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SCHOOL OF EDUCATION & HUMAN DEVELOPMENT

RESEARCH IN MATHEMATICS EDUCATION

TIER Computations Progress Monitoring System: Item Modeling

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Technical Report 21-02

TIER Computations Progress Monitoring System: Item Modeling

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Abstract

The purpose of the current report is to describe the process of item modeling for the Tiered Intervention with Evidence-Based Research (TIER) Computations Progress Monitoring System. We recruited 24 teachers to collaboratively develop 220 item models for Grades K-6. The item models were developed to create 20 comparable assessment forms per grade (each with 30-40 items) to gauge students' computations-based progress within their grade level throughout the academic year. This work is in collaboration with the University of Texas at Austin and the Texas Education Agency.

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TIER: Item Modeling

Introduction

The purpose of the current report is to describe the item modeling process for the computations progress monitoring tools of the Tiered Interventions with Evidence-Based Research (TIER) project. Below we define this vocabulary:

- An **item** is a test question that is written to assess students' computational fluency, as described in the Texas Essential Knowledge and Skills (TEKS).
- An **item model** is a template that specifies the mathematical constraints for a specific item and is used in this project as the basis for future items (subsequently referred to as cousin items) assessing the same TEKS.
- A **cousin item** is an item written based on a specific item model. The primary goal for writing cousin items is to use the item model to create additional items that are parallel in difficulty, format, and response options.

The development of the progress monitoring tools is part of the larger TIER project in collaboration with the University of Texas at Austin and the Meadows Center for Preventing Educational Risk and is funded by the Texas Education Agency (TEA). The purpose of the TIER Computations Progress Monitoring System is to create 20 comparable forms per grade of computations-based progress monitoring probes for students in Grades K-6. Teachers will use data from these probes to monitor students' progress in developing procedural fluency with the grade-level Texas Essential Knowledge and Skills (TEKS) standards. This report details the item modeling process of the instrument development project. We first begin with a description of the content blueprint process. Then, we describe the training webinar and workshops during which we collaborated with a team of highly qualified, experienced educators who served as assessment item designers and writers that aligned to the content blueprint.

Content Blueprint

This current section describes the content blueprint development and review process for the instrument. The content blueprint is the content framework for the progress monitoring probes for each Grade (K-6) aligned to the TEKS. Before writing item models, TEA reviewed and approved the content blueprint.

Development

Before modeling items, we needed to understand the coverage of content needed for the assessment. The items needed to be reflective of the Texas Essential Knowledge and Skill standards (TEKS) and be related to computational fluency. Principles and Standards for School Mathematics (NCTM 2000) defined computational fluency as the following:

> Computational fluency refers to having efficient and accurate methods for computing. Students exhibit computational fluency when they demonstrate flexibility in the computational methods they choose, understand and can explain these methods, and produce accurate answers efficiently. The computational methods that a student uses should be based on mathematical ideas that the student understands well, including the structure of the base-ten number system, properties of multiplication and division, and number relationships (p.152).

Russell (2000) discussed details on what efficiency, accuracy, and flexibility mean in math assessment:

> Efficiency implies that the student does not get bogged down in many steps or lose track of the logic of the strategy. An efficient strategy is one that the student can carry out easily, keeping track of sub-problems and making use of intermediate results to solve the problem. Accuracy depends on several aspects of the problem-solving process, among them, careful recording, the knowledge of basic number combinations and other important number relationships, and concern for double-checking results. Flexibility requires the knowledge of more than one approach to solving a particular kind of problem. Students need to be flexible to be able to choose an appropriate strategy for the problem at hand and also to use one method to solve a problem and another method to double-check the results (p. 154).

Using the definition of computational fluency, the project staff reviewed the mathematics TEKS to identify standards that could be applied to computational fluency. The project staff identified standards in relevant domains that were appropriate for computational fluency assessment for each grade. Additionally, the project team recorded their rationale for their decisions about each standard to select it for computational fluency. The team also identified appropriate number ranges for the selected standards as specified in TEKS.

After identifying content that could be tested for computational fluency in each grade, the team divided the identified content areas into subcomponents. For some TEKS, subcomponents were necessary to fully test the standard. For example, TEKS 6.3.D (Add, subtract, multiply, and divide integers fluently) was divided into four subsets: Add integers, subtract integers, multiply integers, and divide integers. Then the number of items for TEKS 6.3.D were distributed across each subset for testing.

In Grades K and 1, the project team also identified areas where subcomponents were necessary for standards. Grade K initially contained three subtests: strategic counting, magnitude comparison, and number sequence. Grade 1 initially contained four subtests: strategic counting, number sequence, magnitude comparison, and addition/subtraction. In addition to distributing items across the standards, the team identified subskills within each standard. For example, one standard in Grade 1 reads "Use place value to compare whole numbers up to 120 using comparative language." Our team identified three subskills within this standard of increasing level of difficulty (i.e., up to 50, up to 100, up to 120). The team identified subskills across all standards and all grades and then we distributed the number of items across these standards and subskills. The initial draft was internally reviewed by other team members with expertise in mathematics education. Then, the principal investigator (PI), Leanne Ketterlin-Geller, evaluated the draft of the content blueprint to ensure alignment. Before moving to the item modeling phase, we sent the content blueprint to TEA for review and approval.

Feedback from TEA

TEA reviewed and provided feedback on the test content blueprint. To reduce the number of tests in Grades K and 1, the PI made the recommendation to only use the written subtests, so teachers have fewer subtests that require oral responding. In particular, the PI recommended using the number sequence and magnitude comparison subtests for K, and addition/subtraction and either the number sequence or magnitude comparison subset in Grade 1. The research behind this suggests that magnitude comparison and number sequence have moderate to high predictive validity coefficients with large-scale outcome measures (Gersten et al., 2012). The predictive validity coefficients with large-scale outcome measures range from 0.35 to 0.79.

Ultimately, the magnitude comparison and addition/subtraction subtest were chosen for Grade 1. For Grades 2, 3, and 4, TEA suggested a redistribution of item subtests within certain standards. The project team followed TEA's recommendations. Appendix A contains the content blueprint approved by TEA.

Item Model Training

In this section, we describe the webinar and the item model training workshop. Item models are frameworks for items and they allow for the writing of items in a manner that retains the same difficulty while testing the same content.

Webinar

Before the item modeling workshop in which teachers wrote item models, the item writers watched a pre-recorded webinar to acquaint themselves with the project. The webinar included an overview of the project, an introduction to curriculum-based measures and computational fluency, an overview of the TIER Computations Progress Monitoring Tool, an outline of the development stages of the tool, and a preview of what to expect for the item model workshops. Lastly, the item writers were instructed to perform a test file upload to our file storage system (Box), to ensure they had access and were capable of working in Box. The presentation for pre-webinar that guided the webinar is available in Appendix B.

To develop item models that aligned with the content blueprint, we hired 24 highly qualified and experienced educators as item writers across the seven grades. Item writers met the following qualifications to be selected as item writers for the project:

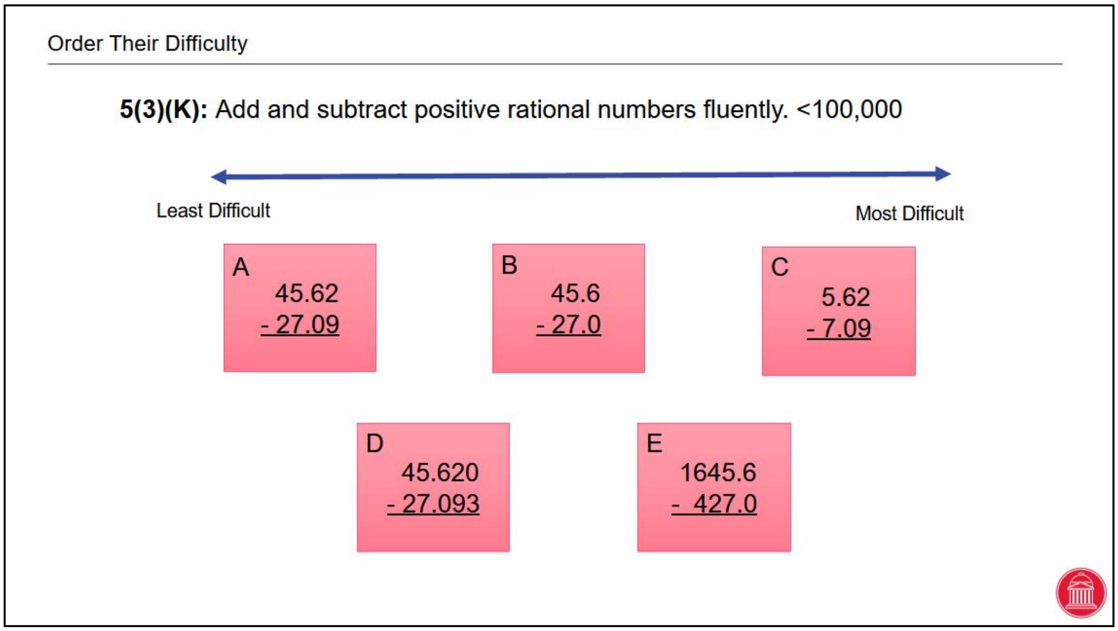
- Bachelor's degree or higher in mathematics, education, or related field
- Three years teaching experience at a Texas Public school in Grade(s) K-6
- Deep understanding of the Texas Essential Knowledge and Skills (TEKS)
- Ability to accept and incorporate critical feedback
- Proficiency in Microsoft Word/Excel
- Ability to scan/upload files to an online repository
- Ability to adhere to tight timelines
- Experience with writing mathematics assessment items in Grades K-6 (preferred)
- Extensive background in supporting elementary or middle school teachers as a mathematics coach (preferred)

Item Model Workshop

The purpose of the item modeling workshop was to train item writers for the development of 30-40 items models required to create the forms for Grades K-6. These item models would later be used to write cousin items with similar difficulties. Unlike the webinar, the workshops were synchronous and held at two different times. The first workshop consisted of teachers who would write items for Grades K and 1, while the second workshop consisted of teachers who would be working on items for Grades 2 through 6. The project team intended to hold three workshops for Grades K-1, 2-4, and 5-6 but due to inclement weather, had to group grade levels and the number of workshop sessions was reduced to two. The PowerPoint presentations that guided each of the workshops are available in Appendix C.

Due to the Covid-19 pandemic, both workshops were hosted remotely via video conference over Zoom. The workshops were approximately seven hours long with a lunch break. The first part of the workshop focused on situating item writers to the Multi-Tiered System of Support (MTSS) and progress monitoring tools. In this part of the training, item writers had the opportunity to take a sample curriculum-based measure. After completing the sample measure, the project team discussed the importance of arranging items by their difficulty level with item writers. Next, the item writers were presented with a set of five subtraction questions. The given five subtraction questions were not arranged by difficulty level (Figure 1). Item writers were asked to arrange the items from least difficult to most difficult. Drawing from this live testing experience, the project PI discussed item difficulty in more detail, including what factors impact item difficulty, and how to write items of varying difficulty levels. Finally, this first portion of the session was ended with a discussion about the goals of the workshop.

Figure 1: Sample Exercise to Arrange Items by Difficulty Level



After a short break, a team member introduced cousin items, how to write cousin items using an item model, and how to complete the item writing template (Figure 2). The team member also discussed details on each part of the item writing template and what was expected from the item writers in each section.

Figure 2: Item Writing Template

Item Writer: Date:

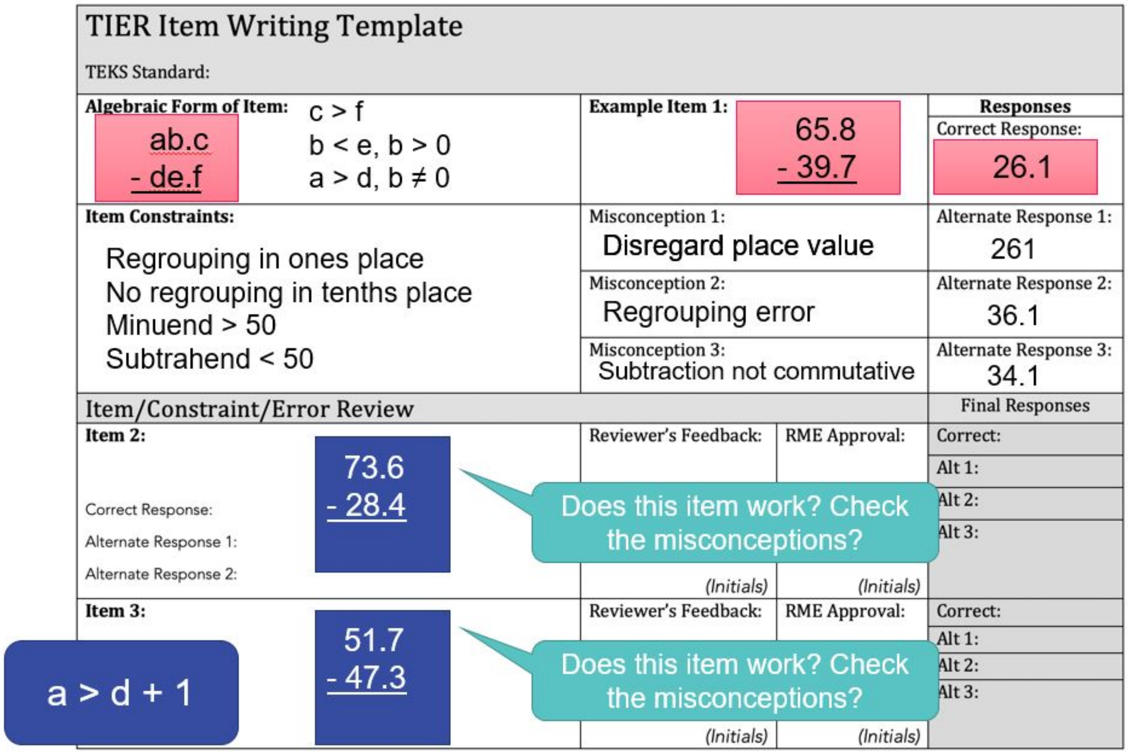
TIER Item Writing Template
TEKS Standard:

Algebraic Form of Item:	**Example Item 1:**		**Responses** Correct Response:
Item Constraints:	Misconception 1:		Alternate Response 1:
	Misconception 2:		Alternate Response 2:
	Misconception 3:		Alternate Response 3:
Item/Constraint/Error Review			**Final Responses**
Item 2: Correct Response: Alternate Response 1: Alternate Response 2: Alternate Response 3:	Reviewer's Feedback: *(Initials)*	RME Approval: *(Initials)*	Correct: Alt 1: Alt 2: Alt 3:
Item 3: Correct Response: Alternate Response 1: Alternate Response 2: Alternate Response 3:	Reviewer's Feedback: *(Initials)*	RME Approval: *(Initials)*	Correct: Alt 1: Alt 2: Alt 3:

Standard Code: ( ) ( )
Difficulty Code (circle one): Easy, Medium, Difficult

A team member filled in the blank item model to show an example of the process. A sample of a completed item writing template is shown below (Figure 3). The algebraic form and item constraints develop a generic structure of the item. Example item 1 was created based on the algebraic form and constraints.

Figure 3: Sample Filled in Item Writing Template



Next, the project team discussed common misconceptions for some math concepts and possible answers as a result of misconceptions with item writers. For example, disregarding place value error, regrouping error, and commutative concept error in subtraction of two decimal numbers are some examples of misconceptions. The purpose of including misconceptions was to capture common misunderstandings students have for each concept. Data from misconceptions may also be useful diagnostic information in the future. Misconceptions were drawn from literature and item writers' teaching experience. For some standards, misconceptions were not necessarily required due to the dichotomous nature of these standards. As shown below in Figure 4, the team discussed component error and strategy error in adding two mixed fractions.

Figure 4: Sample Misconception and Error

Add and simplify.

$$3\frac{1}{2}+4\frac{1}{4}=$$

Component Error

$$\frac{4}{2}+\frac{5}{4}=\frac{13}{4}=3\frac{1}{4}$$

Strategy Error

$$3\frac{1}{2}+4\frac{1}{4}=7\frac{1}{3}$$

After the group presentation and training, item writers were divided into groups by grade level to start writing item models. We teamed item writers with a member of the project team to help guide their item writing process. The team member either guided the item writers through their first assigned standard or they collectively worked on the same standard within their grade level. Each item writer received feedback on their first item from the project team member leading the group. The feedback on the first item was provided to make sure item writers had a clear understanding of the task and the process before moving on to the other items assigned to them during the workshop.

Item writers worked on the remaining item models asynchronously within their grade-level content while a team member stayed present in the breakout room to help with any questions and support developing item models. Item writers also reviewed other item writer’s work within their group and provided feedback to improve the item models. During the peer review process, each pair of item writers and the reviewer discussed every component of the item in depth. Each reviewer raised questions and concerns and then the pair discussed and resolved any issue to update the item. The peer review was an important step of the process because it provided item writers a chance to not only review others' work but also learn from others.

Overall, the project team made significant conscious efforts to support all item writers at every stage of item model development. In the first daylong workshop, item writers collaborated with the project team to draft 70 item models across two grades. In this second workshop, these consultants collaborated with the project team to draft 150 item models across five grades.

Internal Review

To prepare item models for expert and TEA review, project team members first reviewed the item models developed by the item writers. The purpose of the internal review was to ensure that each item model met all the criteria listed below; if not, the project team member revised the item models, as needed. The internal review process consisted of an analysis of each item model to determine whether the:

- Item aligns with the specified standard in the approved content blueprint

- Constraints are clearly specified and will lead to items of the same difficulty
- A specified number of cousin items can be written based on the constraints
- Item difficulty is consistent across all cousin items
- Example items match the constraints

The PI and a senior team member developed a step-by-step process and a spreadsheet for the internal review process. The internal review team used the process document to review each item, correct response, misconceptions, and alternate responses for each item model. Where applicable, team members updated the item to reflect appropriate responses to the review. The project team also updated the example items if they did not meet the expectations above. Items went through a 20% verification by another team member who made adjustments where necessary.

The internal review was completed by a team of experts consisting of the following members.

Leanne Ketterlin-Geller, Ph.D., is the principal investigator (PI) for the TIER Computations Progress Monitoring Tool project and Director at Research in Mathematics Education. Her research interests include formative assessment design frameworks using modern test theory, including item response theory, the empirical impact of accommodations and other test changes on the validity of test-score interpretations and uses, implications of using technology to implement the universal design of assessment principles to support accessibility, and mathematics teachers' decision-making with a focus on integrated research-based instructional design and delivery principles with content teacher knowledge.

Jennifer McMurrer, Ph.D., is the project manager for the TIER Computations Progress Monitoring Tool project and Senior Research Specialist at Research in Mathematics Education. She has worked in numerous research roles, including senior research analyst, and senior director of research. Dr. McMurrer's research interests focus on K-12 federal education policy and program implementation in persistently low-achieving schools.

Muhammad Qadeer Haider, Ph.D., is a research and assessment coordinator at Research in Mathematics Education. Dr. Haider has developed and validated a reliable assessment tool to measure students' procedural and conceptual understanding of introductory linear algebra concepts as part of his doctoral dissertation. He also has mathematics and computer science teaching experience in Pakistan, Qatar, and the United States.

Tina Barton, M.A., is a design research strategist at Research in Mathematics Education. She currently works to implement Human-Centered Design principles and practices into the educational research and assessment development processes. She has teaching experience as a reading specialist and teacher.

Josh Geller, M.S., is a researcher at Research in Mathematics Education. He received his graduate degree from the University of Oregon in special education. Josh has also assisted in the creation of web-delivered math assessments researching the effectiveness of accommodations. He has also been a member of several item-writing teams.

Most of the issues were resolved among the team members, however, in cases of disagreement the project manager and the PI were consulted to make final decisions.

Conclusion

The current report outlines the item modeling process. We created a content blueprint for the item models based upon the TEKS standards. Then, we conducted a webinar and workshop where item writers wrote 220 item models across seven grades. Lastly, the item models went through an extensive internal review. The next steps include the expert review of the item models, then TEA approval of the master forms, followed by cousin item writing with the item writers. These steps are described in future reports (Tech. Rep. No. 21-03 and Tech. Rep. No. 21-04).

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Appendix A – Content Blueprint for Item Models

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Project TIER
Computations Progress Monitoring System
Test Blueprint

Grade Kindergarten

Number Sequence Subtest

Standard		Total Number of Items
K(2)(F)	Generate a number that is one more than or one less than another number up to at least 20.	10
	Total	10

Magnitude Comparison Subtest

Standard		Total Number of Items
K(2)(G)	Compare sets of objects up to at least 20 in each set using comparative language.	10
K(2)(H)	Use comparative language to describe two numbers up to 20 presented in written numerals.	10
	Total	20

Project TIER
Computations Progress Monitoring System
Test Blueprint

Grade 1

Magnitude Comparison Subtest

Standard			Total Number of Items
1(2)(E)	Use place value to compare whole numbers up to 120 using comparative language.		20
		Total	20

Addition and Subtraction Subtest

Standard and subcomponents		Sub Items	Total Number of Items
1(3)(D)	Apply basic fact strategies to add and subtract within 20, including making 10 and decomposing a number leading to a 10.		10
	Add within 20	5	
	Subtract within 20	5	
1(5)(F)	Determine the unknown whole number in an addition or subtraction equation when the unknown may be any one of the three or four terms in the equation.		10
	Addition equation	5	
	Subtraction equation	5	
		Total	20

Project TIER
Computations Progress Monitoring System
Test Blueprint

Grade 2

Standard and subcomponents		Sub Items	Total Number of Items
2(2)(C)	Generate a number that is greater than or less than a given whole number up to 1,200.		4
2(4)(A)	Recall basic facts to add and subtract within 20 with automaticity.		10
	Add within 20	5	
	Subtract within 20	5	
2(4)(B)	Add up to four two-digit numbers and subtract two-digit numbers using mental strategies and algorithms based on knowledge of place value and properties of operations.		16
	Add up to four two-digit numbers	9	
	Subtract two-digit numbers	7	
		Total	30

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Project TIER
Computations Progress Monitoring System
Test Blueprint

Grade 3

Standard and subcomponents		Sub Items	Total Number of Items
3(4)(A)	Solve with fluency one-step and two-step problems involving addition and subtraction within 1,000 using strategies based on place value, properties of operations, and the relationship between addition and subtraction.		5
3(4)(F)	Recall facts to multiply up to 10 by 10 with automaticity and recall the corresponding division facts.		8
	Multiply up to 10 by 10	4	
	Recall the corresponding division facts	4	
3(4)(G)	Use strategies and algorithms, including the standard algorithm, to multiply a two-digit number by a one-digit number.		5
3(4)(K)	Solve one-step and two-step problems involving multiplication and division within 100 using strategies based on objects; pictorial models, including arrays, area models, and equal groups; properties of operations; or recall of facts.		7
3(5)(D)	Determine the unknown whole number in a multiplication or division equation relating three whole numbers when the unknown is either a missing factor or product.		5
		Total	30

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Project TIER
Computations Progress Monitoring System
Test Blueprint

Grade 4

Standard and subcomponents		Sub Items	Total Number of Items
4(4)(A)	Add and subtract whole numbers and decimals to the hundredths place using the standard algorithm.		8
	Add whole numbers and decimals	4	
	Subtract whole numbers and decimals	4	
4(4)(D)	Use strategies and algorithms, including the standard algorithm, to multiply up to a four-digit number by a one-digit number and to multiply a two-digit number by a two-digit number.		8
	Multiply up to a four-digit number by a one-digit number	5	
	Multiply a two-digit number by a two-digit number	3	
4(4)(F)	Use strategies and algorithms, including the standard algorithm, to divide up to a four-digit dividend by a one-digit divisor.		8
4(4)(H)	Solve with fluency one- and two-step problems involving multiplication and division, including interpreting remainders.		6
		Total	30

Project TIER

Computations Progress Monitoring System

Test Blueprint

Grade 5

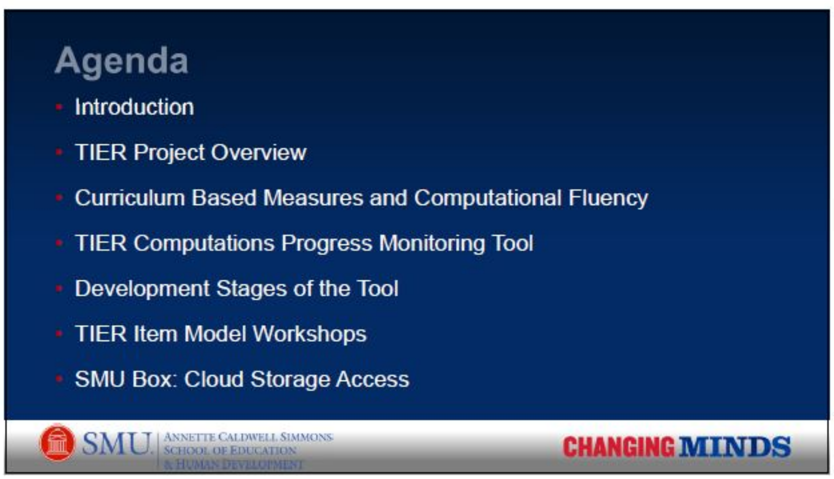
Standard and subcomponents		Sub Items	Total Number of Items
5(3)(B)	Multiply with fluency a three-digit number by a two-digit number using the standard algorithm.		5
5(3)(C)	Solve with proficiency for quotients of up to a four-digit dividend by a two-digit divisor using strategies and the standard algorithm.		5
5(3)(E)	Solve for products of decimals to the hundredths, including situations involving money, using strategies based on place-value understandings, properties of operations, and the relationship to the multiplication of whole numbers.		3
5(3)(G)	Solve for quotients of decimals to the hundredths, up to four-digit dividends and two-digit whole number divisors, using strategies and algorithms, including the standard algorithm.		3
5(3)(K)	Add and subtract positive rational numbers fluently.		10
	Add positive rational numbers	5	
	Subtract positive rational numbers	5	
5(3)(L)	Divide whole numbers by unit fractions and unit fractions by whole numbers.		4
	Divide whole numbers by unit fractions	2	
	Divide unit fractions by whole numbers	2	
		Total	30

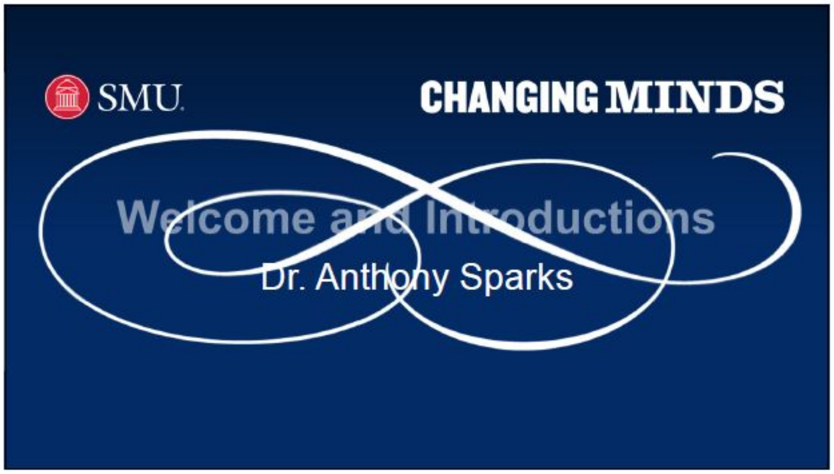
Project TIER
Computations Progress Monitoring System
Test Blueprint

Grade 6

Standard and subcomponents		Sub Items	Total Number of Items
6(3)(D)	Add, subtract, multiply, and divide integers fluently.		16
	Add integers	3	
	Subtract integers	3	
	Multiply integers	5	
	Divide integers	5	
6(3)(E)	Multiply and divide positive rational numbers fluently.		14
	Multiply positive rational numbers	7	
	Divide positive rational numbers	7	
		Total	30

Appendix B – Item Model Webinar

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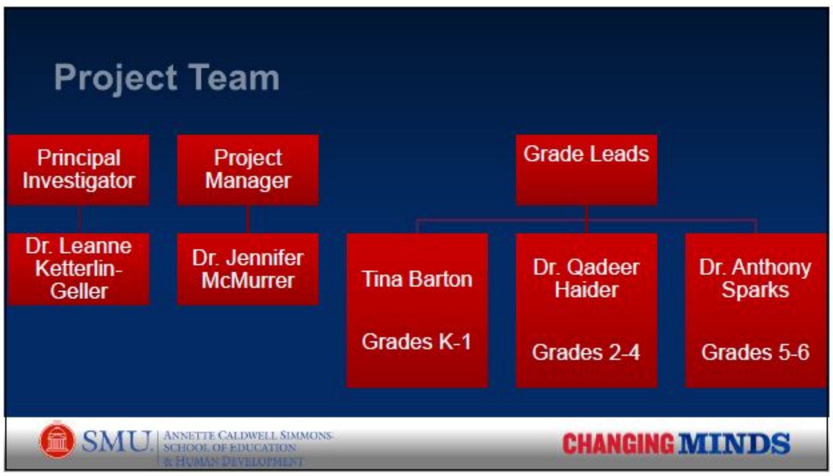
Welcome and Introductions
Dr. Anthony Sparks


Project Team
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Grades K-1
Dr. Qadeer Haider
Grades 2-4
Dr. Anthony Sparks
Grades 5-6
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SMU CHANGING MINDS

TIER Project Overview

TIER Project Overview

- Tiered Interventions using Evidence-based Research (TIER) is a project funded by the Texas Education Agency to the University of Texas at Austin.
  - Provides an integrated system to support the academic and behavioral needs of students
  - Uses assessment data to drive differentiated instruction for all students
  - Assists with identifying students in need of additional support
  - Provides students experiencing difficulty with additional evidence-based intervention support to reduce the widening of academic and behavioral skillset gaps
  - Promotes collaboration among teachers
  - Communicates student progress to caregivers

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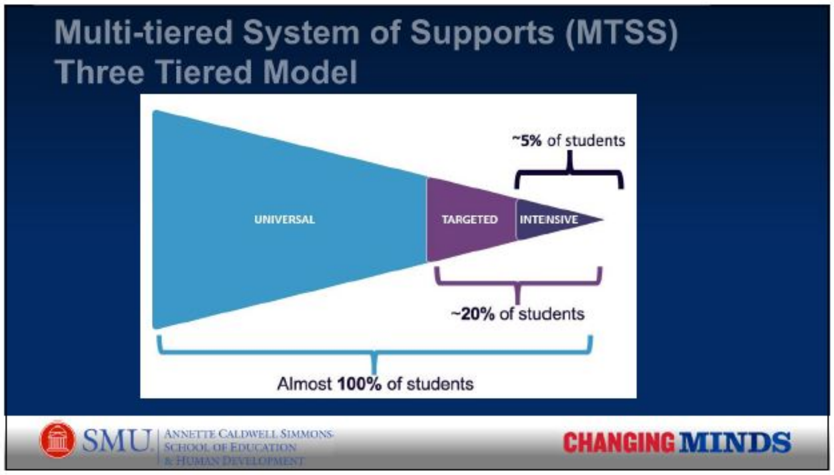
Multi-tiered System of Supports (MTSS)
Three Tiered Model
~5% of students
UNIVERSAL
TARGETED
INTENSIVE
~20% of students
Almost 100% of students
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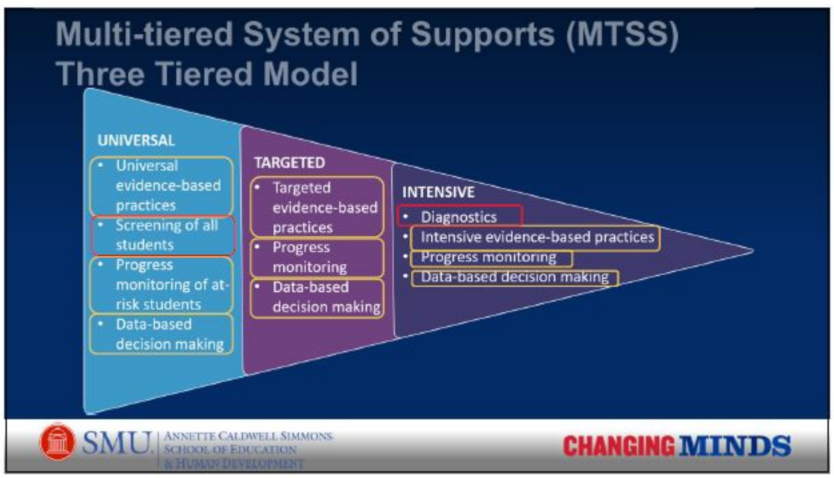
Multi-tiered System of Supports (MTSS)
Three Tiered Model
UNIVERSAL
• Universal evidence-based practices
• Screening of all students
• Progress monitoring of at-risk students
• Data-based decision making
TARGETED
• Targeted evidence-based practices
• Progress monitoring
• Data-based decision making
INTENSIVE
• Diagnostics
• Intensive evidence-based practices
• Progress monitoring
• Data-based decision making
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TIER Project Overview

- Three collaborators in this work
  - Texas Education Agency (TEA)
  - University of Texas (UT) @ Austin
  - Research in Math Education unit (RME)
- RME is working closely with UT to develop a small part of the TIER
  - Computations-based progress monitoring assessment system for grades K-6 for the TEA's TIER Initiative

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Curriculum Based Measurement & Computational Fluency

Curriculum Based Measures (CBM)

- Curriculum-based measurement (CBM)
- CBM of mathematics (CBM-M) instruments can be used to assess either computation or application skills of students
- The scope of this work
  - Computational Fluency (2-6)
  - Early Numeracy (K-1)

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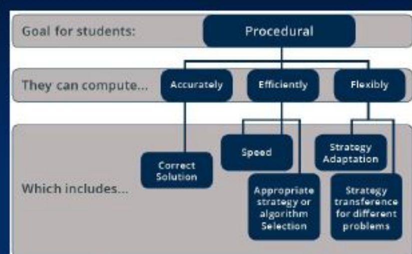
Procedural Fluency

- Procedural Fluency:
  - Efficiency
  - Accuracy
  - Flexibility
- Computational Fluency
  - Nested in Procedural fluency



Source: Bay-Williams, J. M., & Stokes Levine, A. (2017). The Role of Concepts and Procedures in Developing Fluency. In D. Spangler & J. Wanko (Eds.) *Enhancing Professional Practice with Research Behind Principles to Actions*. Reston, VA: NCTM.

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Computational Fluency

- Computational fluency means more than quickly producing correct answers
- Computational fluency requires conceptual understanding
- Computational fluency is exhibited through efficiency, accuracy, and flexibility.

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TIER Computations Progress Monitoring Tool

TIER Computations Progress Monitoring Tool

- Purpose of TIER Computations Progress Monitoring Tool
  - Provide teachers with timely data to monitor students' progress towards computational fluency with grade-level TEKS
- Comparable forms
  - Consist of different but comparable items that assess the same skill at a similar level of difficulty

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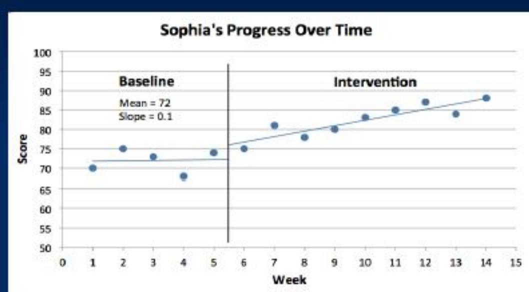
Purpose of TIER Progress Monitoring Tool



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Development Stages of the Tool

Development Stages of the Tool

- Test Blueprints (RME Team with UT and TEA)
- **Item Models** (Item Writers and RME Team)
- **Items development** (Items Writers and RME Team)
- Scoring Procedures and Administration (RME Team)
- Use Guide (RME Team)

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Development Stages of the Tool

- Item Models
  - Initial item models for each probe for each grade aligned with the test blueprints
    - 30 item models per grade (2-6)
    - Develop 20 parallel forms (aka cousin items) for each item model.
- Items Development
  - 20-30 items per model

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TIER Item Model Workshops

Item Design Workshop

- Practice developing item models
- How to design an item and its constraints
- Practice writing items to a set of constraints
- Verify items with a partner
- Review items with RME Staff

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Expectations for Item Design Workshop

- Have access to reliable internet
- Be free from distractions as much as possible
- Have space/place to create items
- Some writing materials (if you prefer)
  - Papers, markers etc.

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SMU CHANGING MINDS

SMU Box: Cloud Storage Access

SMU Box Storage Access

- You will use SMU's Box cloud storage to upload your work
- Please use above link to ensure access to Box before your workshop

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SMU Box Storage Access

- Action Item to access the box storage
  - Create a word file on your computer
    - Include your full name, email, phone number, and your institute (if applicable)
    - Save the word file with file name "Introduction_your Initials" (use three letters initials if applicable)
    - Upload the word file on the box using the link given on the previous slide. The link is also available in the video description below

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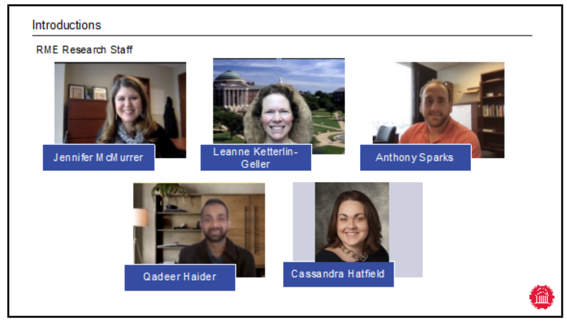
Thank you!

Questions?

Email us: rme@smu.edu

Appendix C – Item Model Workshop Presentations

1



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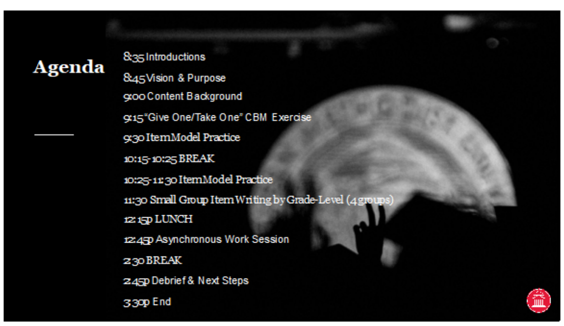

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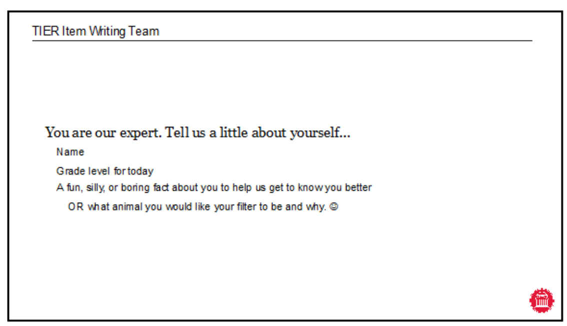

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Housekeeping

Objective

Generate 30-40 Item Models per grade based on early numeracy and computational fluency TEKS for Computational Progress Monitoring Assessments

6

Housekeeping

Group Norms

Communication

- Ask questions
- Share information
- Disagree/ask for more information
- Celebrate!

Collaboration

- Be mindful of others
- Be present
- Be flexible

7

Vision & Purpose

Dr. Leanne Ketterlin-Geller

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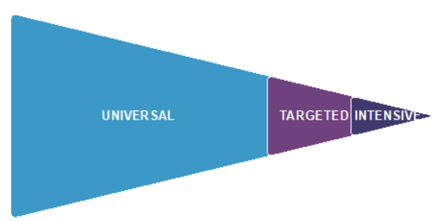
TIER Project MTSS Model



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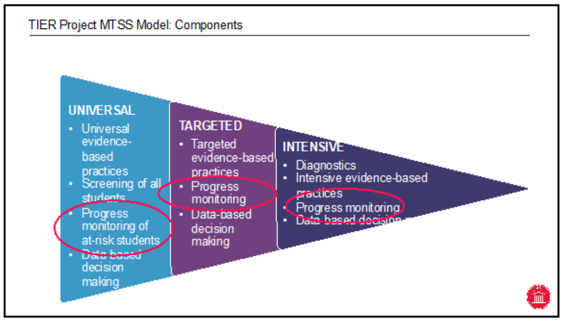

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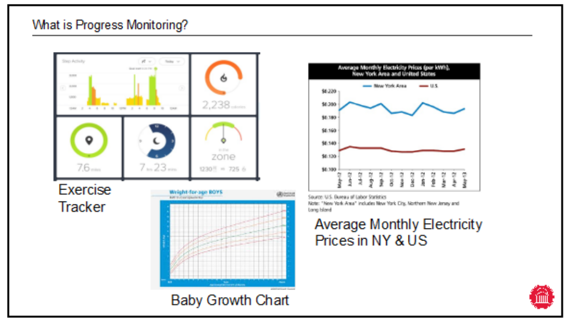

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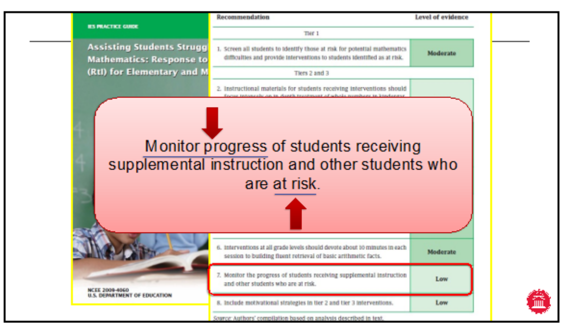

12

Decisions from Progress Monitoring Data

- Evaluate the rate of growth over time for students who are receiving interventions to determine:
  - If the student is making adequate progress
  - If the intervention is effectively meeting the student's need
- Administered frequently depending on intensity of intervention, at least monthly

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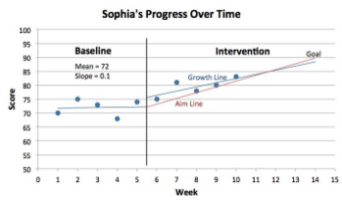
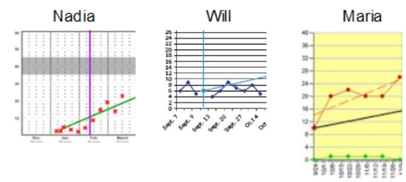
Steps in Progress Monitoring



14

How would you support these students?



15

Key Considerations of Progress Monitoring Measures

Technical Adequacy	Content
Efficiency of Administration	Timeliness for Making Decisions

= Curriculum Based Measures

16

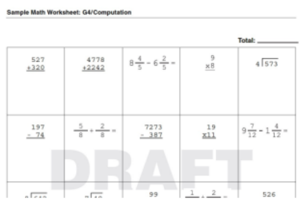
Small Group

"Give One/Take One" CBM Exercise

17

Curriculum Based Measures

- Let's give it a try
- Timed for 1 minute



18

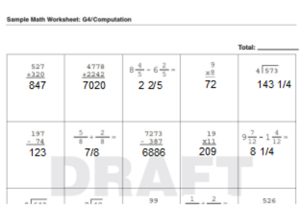
Reflections on Progress Monitoring and Curriculum Based Measures

- What were your thoughts as you took the test?
- What did you notice about the test that was related to the 4 key considerations of progress monitoring?
  - Technical adequacy
  - Content
  - Efficiency of administration
  - Timeliness for making decisions
- How might tests like this support the goals of progress monitoring?

19

Curriculum Based Measures

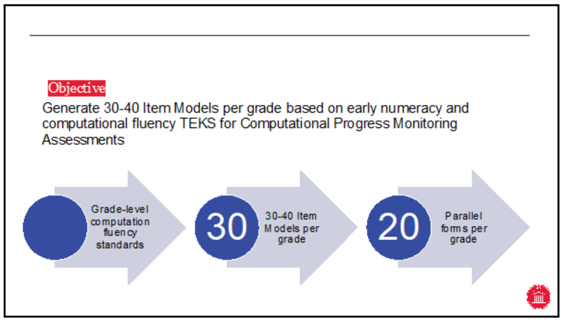
- Let's give it a try
- Timed for 1 minute



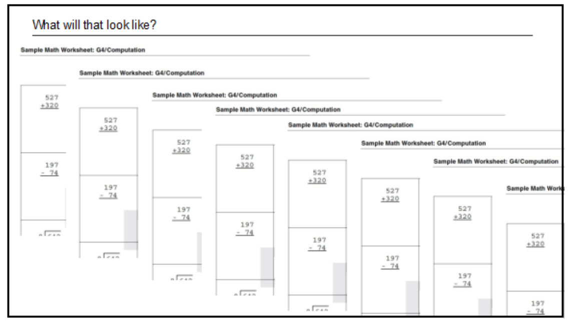
20

Whole Group

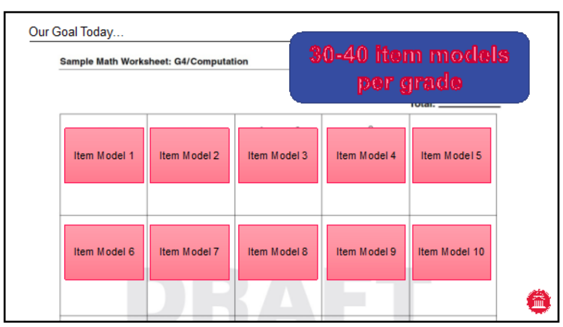
22


Objective
Generate 30-40 Item Models per grade based on early numeracy and computational fluency TEKS for Computational Progress Monitoring Assessments
Grade-level computation fluency standards
30
30-40 Item Models per grade
20
Parallel forms per grade

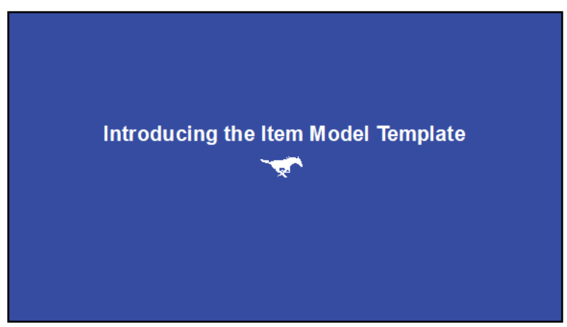
23


What will that look like?
Sample Math Worksheet: G4/Computation

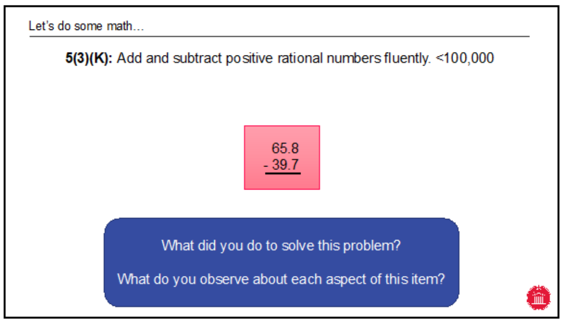
24


Our Goal Today…
Sample Math Worksheet: G4/Computation
30-40 item models per grade
Item Model 1
Item Model 2
Item Model 3
Item Model 4
Item Model 5
Item Model 6
Item Model 7
Item Model 8
Item Model 9
Item Model 10
DRAFT

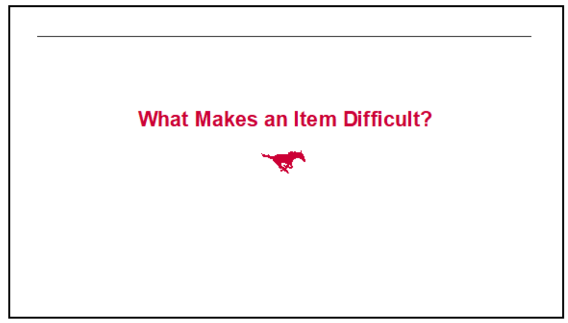
25


Introducing the Item Model Template

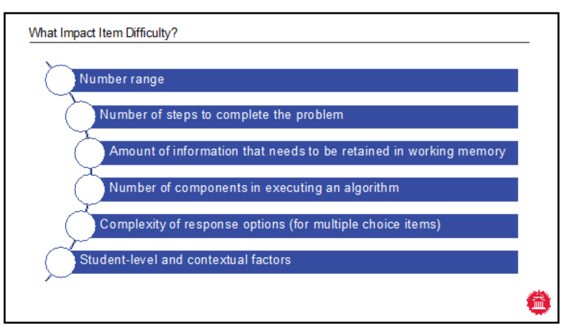
26


Let's do some math…
5(3)(K): Add and subtract positive rational numbers fluently. <100,000
65.8
- 39.7
What did you do to solve this problem?
What do you observe about each aspect of this item?

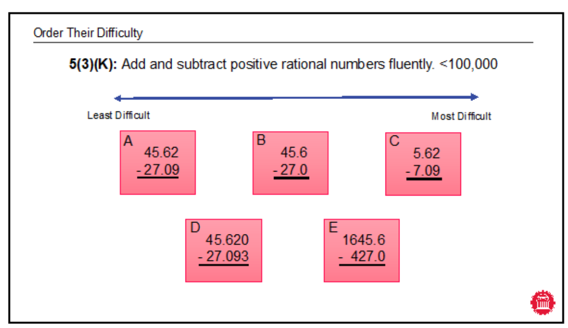
27


What Makes an Item Difficult?

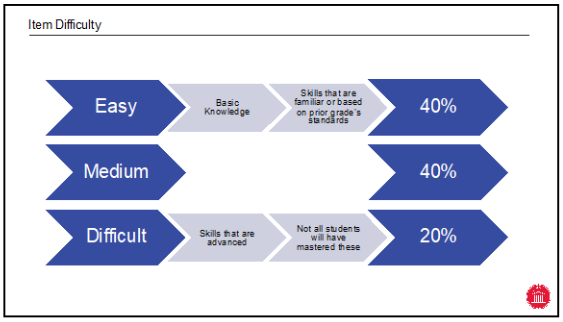
28


What Impact Item Difficulty?
Number range
Number of steps to complete the problem
Amount of information that needs to be retained in working memory
Number of components in executing an algorithm
Complexity of response options (for multiple choice items)
Student-level and contextual factors

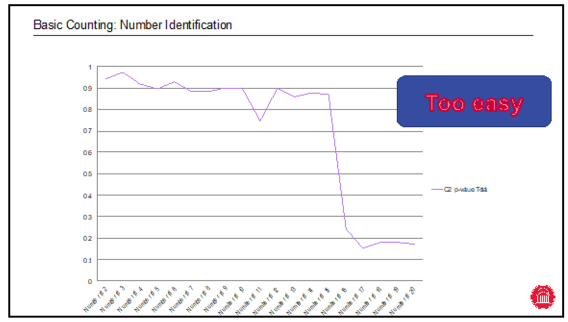
29


Order Their Difficulty
5(3)(K): Add and subtract positive rational numbers fluently. <100,000
Least Difficult
Most Difficult
A
45.62
- 27.09
B
45.6
- 27.0
C
5.62
- 7.09
D
45.620
- 27.093
E
1645.6
- 427.0

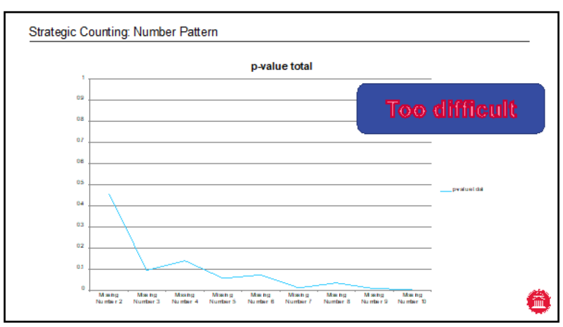
30


Item Difficulty
Easy
Basic Knowledge
Skills that are familiar or based on prior grade's standards
40%
Medium
40%
Difficult
Skills that are advanced
Not all students will have mastered these
20%

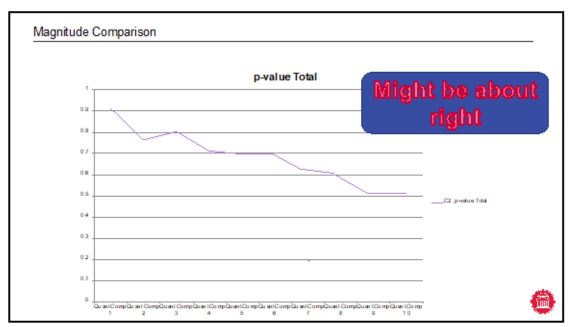
31


Basic Counting: Number Identification
Too easy

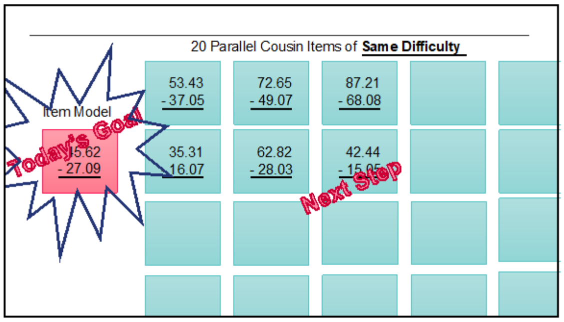
32


Strategic Counting: Number Pattern
p-value total
Too difficult

33


Magnitude Comparison
p-value Total
Might be about right

34


20 Parallel Cousin Items of Same Difficulty
Item Model
Today's Goal
Next Step
53.43
- 37.05
72.65
- 49.07
87.21
- 68.08
35.31
- 16.07
62.82
- 28.03
42.44
- 27.09

35


BREAK
Timer/Music

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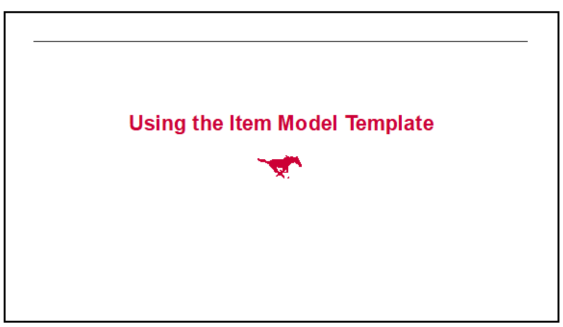
Using the Item Model Template

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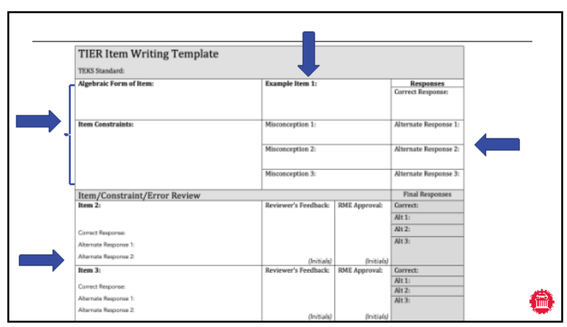
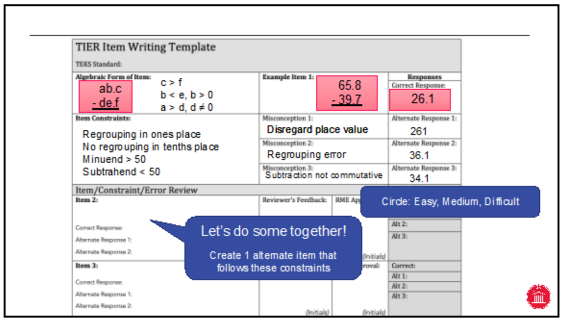
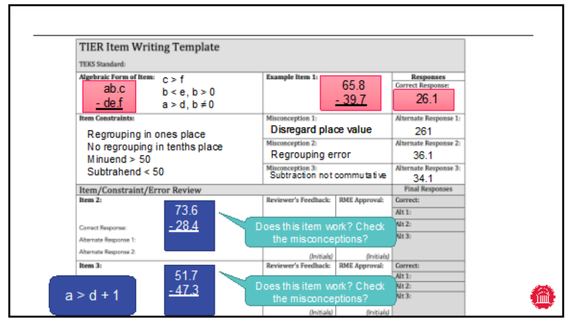

TIER Item Writing Template
TEKS Standard:
Algebraic Form of Item:
Example Item 1:
Responses
Correct Response:
Item Constraints:
Misconception 1:
Alternate Response 1:
Misconception 2:
Alternate Response 2:
Misconception 3:
Alternate Response 3:
Item/Constraint/Error Review
Final Responses
Item 2:
Reviewer's Feedback:
RME Approval:
Correct:
Alt 1:
Alt 2:
Alt 3:
Correct Response:
Alternate Response 1:
Alternate Response 2:
(Initials)
(Initials)
Item 3:
Reviewer's Feedback:
RME Approval:
Correct:
Alt 1:
Alt 2:
Alt 3:
Correct Response:
Alternate Response 1:
Alternate Response 2:
(Initials)
(Initials)

38



39



40

Take a look at your items…

- Let's review the items you wrote…
  - How do they align with these expectations?
  - Are there unique responses for each of the common misconceptions?
- When you're ready, we'll head back to the main room and send your items to Jennifer via private chat
  - Send the item, the correct response, and 3 alternate responses

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More About Errors and Alternate Responses

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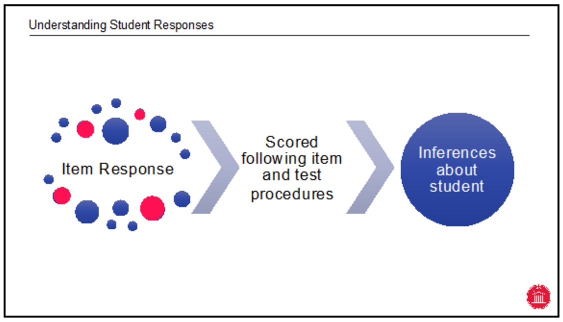
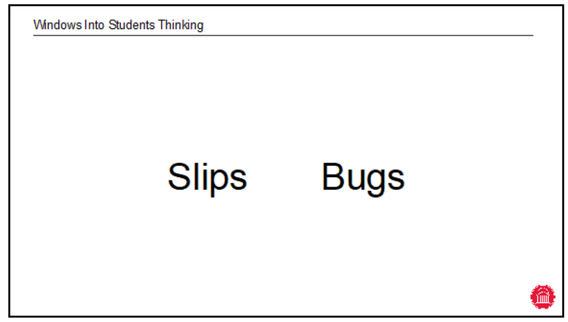
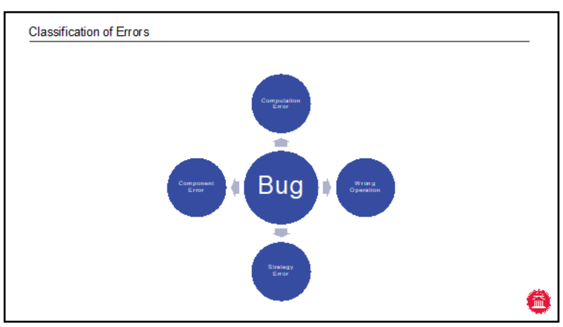

Understanding Student Responses
Item Response
Scored following item and test procedures
Inferences about student

45


Windows Into Students Thinking
Slips
Bugs

46


Classification of Errors
Computation Error
Component Error
Bug
Wrong Operation
Strategy Error

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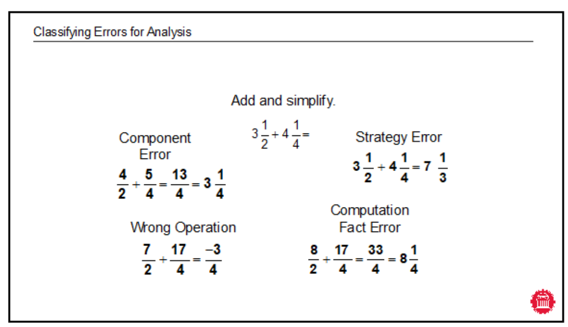
Classifying Errors for Analysis
Add and simplify.
$3\frac{1}{2} + 4\frac{1}{4} =$
Component Error
$\frac{4}{2} + \frac{5}{4} = \frac{13}{4} = 3\frac{1}{4}$
Strategy Error
$3\frac{1}{2} + 4\frac{1}{4} = 7\frac{1}{3}$
Wrong Operation
$\frac{7}{2} + \frac{17}{4} = \frac{-3}{4}$
Computation Fact Error
$\frac{8}{2} + \frac{17}{4} = \frac{33}{4} = 8\frac{1}{4}$

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What Errors?

Problem Number	Problem	Error
Problem 2	91 − 81 = 12	Analyzing these errors may provide insights into the student's understanding. The error appears to be associated with misapplication of the commutative property.
Problem 6	159 − 90 = 159	
Problem 7	406 − 215 = 211	

Objective

Generate 30-40 Item Models per grade based on computational fluency TEKS for Computational Progress Monitoring Assessments

Grade-level computation fluency standards

30 — 30-40 Item Models per grade

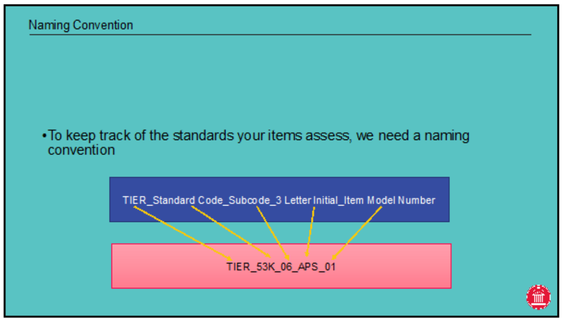
20 — Parallel forms per grade
- same difficulty

Assignments

2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Leanne + Jennifer	*Leanne + Jennifer*	*Qadeer*	*Cassandra*	*Anthony*

Group Work Session

- You will work in small groups synchronously and asynchronously
- Your facilitator will be available at all times to help answer your questions or prompt your thinking if you get stuck


Naming Convention
•To keep track of the standards your items assess, we need a naming convention
TIER_Standard Code_Subcode_3 Letter Initial_Item Model Number
TIER_53K_06_APS_01

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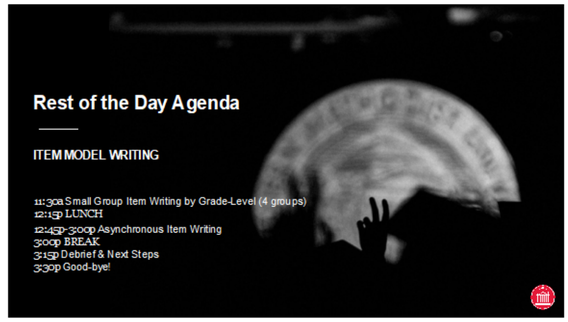
Rest of the Day Agenda
ITEM MODEL WRITING
11:30a Small Group Item Writing by Grade-Level (4 groups)
12:15p LUNCH
12:45p-3:00p Asynchronous Item Writing
3:00p BREAK
3:15p Debrief & Next Steps
3:30p Good-bye!

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Questions?

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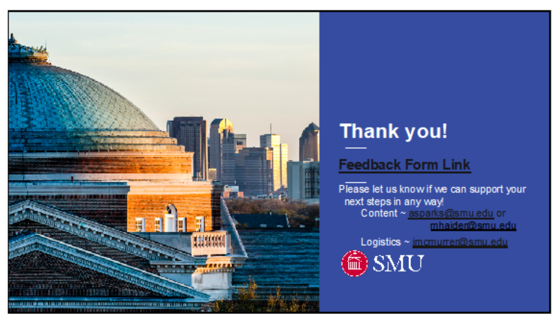
Thank you!
Feedback Form Link
Please let us know if we can support your next steps in any way!
Content ~ asparks@smu.edu or mhaiden@smu.edu
Logistics ~ jmcmurren@smu.edu
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