Constructing and Using Content Progressions for Teaching and Learning Math

NCTM, 2018

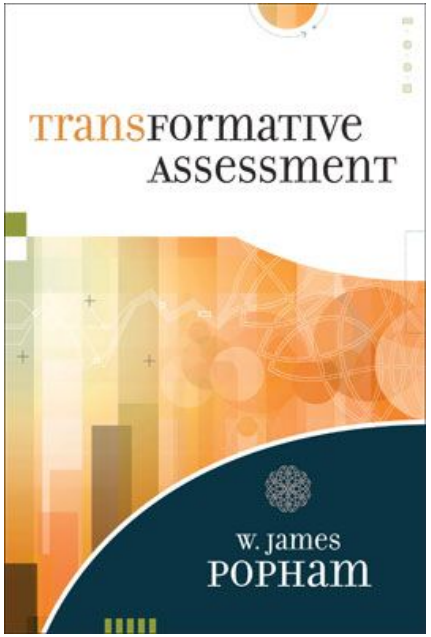
Guiding Principles for School Mathematics

"An excellent mathematics program includes a curriculum that develops important mathematics along coherent learning progressions and develops connections among areas of mathematical study and between mathematics and the real world."

NCTM
Principles to Actions

How do we define a Learning Progression?

"A learning progression is a sequenced set of subskills and bodies of enabling knowledge that, it is believed, students must master en route to mastering a more remote curricular aim."



James Popham
Transformative Assessment

In this session you will...

- **learn** how our district is defining, developing, and using conceptual learning **progressions**,
- **do** some **math** thinking and construct a learning progression with your peers,
- and **understand** that **ownership** of curriculum is key to high quality instruction.

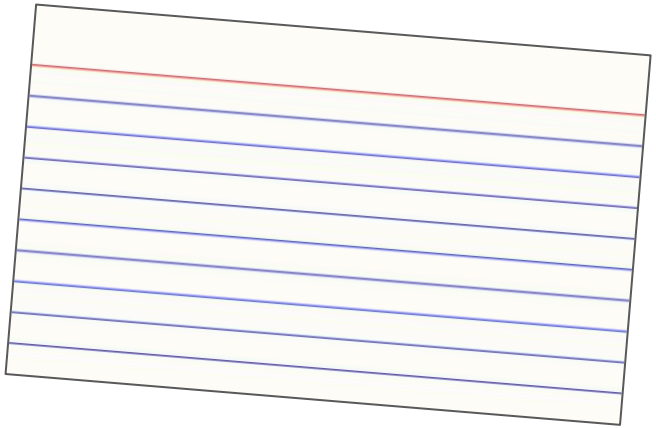
Meet Us...

Nicole Caulfield
K-6, Instructional Coach

John Ulbright
K-12 , Math Specialist

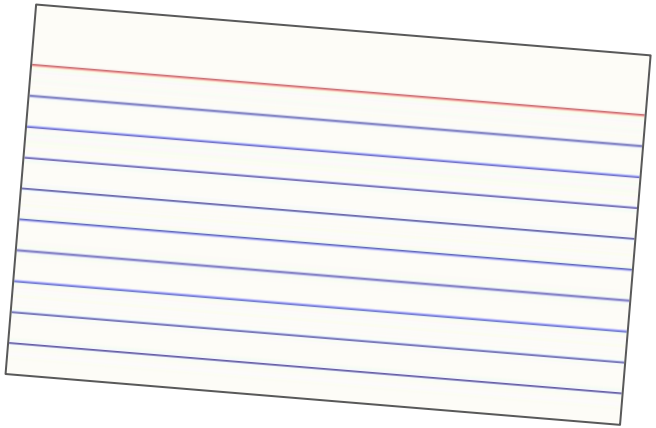
MSD of Wayne Township
(Indianapolis)


1-4



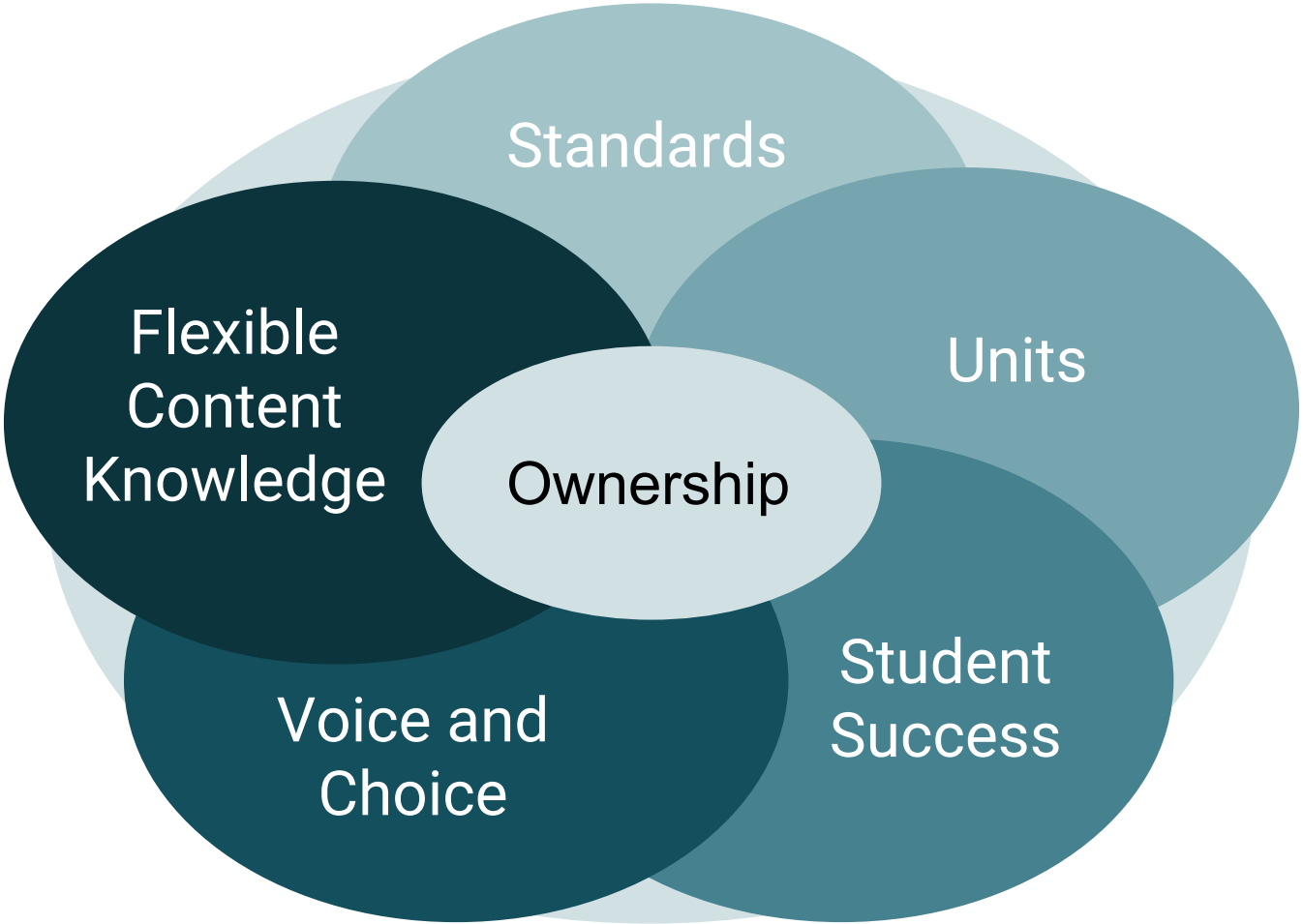

What will that level of engagement look like for you today?

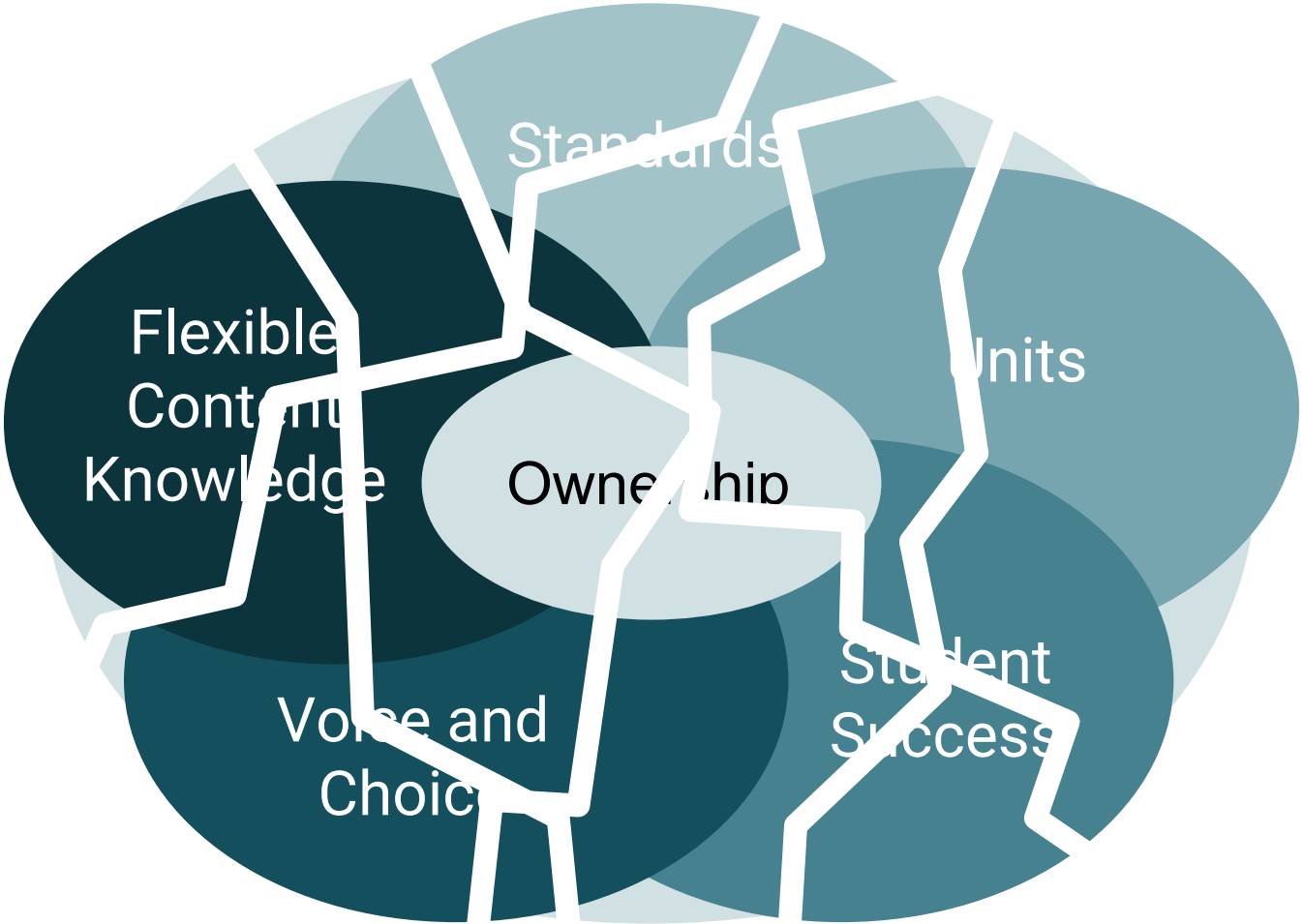

1-4



Why Learning Progressions?

- Student learning
- Lack of content knowledge
- Differentiation struggles
- Formative assessment
- Ownership of curriculum


Standards
Flexible Content Knowledge
Units
Ownership
Voice and Choice
Student Success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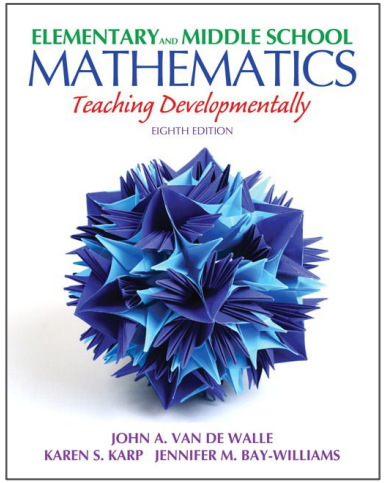
Our Process

- One unit at a time
- 1-2 hours, depending on the building
- Players:
  - Team of teachers (grade or course)
  - Math “expert” (usually John)
  - Coach (like Nicole)

Our Process

- Read Standards

A quick note about the problems...



Illustrative Mathematics

Open Middle

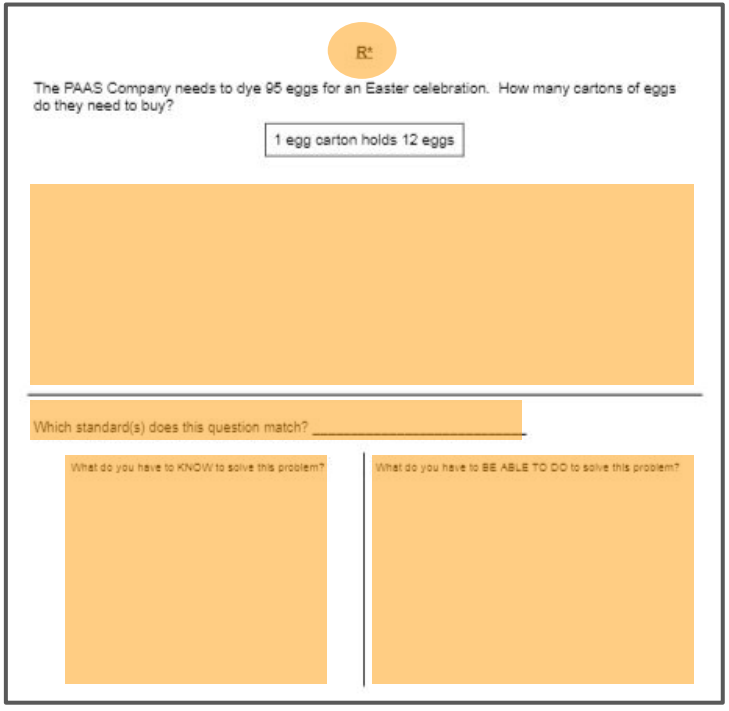
Challenging math problems worth solving

WE ARE WAYNE!

GREAT SCHOOLS :: GREAT COMMUNITY

Our Process

- Read Standards
- Solve Problems
- Record “Knows” and “Dos”



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- Write Curricular Aim (“Students…”)

Our Process

- Read Standards
- Solve Problems
- Discuss and Order
- Link problems to subskills and enabling bodies of knowledge
- Identify the Curricular Aim
- Identify Look-fors

Students understand the significance of a remainder

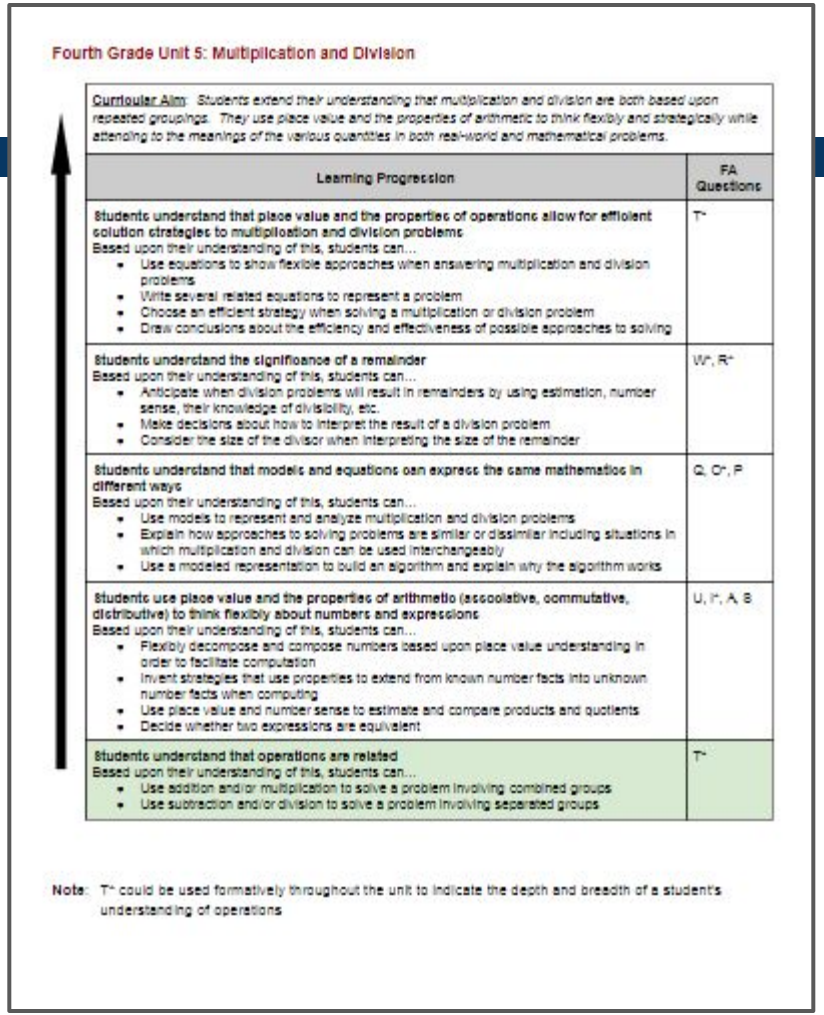
Based upon their understanding of this, students can…

- Anticipate when division problems will result in remainders by using estimation, number sense, their knowledge of divisibility, etc.
- Make decisions about how to interpret the result of a division problem
- Consider the size of the divisor when interpreting the size of the remainder

Next Steps

The team...

- considers formative assessment
- and plans instruction.



Fourth Grade Unit 5: Multiplication and Division

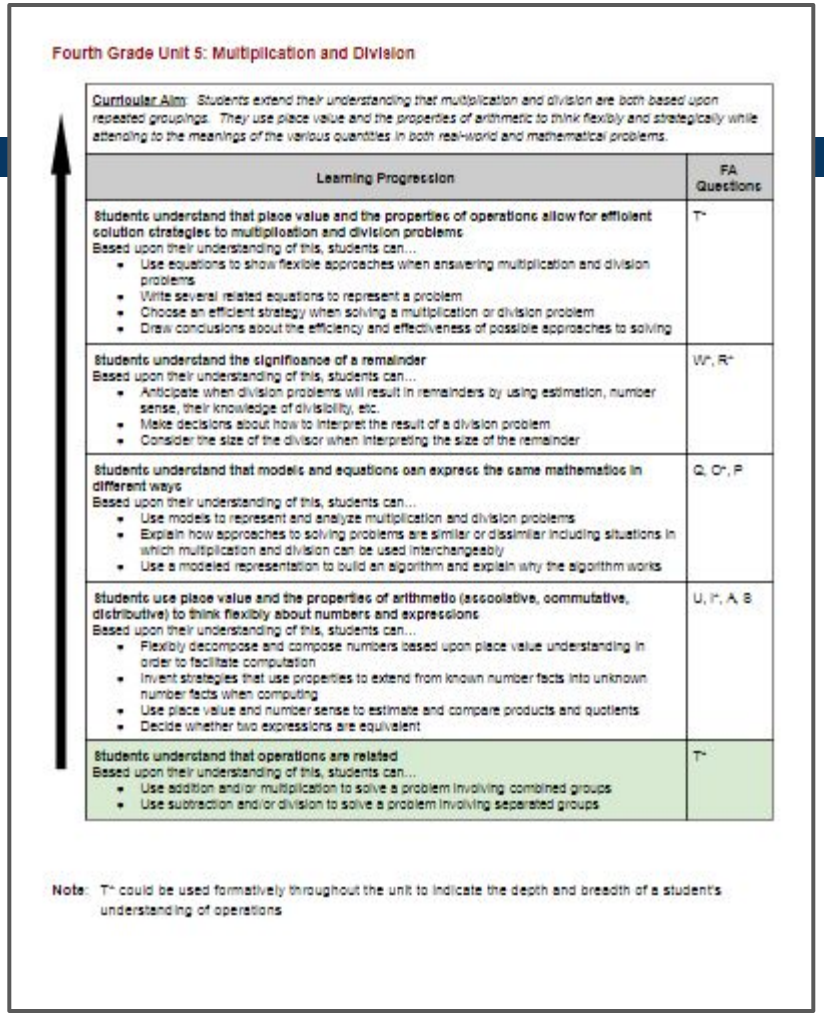
Curricular Aim: *Students extend their understanding that multiplication and division are both based upon repeated groupings. They use place value and the properties of arithmetic to think flexibly and strategically while attending to the meanings of the various quantities in both real-world and mathematical problems.*

Learning Progression	FA Questions
Students understand that place value and the properties of operations allow for efficient solution strategies to multiplication and division problems Based upon their understanding of this, students can… • Use equations to show flexible approaches when answering multiplication and division problems • Write several related equations to represent a problem • Choose an efficient strategy when solving a multiplication or division problem • Draw conclusions about the efficiency and effectiveness of possible approaches to solving	T*
Students understand the significance of a remainder Based upon their understanding of this, students can… • Anticipate when division problems will result in remainders by using estimation, number sense, their knowledge of divisibility, etc. • Make decisions about how to interpret the result of a division problem • Consider the size of the divisor when interpreting the size of the remainder	W*, R*
Students understand that models and equations can express the same mathematics in different ways Based upon their understanding of this, students can… • Use models to represent and analyze multiplication and division problems • Explain how approaches to solving problems are similar or dissimilar including situations in which multiplication and division can be used interchangeably • Use a modeled representation to build an algorithm and explain why the algorithm works	Q, O*, P
Students use place value and the properties of arithmetic (associative, commutative, distributive) to think flexibly about numbers and expressions Based upon their understanding of this, students can… • Flexibly decompose and compose numbers based upon place value understanding in order to facilitate computation • Invent strategies that use properties to extend from known number facts into unknown number facts when computing • Use place value and number sense to estimate and compare products and quotients • Decide whether two expressions are equivalent	U, I*, A, S
Students understand that operations are related Based upon their understanding of this, students can… • Use addition and/or multiplication to solve a problem involving combined groups • Use subtraction and/or division to solve a problem involving separated groups	T*

Note: T* could be used formatively throughout the unit to indicate the depth and breadth of a student's understanding of operations

Putting it together

With a shared vision for the unit in place, we now assemble our work into a learning progression.



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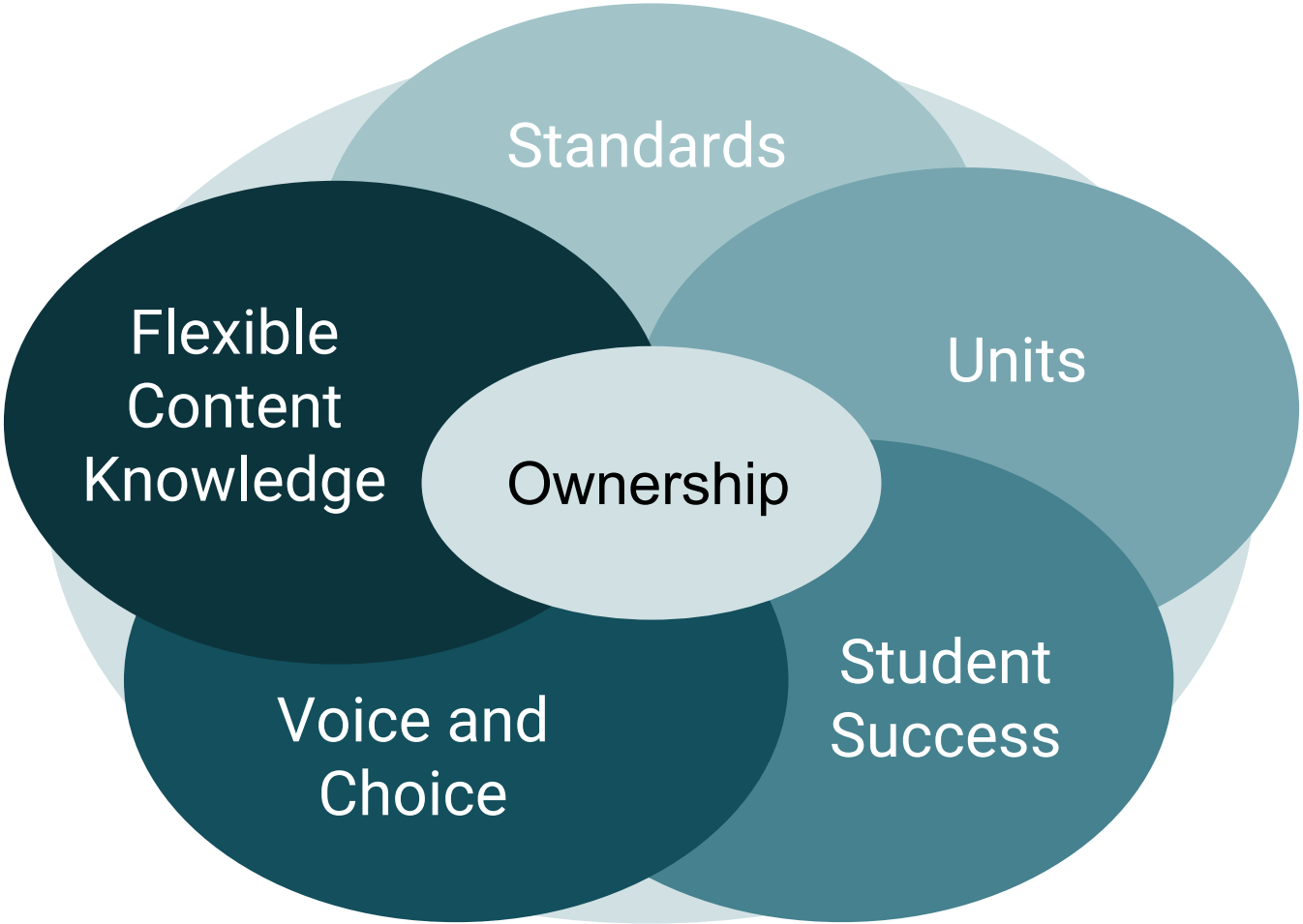
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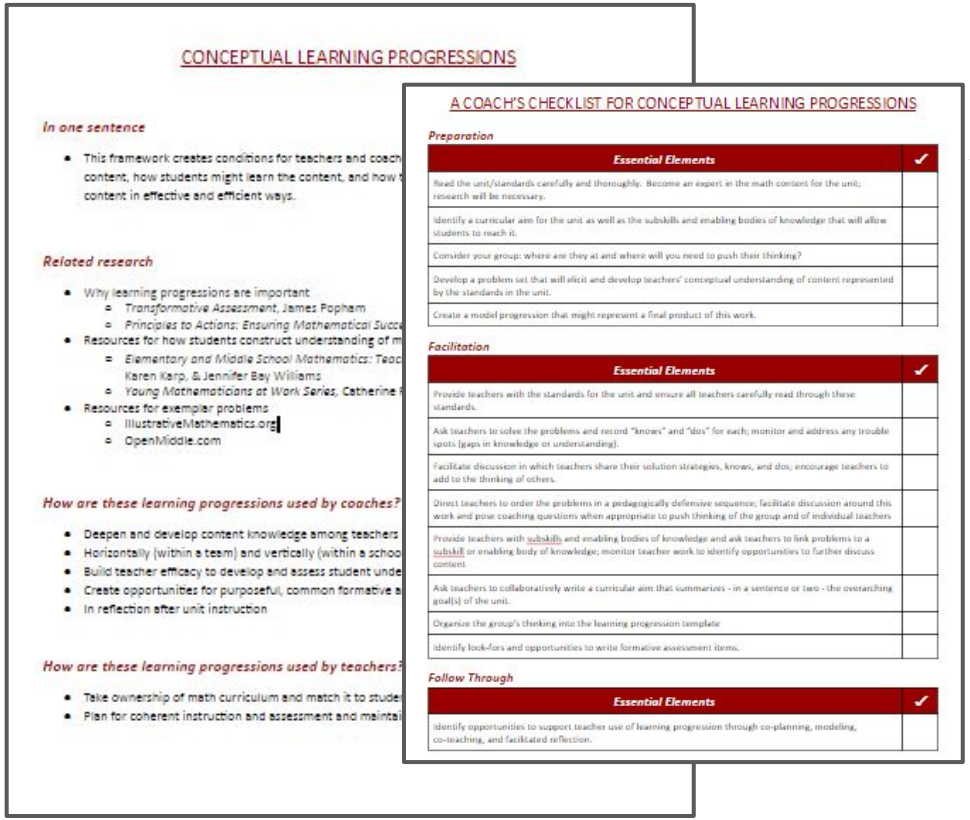
Student Success

Our Case for Learning Progressions

- Increased student learning
- Building content knowledge
- Improved differentiation
- Opportunities for formative assessment
- Ownership of curriculum

Checklist...

Theory



CONCEPTUAL LEARNING PROGRESSIONS

In one sentence

- This framework creates conditions for teachers and coach
  content, how students might learn the content, and how t
  content in effective and efficient ways.

Related research

- Why learning progressions are important
  - *Transformative Assessment*, James Popham
  - *Principles to Actions: Ensuring Mathematical Succ*
- Resources for how students construct understanding of m
  - *Elementary and Middle School Mathematics: Teac*
    Karen Karp, & Jennifer Bay Williams
  - *Young Mathematicians at Work Series*, Catherine
- Resources for exemplar problems
  - IllustrativeMathematics.org
  - OpenMiddle.com

How are these learning progressions used by coaches?

- Deepen and develop content knowledge among teachers
- Horizontally (within a team) and vertically (within a schoo
- Build teacher efficacy to develop and assess student unde
- Create opportunities for purposeful, common formative a
- In reflection after unit instruction

How are these learning progressions used by teachers?

- Take ownership of math curriculum and match it to stude
- Plan for coherent instruction and assessment and maintai

A COACH'S CHECKLIST FOR CONCEPTUAL LEARNING PROGRESSIONS

Preparation

Essential Elements	✓
Read the unit/standards carefully and thoroughly. Become an expert in the math content for the unit; research will be necessary.	
Identify a curricular aim for the unit as well as the subskills and enabling bodies of knowledge that will allow students to reach it.	
Consider your group: where are they at and where will you need to push their thinking?	
Develop a problem set that will elicit and develop teachers' conceptual understanding of content represented by the standards in the unit.	
Create a model progression that might represent a final product of this work.	

Facilitation

Essential Elements	✓
Provide teachers with the standards for the unit and ensure all teachers carefully read through these standards.	
Ask teachers to solve the problems and record "knows" and "dos" for each; monitor and address any trouble spots (gaps in knowledge or understanding).	
Facilitate discussion in which teachers share their solution strategies, knows, and dos; encourage teachers to add to the thinking of others.	
Direct teachers to order the problems in a pedagogically defensive sequence; facilitate discussion around this work and pose coaching questions when appropriate to push thinking of the group and of individual teachers	
Provide teachers with subskills and enabling bodies of knowledge and ask teachers to link problems to a subskill or enabling body of knowledge; monitor teacher work to identify opportunities to further discuss content	
Ask teachers to collaboratively write a curricular aim that summarizes - in a sentence or two - the overarching goal(s) of the unit.	
Organize the group's thinking into the learning progression template	
Identify look-fors and opportunities to write formative assessment items.	

Follow Through

Essential Elements	✓
Identify opportunities to support teacher use of learning progression through co-planning, modeling, co-teaching, and facilitated reflection.	

Planning

Implementation

Our Challenges

- Teacher time
- Facilitator time
- Maintaining coaching posture
- Flexible thinking
- Admin buy-in

Our Next Steps

- Sustainability and teacher capacity
- More focus on planning and assessment
- Student-friendly progressions

Questions and/or Comments?

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