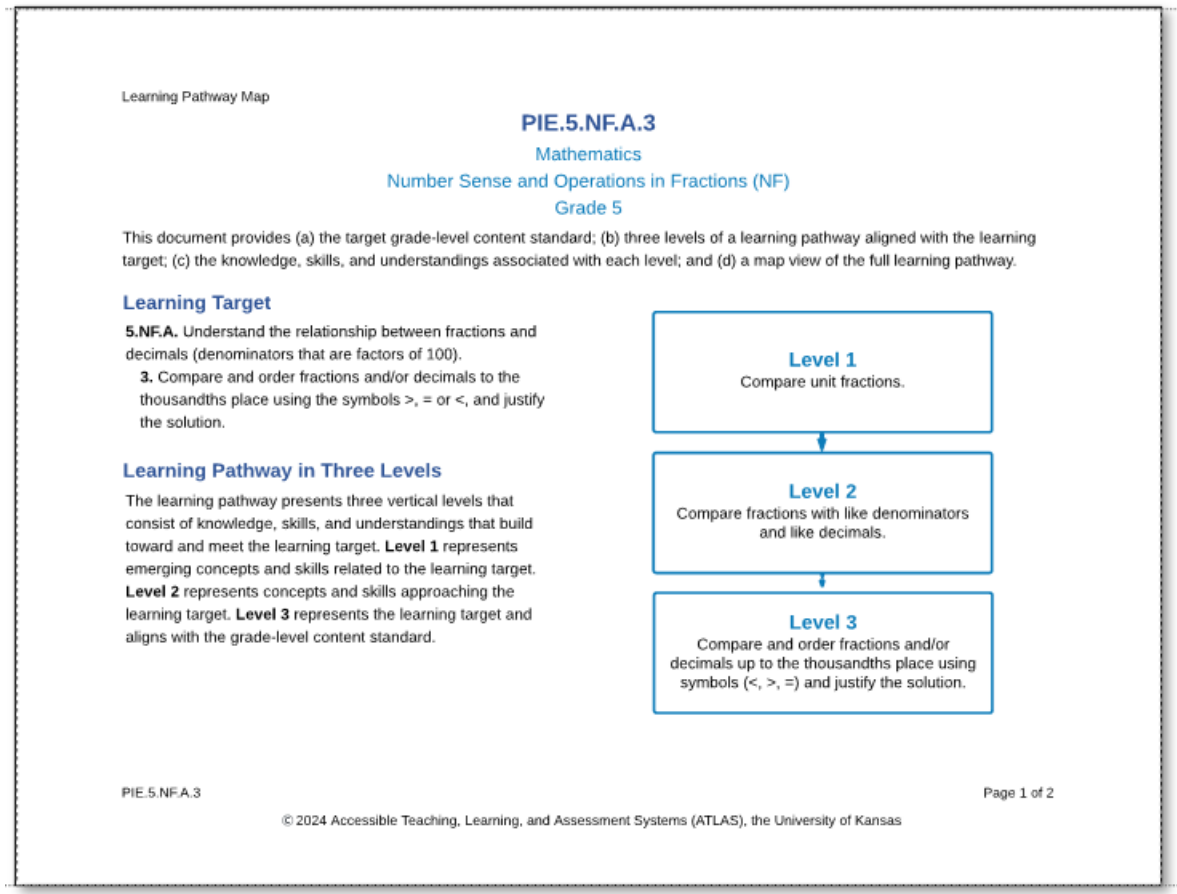
PIE THEORY OF ACTION



PIE Assessment System Features

- Based on cognitive learning models, known as learning pathways
- Evidence centered design-based (ECD-based) assessments
- Flexible, teacher-driven assessment administration
- Actionable results
- Teacher training

Learning Pathways



Learning Pathway Map

PIE.5.NF.A.3

Mathematics

Number Sense and Operations in Fractions (NF)

Grade 5

This document provides (a) the target grade-level content standard; (b) three levels of a learning pathway aligned with the learning target; (c) the knowledge, skills, and understandings associated with each level; and (d) a map view of the full learning pathway.

Learning Target

5.NF.A. Understand the relationship between fractions and decimals (denominators that are factors of 100).

3. Compare and order fractions and/or decimals to the thousandths place using the symbols >, = or <, and justify the solution.

Learning Pathway in Three Levels

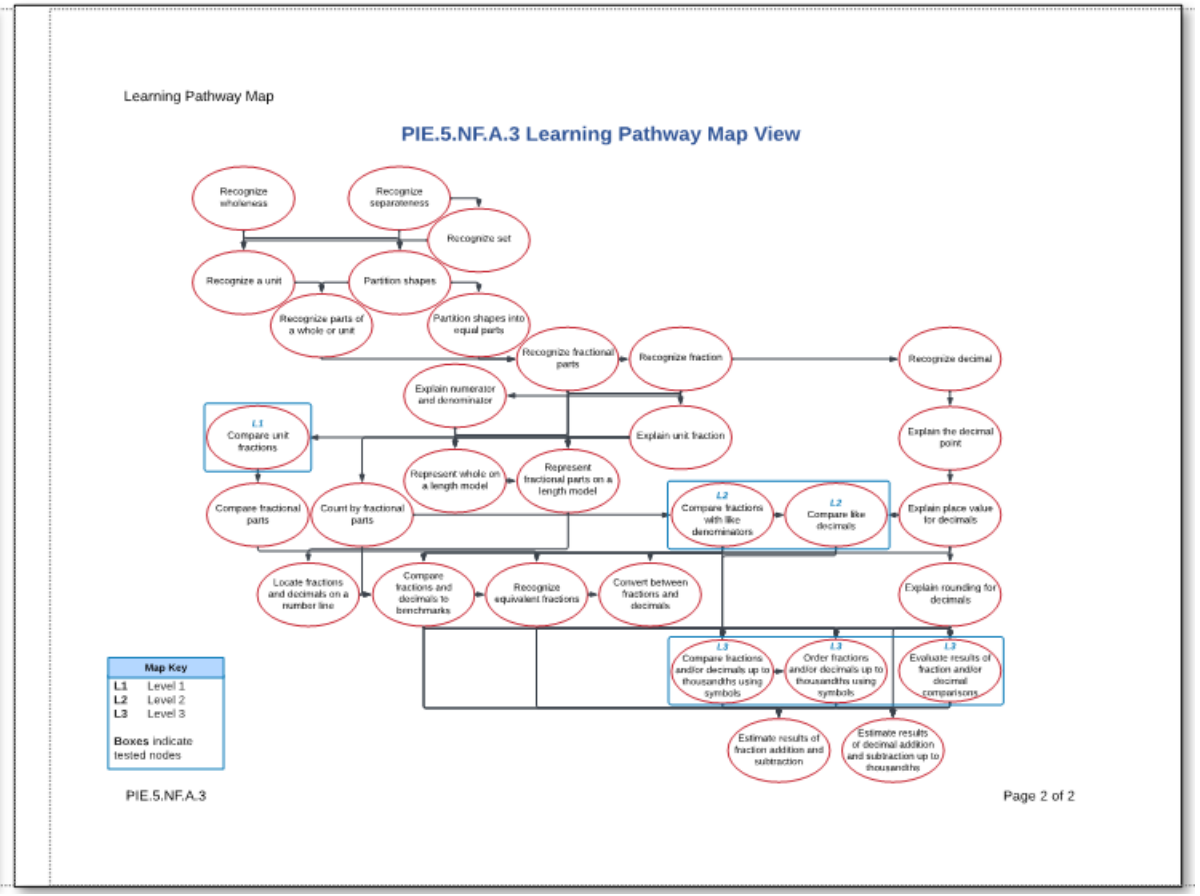
The learning pathway presents three vertical levels that consist of knowledge, skills, and understandings that build toward and meet the learning target. **Level 1** represents emerging concepts and skills related to the learning target. **Level 2** represents concepts and skills approaching the learning target. **Level 3** represents the learning target and aligns with the grade-level content standard.

Level 1
Compare unit fractions.

Level 2
Compare fractions with like denominators and like decimals.

Level 3
Compare and order fractions and/or decimals up to the thousandths place using symbols (<, >, =) and justify the solution.

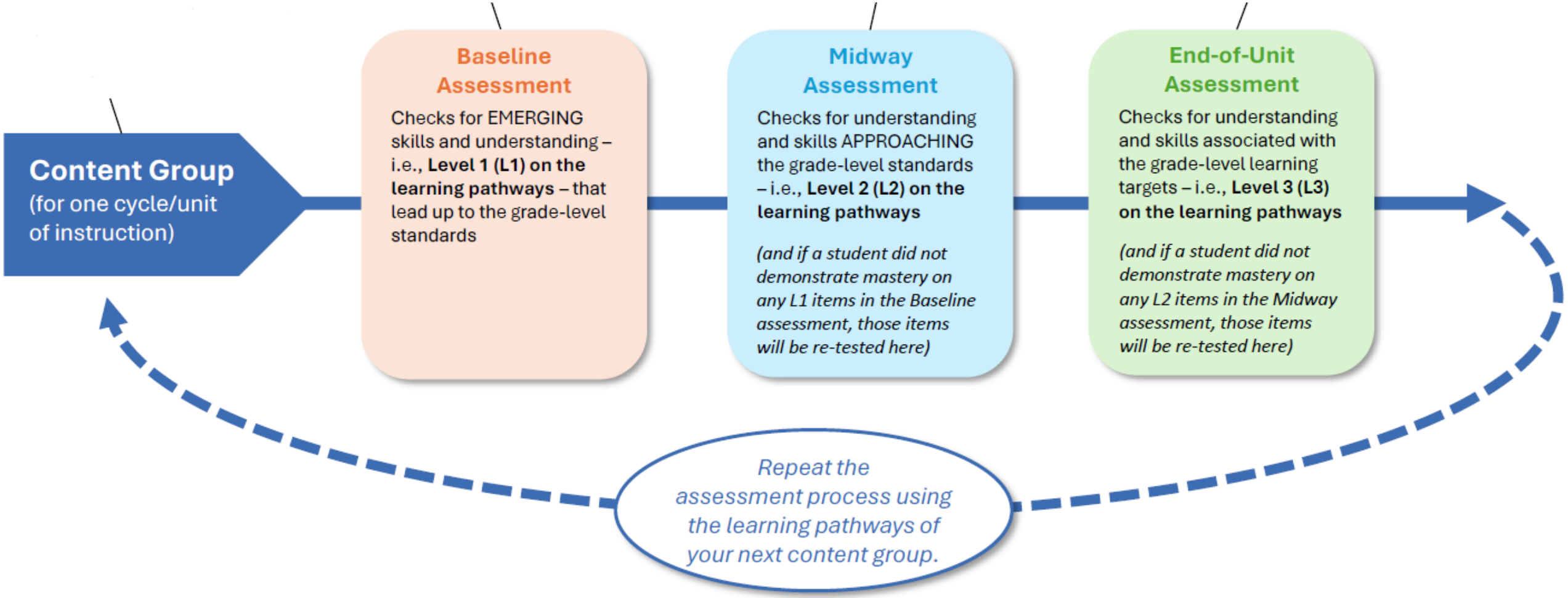
PIE.5.NF.A.3 Page 1 of 2



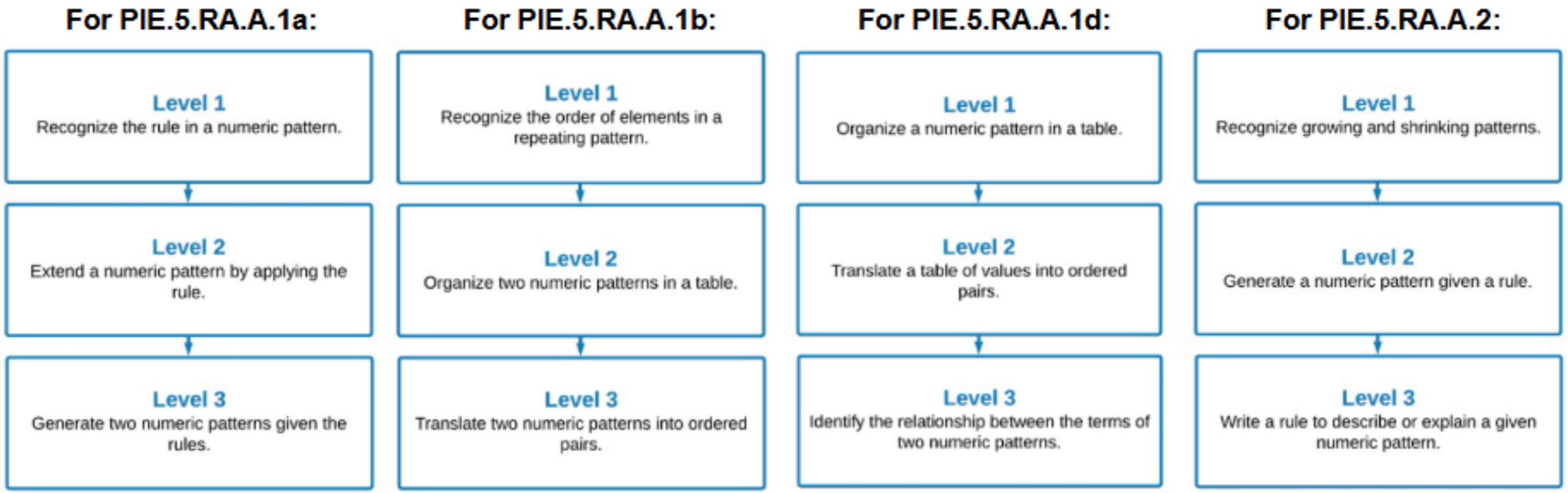
ECD-Based Assessments

- Assessment items measured the knowledge, skills and understandings at each learning pathway level
- Evidence-centered design task models developed and used to guide item development
- Using the task models, educators wrote 402 items to assess the learning-pathway levels aligned to 25 priority fifth-grade Missouri mathematics standards.

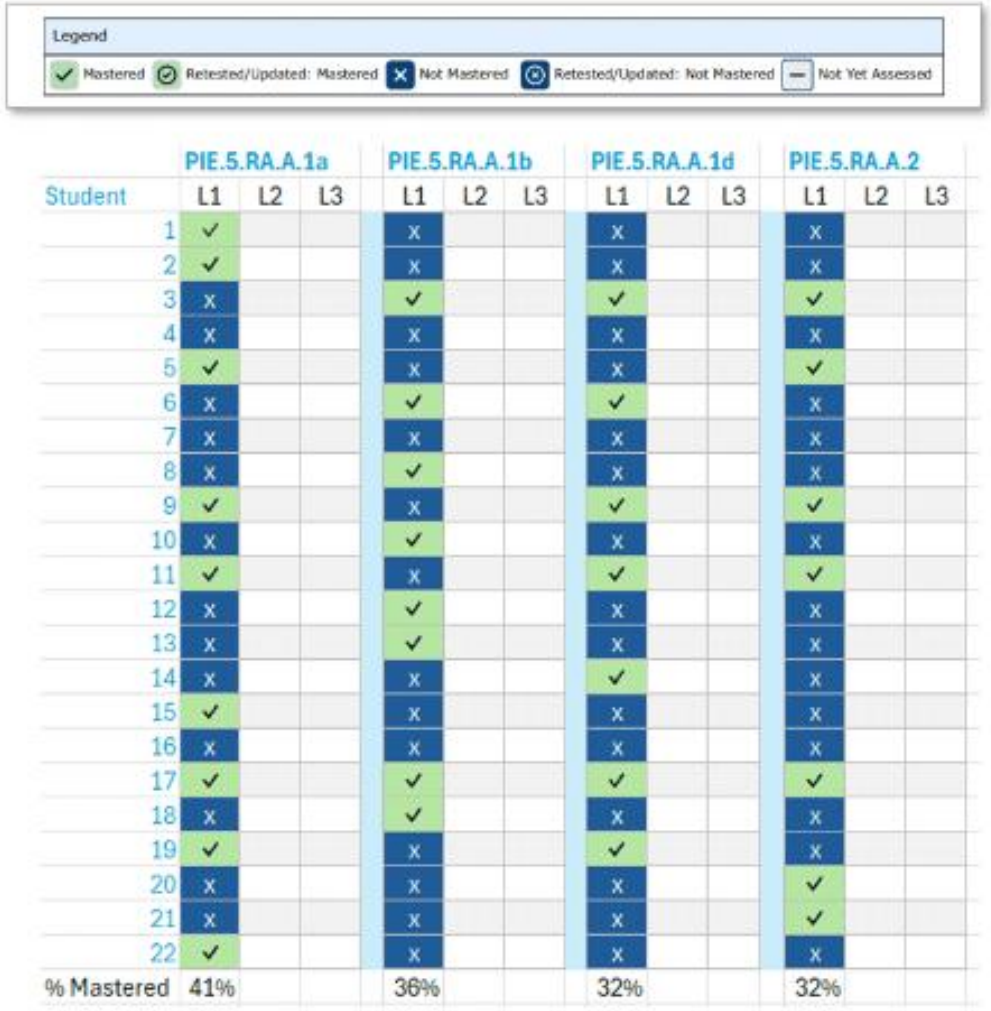
Instructionally Embedded Assessment Cycle



Example Content Group for Assessment



Actionable Results



Student	PIE.5.RA.A.1a			PIE.5.RA.A.1b			PIE.5.RA.A.1d			PIE.5.RA.A.2		
	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
1	✓			x			x			x		
2	✓			x			x			x		
3	x			✓			✓			✓		
4	x			x			x			x		
5	✓			x			x			✓		
6	x			✓			✓			x		
7	x			x			x			x		
8	x			✓			x			x		
9	✓			x			✓			✓		
10	x			✓			x			x		
11	✓			x			✓			✓		
12	x			✓			x			x		
13	x			✓			x			x		
14	x			x			✓			x		
15	✓			x			x			x		
16	x			x			x			x		
17	✓			✓			✓			✓		
18	x			✓			x			x		
19	✓			x			✓			x		
20	x			x			x			✓		
21	x			x			x			✓		
22	✓			x			x			x		
% Mastered	41%			36%			32%			32%		

Baseline assessment results for the "*Number Patterns*" content group

Student	PIE.5.RA.A.1a			PIE.5.RA.A.1b			PIE.5.RA.A.1d			PIE.5.RA.A.2		
	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
1	✓	✓		✓	✓		✓	x		⊗	x	
2	✓	✓		✓	x		✓	x		✓	✓	
3	⊗	x		✓	✓		✓	✓		✓	✓	
4	✓	✓		⊗	x		⊗	x		⊗	x	
5	✓	✓		✓	✓		✓	x		✓	x	
6	✓	✓		✓	✓		✓	x		✓	✓	
7	⊗	x		✓	x		✓	✓		✓	✓	
8	✓	✓		✓	✓		⊗	x		⊗	x	
9	✓	x		⊗	x		✓	x		✓	x	
10	✓	✓		✓	✓		✓	✓		✓	✓	
11	✓	✓		✓	✓		✓	x		✓	✓	
12	✓	x		✓	x		⊗	x		⊗	x	
13	⊗	x		✓	x		✓	✓		✓	✓	
14	✓	x		✓	✓		✓	✓		✓	✓	
15	✓	✓		✓	✓		✓	✓		✓	✓	
16	⊗	x		⊗	x		⊗	x		⊗	x	
17	✓	✓		✓	✓		✓	✓		✓	✓	
18	⊗	x		✓	x		✓	x		✓	x	
19	✓	✓		✓	x		✓	✓		✓	✓	
20	✓	✓		✓	✓		✓	x		✓	✓	
21	✓	✓		✓	✓		✓	x		✓	✓	
22	✓	✓		✓	✓		✓	✓		✓	✓	
% Mastered	77%	64%		86%	59%		82%	41%		77%	64%	

Midway assessment results for the "*Number Patterns*" content group

Teacher Training

A series of six eLearning modules:

1. Enriching Your Classroom Instruction With PIE
2. Creating and Using Content Standard Groups
3. Understanding the PIE Assessment
4. Administering the PIE Assessment
5. Interpreting PIE Assessment Results
6. Using PIE to Inform Your Instructional Activities

	Working title	Performance-based objectives	Essential (enabling) knowledge, skills, etc.
1	Enriching Your Classroom Instruction with PIE	*[n/a - this module is cultivating overall teacher interest and motivation for the performance-based objectives of subsequent modules]*	• Overview/vision of the PIE instruction and assessment model, including how PIE is unique • Potential benefits to teachers and students • Very high-level intro to PIE system components and preview to the module series (learning pathways, assessments, reporting)
2	Creating and Using Content Standard Groups	Using the learning pathways framework as a reference, teachers will create groups of content standards for assessment and instruction cycles that are consistent with local pacing guides and curricular plans. Teachers will refer to the PIE Learning Pathways to inform instructional plans.	• Fundamentals of PIE Learning Pathways (what they are/aren't, how they can inform instructional plans) • What content standard groups are • What an assessment and instruction cycle is • How to create and use content standard groups (informed by the learning pathways framework) in instruction and assessment cycles • How to calendar assessment sessions based on content standard groups
3	Understanding PIE Assessments	*[n/a - this module has an enabling knowledge-based objective: Teachers will understand the fundamentals of PIE assessments.]*	• Test length • Item types • Accessibility supports • Practices allowed and not allowed • Security of test content
4	Administering the PIE Assessment	Teachers will administer PIE assessments consistent with the intended instructionally embedded administration design. Teachers will navigate the PIE online assessment tool with ease.	• Tasks completed in Kite EP • Step-by-step how to administer PIE assessments
5	Interpreting PIE Assessment Results	Teachers will navigate the PIE reporting dashboard with ease. Teachers will interpret PIE assessment results as intended.	• How scoring works • Key components of the PIE reporting dashboard • Key elements of PIE assessment results • How to interpret PIE assessment results • Dashboard use cases (i.e., when/why will teachers use the dashboard)
6	Using PIE to Inform Your Instructional Activities	Teachers will use assessment results to inform next steps in instructional and learning activities.	• Step-by-step how to use assessment results to inform instructional decisions within the assessment and instruction cycles • Where to access the Learning Pathways and how to use them in this process

Pilot Study Context

- Occurred during 2024–2025 school year in 5th grade mathematics classrooms
- Teachers administered instructionally embedded assessments to their students during each instructional unit beginning in September 2024 through March 2025.
- Included a final student assessment that measured level 3 skills across all 25 content standards

- Goal: evaluate PIE as a proof-of-concept innovative assessment model that could meet instructional and summative reporting purposes

Participation and Data

- 55 teachers in 32 schools across 28 districts
- ~1,500 students

- Data:
  - Student assessment data
  - System use data
  - Teacher interviews and focus groups
  - Teacher survey
  - Student survey

Classroom reporting for PIE

- During the pilot, instructionally embedded assessments were scored using a hierarchical diagnostic classification model (HDCM; Templin & Bradshaw, 2014).
- Each of the 25 learning pathways was calibrated separately using its own HDCM, with each pathway level (Level 1, Level 2, and Level 3) defined as a distinct attribute.

ATLAS, 2025a

Summative POC reporting for PIE

- Used data collected from the PIE pilot study to investigate several possible models as a proof-of-concept
  - IRT, DCM, Hybrid IRT/DCM
- Evaluated against the PIE theory of action

ATLAS (2025b)

Findings

- We describe select findings relative to a subset of claims in the PIE theory of action (D, E, F, I, K, L and M).
- For more information, please refer to *PIE Pilot Study: Design and Administration Evidence* (ATLAS, 2025a) and *PIE as a Proof of Concept for Future Summative Use: Evidence From a Pilot Study* (ATLAS, 2025b).

Claim D: Training and resources support educators in using the PIE system to inform instruction

- The participation rate for the training modules was at or near 100% for 5 of the modules and 70%-80% for the other two.
- Most teachers (75%-95%) agreed or strongly agreed that the training and resources prepared them:
  - to create content groups for instruction and assessment
  - with the requisite knowledge and skills to support implementing cycles of instruction and assessment
  - to interpret and use PIE reports and data to inform their instruction

Claim E. Educators provide instruction aligned with the learning pathways to students.

- 83% of teachers agreed that students had the opportunity to learn content aligned with learning pathways and 77% reported using instructional strategies to reach a continuum of learners at various places in the learning pathways.
- Teachers thought the PIE system was a valuable resource for:
  - gauging student understanding,
  - identifying content to reteach,
  - informing instructional small groups, and
  - planning future lessons.
- However, several expressed concerns about the length of the IE assessment window; only 26 (1.7%) students completed all 25 blueprint standards.

Claim F. Educators administer assessments consistent with intended design.

- 79% of teachers indicated they were able to administer assessments at instructionally-relevant points in time
- 74% indicated they could use the PIE assessment results to plan next steps for their instruction.
- However, 62% thought the assessment tasks were aligned with instruction and only 56% agreed that the length of the assessment window was sufficient
- Given the varied blueprint coverage and assessment completion rates, there are opportunities to improve the system to support intended implementation practices.

Evaluating Summative Models

Claim	IRT Model	Diagnostic Model	Hybrid Model
I: Mastery results represent what students know and can do relative to the learning pathways.	Not supported	Results reported directly as the set of mastery KSUs	Mastery results directly inform summative scale score
K: Summative results accurately reflect student achievement of grade-level academic content standards.	Supported with a single scale score	Supported with a profile of mastered KSUs	Supported with both scale score and diagnostic profile
L: Educators make instructional decisions based on data from the PIE assessments.	Not well suited to instructional decisi on-making	Instructional decision -making based on mastery profile	Instructional decision -making based on mastery profile
M: Students make progress towards mastery of grade-level content standards.	Supported with existing growth models	Additional research needed to evaluate profile-based growth	Supported with existing growth models

Future Directions

- Continue research and development efforts that bridge the gap between assessment and classroom instruction
- Develop vertically articulated learning pathway structures for grades 3–8 to track student progress over time
- Prioritize solving implementation hurdles, such as professional learning and training needs and operational feasibility

THANK YOU!

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