Imagination Station (Istation): Universal Screener Instrument Development for Algebra 1

Abstract

In this technical report, we describe the development of an item bank for the Algebra 1 Universal Screener for Imagination Station (Istation). The formative assessment item bank will be used to deliver a computer-

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Construct Definition

The test blueprint defines both mathematics content and levels of cognitive engagement, or independent strands promoting mathematical proficiency, (National Research Council [NRC], 2001) elicited by each item in the ALG1-

Item Writing

Item Specifications

holds a Master's degree in Mathematics Education, a Bachelor's degree in Education and Social Policy, and also holds an ESL Endorsement. She has 12 years of experience at the middle and high school level, and is currently working as a high school teacher.

hold's a Master's degree in Mathematics Education and Bachelor's degree in Mathematics.

In developing the ALG1-IB, item writers were trained on the importance of using a universal screener as part of an RtI process to identify whether or not students need additional support in Algebra 1. The data resulting from the screener is designed to assist teachers in identifying the level of targeted instructional support, and must be reliable, valid, and fair. In order to ensure the items within the ALG1-IB meet these criteria, item writers were trained on the critical elements of universal design and universal design for assessment. Item writers were encouraged to write items that allow students to better access the intended constructs in the assessment without bias, through the lens of the cognitive engagement component.

The second training consisted of these topics:

- the SMU Honor Code for writing original items;
- the RME Style Guide; and
- guidelines for writing selected response items.

During this training, item writers were asked to develop original items and refrain from repurposing any work previously developed. The training included information about the RME internal review process, which included items being submitted through a plagiarism prevention service to ensure originality. Item writers received training focused on the ability to construct multiple-choice items in alignment with the elements of universal design, and appropriate distractors that address the misconceptions and procedural errors common to students in Algebra 1.

Item writers continued to receive training from RME subject matter experts throughout the duration of the project to ensure the expectations for writing were being met. RME subject matter experts were able to provide one-on-one virtual training over the levels of cognitive engagement, and established weekly communication with each item writer to provide coaching on how to develop appropriate items.

Item Writing Process

After completing the training and attending a project conference call, item writers were given the item writing template to create items. Upon completion of the items, items were submitted to RME project staff for review. An assigned staff reviewer provided feedback for each item. Reviewers evaluated items for:

- mathematical accuracy,
- alignment with the content standards,
- age-appropriateness of language and graphics for students in Grade 8, and
- compliance with universal design principles.

Reviewer comments were returned to the item writers to revise and resubmit the item for approval. All finalized items were cross-referenced to the test blueprint to ensure a corresponding item represented each content standard and the specified levels of cognitive engagement.

Once items written by the item writers were reviewed and accepted, item level information was entered into an Item Database. The Istation graphic design team created all graphics. The finalized items with graphics were reviewed for grammatical errors as well as visual spacing and alignment within the interface by RME project staff and Istation staff. outlines the item writing process.

Content-Related Evidence for Validity

The finalized items in the ALG1-IB were reviewed by mathematics teacher educators and high school mathematics teachers or content specialists. Each reviewer was required to evaluate and rate all items across several key criteria to ensure the appropriateness and accuracy of the content in the ALG1-IB.

Mathematics Teacher Educator Reviewer Biographies

Five mathematics teacher educators reviewed the items in the ALG1-IB. The mathematics teacher educators were selected based on current research and teaching in mathematics or mathematics education at the university level.

holds a Master's degree in Mathematics and a Bachelor's degree in Mathematics. He has seven years of experience working in education. He is currently a research assistant and doctoral student, but also has over four years of experience teaching at the college level.

holds a Doctoral degree in Mathematics Education, a Master's degree in Mathematics, and a Bachelor's degree in Mathematics. She has nine years of experience teaching undergraduate mathematics courses in Elementary College Mathematics, Calculus I, II, III, and Introduction to Combinatorial Analysis.

holds a Doctoral degree in Curriculum and Instruction with an emphasis on Mathematics Education, a Master's degree in Curriculum and Instruction, a

reviewers were used to further refine the existing items for consistency (e.g., language, standards alignment, etc.).

The items received ratings above 85% in each criterion evaluated by the reviewers. In addition, 89% of the items included the correct response, 93% were assigned the correct level of cognitive response, and 94.6% were found to align with the designated standard. Items that were designated for priority review and comments from the reviewers on all items prompted further revisions. See Table 2 for full results from mathematics education expert review.

Mathematics Teacher Reviewer Biographies

Four mathematics teachers reviewed the items in the ALG1-IB. The high school mathematics teachers and content specialists selected as external reviewers are state-certified educators who are experts in their knowledge of middle and high school mathematics content, particularly Algebra 1.

holds a Master's degree in Educational Administration and a Bachelor's degree in Chemical Engineering. She has experience as a math teacher, instructional coach, and a math methods teacher. She currently works as a graduate research assistant, an instructional specialist, and an adjunct instructor.

holds Master's degree in Industrial and Organizational Psychology and a Bachelor's degree in Secondary Mathematics Education. She has nineteen years experience in education and is currently a mathematics department chair, instructional coach, and Algebra 1 teacher.

holds a Master's degree in Secondary Education with an emphasis in Mathematics Education and a Bachelor's degree in Computer Science with a minor in German. She has experience as a mathematics teacher and as an instructional mathematics coach.

holds a Doctoral degree in Education, Curriculum, and Instruction and Master's degree in Mathematics. She has 21 years experience as a math teacher and high school math instructional specialist. She is currently a secondary mathematics coordinator.

Mathematics Teacher Review

The mathematics teachers were each required to review approximately 200 items and evaluate the (a) appropriateness of language, (b) appropriateness of mathematical vocabulary, (c) appropriateness of visual representations, and (d) language bias. The mathematics teachers were also required to verify the correct response option. The criteria used for item evaluation were as follows:

- : Is the language used in the item appropriate for students in grades 8, 9 and 10? Are the question and response options written in a clear manner?

Conclusion

The purpose of this technical report

Table 2

Mathematics Education Expert Review Ratings

Table 3

Mathematics Teacher Review Ratings

Overall Language		80%	14.6%	4%	1.4%

Appendix A – State Content Standards Referent Sources

The Texas Essential Knowledge and Skills (adoption 2012) were retrieved from: http://ritter.tea.state.tx.us/rules/tac/chapter111/index.html

The Common Core Standards in Mathematics were retrieved on September 15, 2015 from http://www.corestandards.org/Math/. These standards were published in 2010. They were developed as part of an initiative led by the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO).

Virginia's Standards for Learning Document for Mathematics (adopted 2009 for full implementation in 2011-2012) were retrieved from http://www.doe.virginia.gov/testing/sol/standards_docs/mathematics/

Determine the slope of a line given an equation written in the form
$! \; ! \quad m(\quad !_{|})$

Calculate the rate of change of a linear function represented tabularly in context of mathematical problems.

Calculate the rate of change of a linear function represented graphically in context of mathematical problems.

Calculate the rate of change of a linear function represented algebraically in context of mathematical problems.

Calculate the rate of change of a linear function represented tabularly in context of real-world problems.

Calculate the rate of change of a linear function represented graphically in context of real-world problems.

Calculate the rate of change of a linear function represented algebraically in context of real-world problems.

Graph linear functions on the coordinate plane and identify slope in real-world problems.

Graph linear functions on the coordinate plane and identify slope in mathematical problems.

Graph linear functions on the coordinate plane and identify the -intercept in mathematical problems.

Graph linear functions on the coordinate plane and identify the -intercept in real-world problems.

Graph linear functions on the coordinate plane and identify the -intercept in real-world problems.

Graph linear functions on the coordinate plane and identify the -intercept in mathematical problems.

Graph linear functions on the coordinate plane and identify zeros in mathematical problems.

Determine the effects on the graph of the parent function !( ) !!when is replaced by !!!! ! for specific values of .

Determine the effects on the graph of the parent function when is replaced by !" for specific values of .

Determine the effects on the graph of the parent function when is replaced by !!! for specific values of .

Determine uncermine

Solve systems of two linear equations with two variables for real-world problems.

Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line ! ! ! ! and the circle ! ! ! ! !

Strand 2: Quadratic Functions and Equations

Determine the domain of quadratic functions.

Determine the range of quadratic functions.

Represent the domain of quadratic functions using inequalities.

Represent the range of quadratic functions using inequalities.

Write equations of quadratic functions given the vertex and another point on the graph.

Write equations of quadratic functions in vertex form *f*

Interpret the meaning of the values of in exponential functions of the form !( ) !

Strand 4: Number and Algebraic Methods

Interpret parts of an expression, such as terms, factors, and coefficients.

Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret ! ! ! ! as the product of and a factor not depending on !.

Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is

Strand 5: Building Functions

Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Solve an equation of the form `!(!)!` for a simple function f that has an invers

Appendix C – RME Subject Matter Experts Biographies