PROJECT AAIMS: ALGEBRA ASSESSMENT AND INSTRUCTION – MEETING STANDARDS

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Effects of Teachers' Engagement with Student Data on Students' Algebra Progress

Technical Report 16

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ABSTRACT

Introduction

Previous work in Project AAIMS has established the reliability and criterion validity of two measures (Basic Skills and Content-Analysis-Multiple Choice) for monitoring student progress in algebra. In Technical Reports 10, 12, 13, and 14 we reported the technical features of the measures when used for static measurement of student performance. We found that these two measures possess acceptable levels of alternate form reliabilities and moderate levels of criterion validity. Technical Reports 12, 13, and 14 also reported examinations of students' growth over time on the measures, with the Content Analysis-Multiple Choice probes more sensitive to change than the Basic Skills probes. In the study reported in Technical Report 15 (Foegen, & Olson, 2007) two levels of teachers' access to student data were contrasted with respect to their association with differential outcomes for students. In the current study, we conducted an additional replication of the technical features of the measures. We also conducted a modified study of teachers' use of student performance data, contrasting higher and lower rates of engagement with students' data and examining whether these varying levels had any effect on student achievement.

Method

The study described in this report was conducted from January 2007 to May 2007 in Districts A and B. District A serves four small towns as well as the rural agricultural areas between the towns. Approximately 7,000 residents reside in the school district. During the 2006-07 academic year, the junior/senior high school had an enrollment of approximately 670 students; approximately 12 percent of these students received special education services. Eighteen percent of the district's students were eligible for free and reduced lunch; three percent were of diverse backgrounds in terms of race, culture and ethnicity. No students in District A were reported as English Language Learners in 2006-07. District B is located in a community of 26,000 people; the high school (grades 9-12) enrolled nearly 1,300 students during the 2006-07 school year. Forty-seven percent of the district's students were eligible for free and reduced lunch; 18% were of diverse backgrounds with regard to race, culture, and ethnicity. Approximately 15% of District B's students received special education services. In both districts, all data collection activities involving students were completed during regular class time. Teachers administered all algebra probes.

Participants

Student Participants. One hundred sixty-four students participated in the study, 93 from District A and 71 from District B. Written parental/guardian consent and written student assent were obtained for all of these students using procedures approved by Iowa State University's Human Subjects Review Committee. Students were only included in the data analysis if they had a minimum of four data points for each type of probe administered by their teachers. Descriptions of the participating students are provided in Table 1. Readers should note that demographic data were not available for 6 students in District B who dropped their algebra course before the end of the school year. In addition, no data were available from District B regarding the free/reduced lunch status of students participating in the study. In past years, this percentage has been approximately 33% of the study participants.

Table 1. Demographic Characteristics of Student Participants by Grade Level

	District A					District B				Total N	Total %
	8	9	10	11	12	9	10	11	12		
Gender											
Male	9	27	4	1	2	23	7	4	1	78	49
Female	13	28	9	0	0	20	10	0	0	80	51
Ethnicity											
White	22	52	13	1	2	37	14	2	0	143	91
Black	0	1	0	0	0	5	2	0	0	8	5
Hispanic	0	1	0	0	0	1	1	2	0	5	3
Asian	0	1	0	0	0	0	0	0	0	1	<1
Indian	0	0	0	0	0	0	0	0	1	1	<1
Lunch											
Free/Red	3	11	4	0	0	--	--	--	--	--	--
ESL	0	0	0	0	0	0	0	1	0	1	<1
Disability	0	7	7	0	0	4	5	1	0	24	15

Note. Calculation of the total column was based on the 158 participants for whom demographic data were available.

As the data in Table 1 indicate, a large majority of the participants (91%) were white and 62% were in ninth grade, the traditional grade in which students in these districts complete algebra. Fifteen of the participating students were identified as having disabilities and receiving special education services.

The students participating in the study were enrolled in one of four types of algebra classes. A total of 97 students were participating in a traditional Algebra 1 course taught using a conventional time frame (one year for schools such as District A with 45 minute periods, and one half year for school such as District B, using block scheduling with 90 minute periods). Of these, 22 were 8th grade students in District A completing a high school algebra course; these students, who comprised a single class, were identified as advanced in mathematics within their district. The remaining 43 students were enrolled in one of six different sections of Algebra 1. Two of these sections were taught by a teacher in District B; the remaining four sections were in District A. Fifteen students were enrolled in one of three sections of Algebra 1A. This course spans the same amount of time as Algebra 1, but covers only the first half of the traditional Algebra 1 content. The intent is to provide additional time for mastering algebra content and skills for students who may require this alternative. Forty-three students were enrolled in one of four sections of Algebra 1B, the companion course to Algebra 1A that addresses algebra content typically taught in the second half of a traditional Algebra 1 course. Readers should note that in District A, the courses previously titled Algebra 1A and Algebra 1B were renamed “Pre-Algebra” and “Basic Algebra” for the 2006-07 academic year. For consistency across districts and with previous Project AAIMS technical reports, we have opted to maintain the Algebra 1A and 1B language in this report.

Across all participants, the average national percentile rank scores on the Iowa Tests of Educational Development were 49.9 on the Concepts/Problem Solving Subtest and 46.5 on the Computation Subtest. For the 22 8th grade students enrolled in Algebra I, the mean scores on the Iowa Tests of Basic Skills were 91.4, 84.8, and 89.0 on the Concepts/Estimation and Problems/Data subtests and the Mathematics Total scores, respectively. Readers should note that the 8th grade students were considered advanced students in mathematics.

Additional Information on Students with Disabilities. Because the applicability of the algebra probes to students with disabilities is an important part of Project AAIMS, additional information about the 24 students with disabilities participating in the project is provided in Table 2.

Table 2. Descriptive Information on the Programs of Students with Disabilities

Characteristic	Quantification
Disability category	24 Entitled Individual (EI)
% time in general education	Range = 76 – 100%; Mean = 93%
# of students with math goals	11
# of students receiving math instruction in general education classes	100

In algebra, students with disabilities earned mean grades of 1.60 [D+] (range 0.00 [F] to 4.00 [A]). In Districts A and B, the Iowa Tests of Educational Development are used as a district-wide assessment for students in grades 9-12. On average, students with disabilities obtained national percentile rank scores of 31.7 and 30.1 in Concepts/Problem Solving and Computation, respectively. The 8th grade students in District A were assessed with the Iowa Tests of Basic Skills, but none of these students had been identified as having disabilities.

Teacher Participants. Two general education teachers and one special education teacher from District A and three general education teachers and two special education teachers from District B were the primary teacher participants in the study. These teachers administered the algebra progress monitoring measures and were responsible for designing and delivering instruction on a daily basis in their classes. All teachers were teaching or co-teaching general education classes in algebra and participated in the data conferences (described later) to review student performance.

The two general education teachers from District A held standard Iowa teacher's licenses with 7-12 Mathematics endorsements. One of these teachers had five years of teaching experience with three years of experience teaching algebra classes. This teacher had earned a Bachelor's degree and had completed some graduate work. The second general education teacher had completed a Master's degree program and had six years of teaching experience with four years of that experience teaching algebra. The special education teacher held an initial Iowa teacher's license with a K-6 Elementary Teacher and a K-6 special education endorsement and had earned a Bachelor's degree and completed some graduate work. She had one year of experience that included teaching algebra.

All of the teachers from District B held standard Iowa teacher's licenses. All of the general education teachers had 7-12 Mathematics endorsements. The special education teachers had 7-12 special education endorsements. Two of the general education teachers had two years of experience that included teaching algebra. One of these teachers had earned a Master's degree, while the other had earned a Bachelor's degree. The third general education teacher had 18 years of teaching experience with nine of those years teaching algebra. This teacher held a Bachelor's degree. One of the special education teachers had 15 years of experience and had earned a Master's degree and completed additional graduate work. The other special education teacher had two years of experience and had earned a Bachelor's degree and completed some graduate work.

Measures

Algebra Progress Monitoring Measures. Two algebra measures were examined in this study; sample copies of each are provided in the Appendix. The following paragraphs summarize the characteristics of each of the two types of measures.

Probe A: Basic Skills Measure

The *Basic Skills* measure is designed to assess the 'tool skills' that students need to be proficient in algebra. Just as elementary students' proficiency with basic facts is associated with their ease in solving more complex problems, we hypothesize that there are some basic skills in algebra that serve as indicators of overall proficiency. In our discussions with teachers, they frequently commented that many students had difficulty with integers and with applying the distributive property. The items included in the *Basic Skills* measure address solving simple equations, applying the distributive property, working with integers, combining like terms and applying proportional reasoning. The *Basic Skills* probe includes many skills one would assume that students proficient in algebra would be able to complete with reasonable levels of automaticity. Students have five minutes to work on this probe; 12 parallel forms were used in the study. Each *Basic Skills* probe consists of 60 items; each item is scored as one point if it is answered correctly.

Probe E: Content Analysis-Multiple Choice Measure

The *Content Analysis-Multiple Choice* measure consists of 16 items that correspond to the first eight chapters in the textbook that is used in the district. Problems are placed in random order on each probe. Students are directed to circle the correct response from four alternatives and to show their work unless they are confident they can solve the problems mentally. Twelve parallel forms of the measure were used in this study. Students have seven minutes to work on the Content Analysis-Multiple Choice probes. Scoring for the *Content Analysis-Multiple Choice* probes is done by comparing student responses to a rubric-based key created by the research staff. Each of the 16 problems is worth up to three points. Students earn full credit (three points) by circling the correct answer from among the four alternatives. If students circle an incorrect response and do not show any work, their answer is considered a 'guess;' the total number of guesses is recorded for each probe. In cases where students show work, the scorer compares the student's work to the rubric-based key, and determines whether the student has earned 0, 1, or 2 points of partial credit. The number of points earned across all 16 problems and the number of guesses are recorded and entered in the data files. A final score is computed by subtracting the number of guesses from the total number of points earned on the probe.

Criterion Measures. In order to replicate previous criterion validity analyses involving the algebra progress monitoring measures, we gathered data on a variety of other indicators of students' proficiency in algebra. Some of these measures were based on students' performance. Other measures reflected students' performance on standardized assessment instruments. The classroom-based measures included grade-based measures and teacher ratings. Each student's *algebra grade*, the grade s/he earned in algebra for the yearlong algebra course, was recorded using a four-point scale (i.e., A = 4.0, B = 3.0).

Student performance on standardized, norm-referenced assessments was evaluated using school records and with an algebra instrument administered as part of the project. In District A, students complete either the *Iowa Tests of Educational Development* (ITED) or the *Iowa Tests of Basic Skills* (ITBS) each year, depending on their grade level. Students in grades 9 to 12 complete the ITED, while students in grade 8 take the ITBS. District records were used to access students' scores on these instruments; national percentile ranks were used for the analyses. We recorded the Concepts/Problems subtest score (which was identical to the Math Total score) and the Computation subtest score for the ITED and the Math Total score for the ITBS.

Growth Measure. We also sought to replicate previous findings related to students' growth on the measures over time. The growth measure in this study, which we called *probe slope*, reflects the growth that students showed on both types of probes over the semester. We used ordinary least square regression to calculate each student's slope on each measure. The obtained slope values were calculated to reflect the amount of weekly progress a student demonstrated on a probe type. Only students having at least four probe scores over the semester are included in this section of the study. If two probes were given within the same week, they were treated as given in the subsequent weeks. For example, if two probes (e.g. E-2, E-3) were given in the same week 7, E-2 probe was considered to given in week 7 and E-3 in week 8. We opted to use each individual data point, rather than to average the scores and use only the mean because of the frequency with which the data were being collected. In addition, a graphing template used by the teachers was designed to record weekly data points.

Procedures

Project AAIMS research staff visited each class at the beginning of the school year (District A) or semester (District B) to present information about the study and gather informed consent. Students completed student assent forms during class and were given parent consent forms to take home. Teachers offered extra credit to students for returning signed consent forms (regardless of whether parents provided or withheld consent). Teachers administered four probes each month. Some teachers (primarily those in District B) opted to administer one measure each week to their students. In District A, the school schedule included approximately two days of early dismissal each month for staff development purposes. Teachers in District A preferred to use the shortened class periods on these days as opportunities to administer two forms of the same type of progress monitoring measure.

Teachers were allowed to choose which measure(s) to administer to their students. In addition to the *Basic Skills* and *Content Analysis-Multiple Choice* measures, teachers also had the option to select the *Algebra Foundations*, though none did. The most frequently selected measure was the *Content Analysis-Multiple Choice* measure. Table 3 shows the types of courses taught by each of the participating teachers, as well as the measures they chose to administer to their students.

Teachers 2 and 3 in District A planned from the beginning to alternate their use of the *Basic Skills* and *Content Analysis-Multiple Choice* measures. They expressed concerns that the students in their co-taught class, many of whom struggled to be successful in mathematics, might find the content of the *Content Analysis-Multiple Choice* measure to be overwhelming at the beginning of the algebra course. They balanced this concern by alternating between the two measures, administered two forms of each once each month. Teacher 2 in District B drew from her experiences in the fall term (noted in Technical Report 15) and began the semester administering the *Basic Skills* measure. At the mid-point of the semester, she switched to administering the *Content Analysis-Multiple Choice* measure.

<u>Contrast Conditions</u>. The primary purpose of this research was to examine the effects of teachers' engagement with student progress data on rates of student growth. Our previous pilot study in the fall semester of the 2006-07 academic year helped us

Table 3. Course Type and Probes Administered, by Teacher

District	Teacher(s)	Period/Block	Course Type	Probe(s)	Administration Schedule
A	1	2	Algebra 1	CA-MC	2 probes,
		3	Algebra 1	CA-MC	twice monthly
		4	8th grade Algebra 1	CA-MC	
		6	Algebra 1	CA-MC	
		7	Algebra 1	CA-MC	
A	2, 3	5	Algebra 1A	BS, CA-MC	2 probes,
		6	Algebra 1B	BS, CA-MC	twice monthly
		7	Algebra 1A	BS, CA-MC	
B	1	1	Algebra 1B	CA-MC	1 probe
		3	Algebra 1B	CA-MC	weekly
B	2	2	Algebra 1B	CA-MC, BS	1 probe
		4	Algebra 1A	CA-MC, BS	weekly
B	3	3	Algebra 1	CA-MC	1 probe
		4	Algebra 1	CA-MC	weekly

Note. CA-MC = *Content Analysis-Multiple Choice*, BS= *Basic Skills*

better understand the importance of teachers having more regular and immediate access to student progress monitoring data. In the present study, we sought to explore the effects of two varying levels of engagement with student data, a High Engagement (treatment) condition, and a Low Engagement (comparison) condition, both of which are described further below. We selected one of each teacher’s class periods and randomly assigned it to the treatment condition and the others to the comparison condition. Table 4 shows the assignment of class periods by teacher to each condition.

Table 4. Assignment to Treatment Conditions

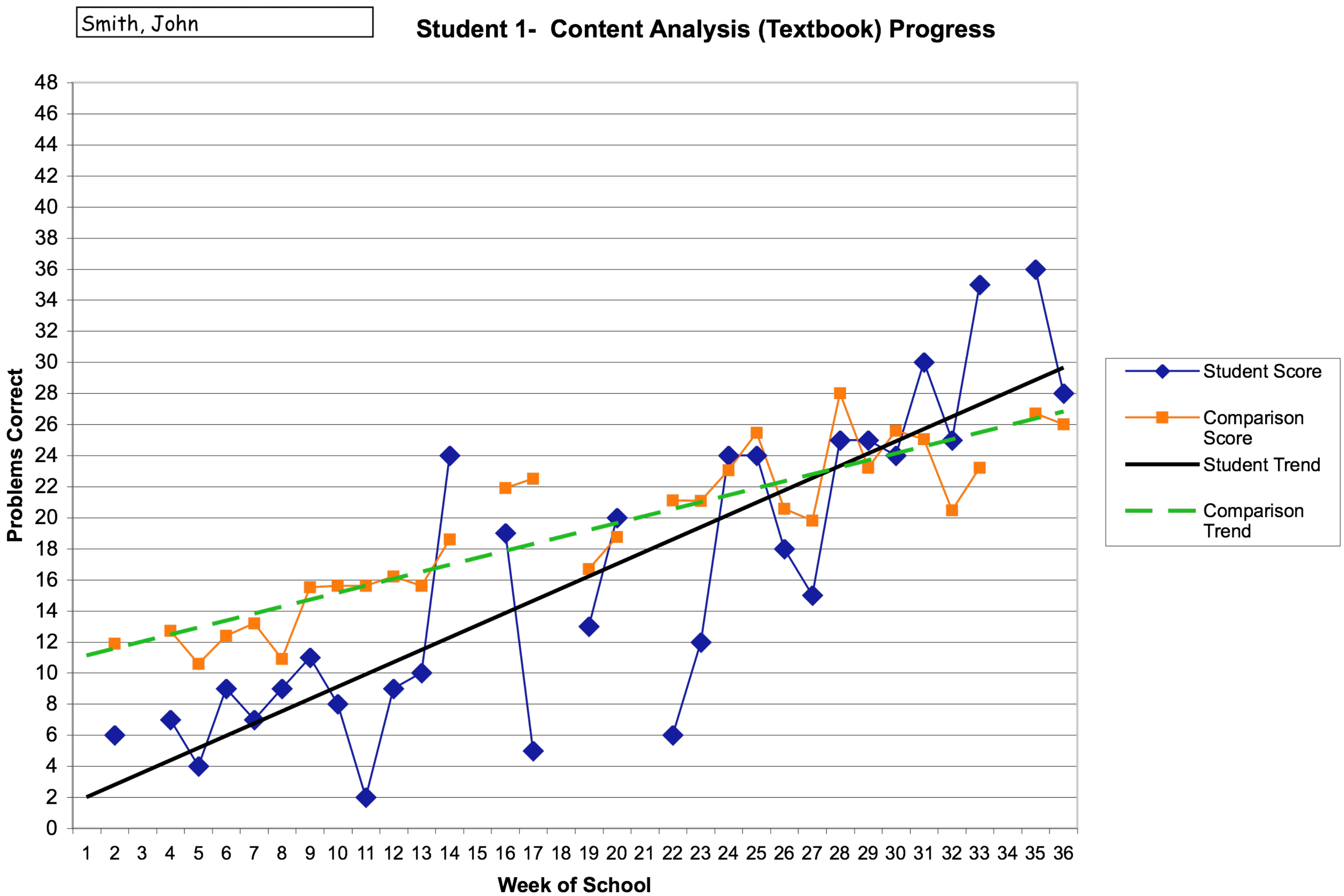
District	Teacher	High Engagement (Treatment)	Low Engagement (Comparison)
A	1	2	6
	2 & 3	5	7
B	1	3	1
	3	4	3

Students in all classes completed four algebra progress monitoring probes each month, following the schedule reported in Table 3. Classroom teachers administered the measures to all classes. Prior to the start of the semester, we provided participating teachers with training in the scoring of both types of measures that had been selected for use this semester. In the High Engagement condition, teachers completed the scoring and data entry for all students. They were also asked to share students' data with them (by either printing out individual graphs or showing students their graphs on the computer) on a regular basis (no less than every other week). Teachers returned the scored graphs for the High Engagement class, along with the unscored data for the Low Engagement classes to project staff, who completed the scoring for the remaining classes and then entered the data for the High Engagement classes into an error analysis summary spreadsheet. As in the previous semester, either the lead researcher or the project coordinator met individually with the teachers monthly for a "Data Conference." During this meeting, we asked teachers to comment on the performance of their students in the High Engagement classes. We also shared the error analysis summary with them for the High Engagement class, though they reported that this information was often redundant now that they were doing their own scoring of the measures. At this meeting, we also shared with the teachers a set of graphing templates containing the data for their Low Engagement classes.

The graphing template used in the project consisted of an Excel spreadsheet showing each student's score on each probe, along with individual graphs (structured as tabs across the bottom of the spreadsheet) for each student. The graphs had a line with the student's data with a trendline imposed on it, along with a second line of comparison data representing the average score on the same probe for all students in the same district enrolled in the same class type (i.e., for students in Algebra 1 this line represented the mean for all students in the same district in Algebra 1). As with the individual student's data, the comparison data line also had a trendline imposed. For the present study, we emailed teachers the scores to enter in the comparison data once we had received High Engagement scores for all teachers in the district. A sample graph, showing a full year's worth of data, is depicted in Figure 1.

The error analysis summaries provided a listing of the different types of items included in each measure, along with the percentage of students obtaining the correct answer, partial credit or incorrect answers, and the percentage who left the item blank. For the *Content Analysis-Multiple Choice* measure, the student performance data were broken down to show the percentage of students who obtained each of the possible point values (e.g., 3 points for correct responses, 0 points for showing work, but not having any elements of the solution correct). For each item type, the response option (correct, incorrect, blank, partial credit) selected by the largest percentage of students (e.g., the largest number of students) was noted with bold text. A sample of the class-wide summary report for a *Content Analysis-Multiple Choice* measure is included in the Appendix. As multiple forms of the measures were administered, we listed the four most recent sets of data for teachers' review.

Figure 1. Sample progress monitoring graph



Scorer Training. Scoring of the algebra progress monitoring measures was completed by two groups of individuals. Project staff included two pre-service teachers (subsequently referred to as "scorers") who were hired and trained to score the probes and enter the data into the respective summary formats (Excel graphing spreadsheet and class-wide summary templates). The hiring process included a demonstration of correct scoring procedures for each type of probe and guided practice activities in which scorers worked with actual student papers. A final activity was the independent scoring of 10 student papers for each of the probe types. We used these probes to evaluate scoring reliability. For each probe, an answer-by answer comparison was conducted and an interscorer reliability estimate was calculated by dividing the number of agreements by the total number of answers scored. These individual probe agreement percentages were then averaged across all the selected probes of a common type to determine an overall average. After training, the scorers' mean interscorer agreement rates were 99% for the Basic Skills probes (range = 96% to 100%) and 95% for the Content Analysis-Multiple Choice probes (range = 81% to 100%). Scorers were informed that we would be checking their scoring accuracy levels throughout the project; they were able to earn bonus pay for maintaining high levels (i.e., >96% agreement) of accuracy in their scoring.

Following training, each scorer was assigned approximately five class periods with two forms of a probe per class to score (a total of 10 class sets of probes twice each month). Scorers also completed the data entry for the classes they were scoring. For each scorer, we conducted a scoring reliability on two of the class sets in each scoring period (i.e., twice each month) by re-scoring all of the probes in those sets.

Analyses of interscorer agreement rates revealed that scorers had high reliability on both types of probes. A total of 62 interscorer reliability checks were conducted across the three scorers throughout the 2006-07 school year. The range of agreement for Basic Skills probes was between 98.6% and 100% with a mean of 99.7%. For Content Analysis-Multiple Choice probes, the interscorer agreement rates ranged from 94.8% to 100%, with a mean of 99.2%.

In addition, we gathered scoring accuracy data on the teachers following both training and throughout the course of the project. After initial training, teachers' reliability was examined and found to be accepted. Project staff provided teachers with feedback on specific errors made during the post-training reliability checks. During the semester, a total of 31 reliability checks were conducted on teachers' scoring, with the checks conducted regularly as the teachers assumed responsibility for scoring the High Engagement classes, and then less often as they demonstrated consistent accuracy in their scoring. For the *Basic Skills* measure, the scoring accuracy rates ranged from 97.4% to 100%, with a mean rate of 99.1%. For the *Content Analysis-Multiple Choice* measure, teachers' scoring accuracy ranged from 95.4% to 100%, with a mean of 98.2%.

Results

In the following sections, we report the results of our analyses. Because of differences in the instructional context in each district (e.g., traditional vs. block scheduling), we conducted the analyses separately by district. We first report the descriptive data on student performance on the measures, followed by analyses related to the measures' reliability and criterion validity. We conclude this section with analyses of differential performance across the two contrast conditions (High Engagement and Low Engagement) investigated in this study.

Descriptive Data on Score Ranges and Distributions

In this section, we report the ranges, means, and standard deviations for each type of measure by the school week during which the measure was administered. Because specific data collection schedules varied, we did not track which specific form of a measure was administered which week and the weekly data likely include multiple versions of the parallel forms of each type of measure. The data are reported separately by district and disaggregated by class type.

Tables 5 and 6 list the ranges, means, and standard deviations for the *Content Analysis-Multiple Choice* probes by class type within each district. On the *Content Analysis-Multiple Choice* measure, the score represents the number of points earned on the probe (each of the 16 problems was worth up to 3 points. The total possible score was 48. On occasion, students who demonstrated high rates of guessing earned computed scores that were negative. We converted all negative scores to zeros.

For the *Content Analysis-Multiple Choice* measure, scores in District A reflected the expected patterns based on class types. The highest scores at the beginning of the spring semester were obtained by the advanced students in the 8th grade algebra class, followed by students in the traditional Algebra 1 class, and finally, by those in Algebra 1B and 1A. Within all classes, gains were observed across the course of the semester, although the more advanced students' increases were larger than those in the slower paced course options. Similar patterns were observed in District B. One exception was that the Algebra 1B students began the semester with a higher score than the students in Algebra 1. This result was not surprising, given that District B uses block scheduling; students in Algebra 1 were beginning their course in January and therefore had not had any formal instruction in algebra.

Students' scores on the *Basic Skills* measure revealed limited growth over time in both districts. Most of the means, regardless of class type, were within a five-point range across the weeks of the semester. Readers should note that only teachers of the slower-paced Algebra 1A and 1B classes chose to use the *Basic Skills* measures, which may have restricted the range of scores.

Table 5. Descriptive Statistics for Content Analysis-Multiple Choice Measures in District A

	8th Grade Algebra				Algebra 1				Algebra 1B				Algebra 1A			
Wk	N	Range	Mean	SD	N	Range	Mean	SD	N	Range	Mean	SD	N	Range	Mean	SD
19	20	10 - 39	26.6	7.2	42	0 - 46	18.0	10.2	7	8 - 28	16.6	8.1	17	0 - 24	12.6	6.5
20	21	16 - 43	29.3	7.1	43	3 - 48	20.4	10.5	7	3 - 32	17.9	10.3	17	0 - 26	8.6	6.2
21																
22	22	13 - 45	31.4	9.0	42	4 - 48	23.3	10.1								
23	22	12 - 48	33.7	7.8	40	3 - 43	22.7	10.5	5	6 - 36	19.4	13.0	16	1 - 22	9.5	5.9
24	21	20 - 48	37.1	8.0	42	0 - 42	25.0	10.3	5	5 - 32	19.8	10.2	17	2 - 26	12.1	6.3
25	18	24 - 48	38.22	8.0	42	0 - 48	27.3	12.2								
26	22	23 - 48	38.0	8.6	39	0 - 48	26.0	12.3								
27	22	27 - 48	40.2	7.6	39	0 - 46	24.4	12.2	7	10 - 32	15.6	7.8	17	0 - 25	14.3	6.9
28	22	23 - 48	39.9	8.1	42	0 - 48	26.3	17.8	7	9 - 34	22.9	9.3	17	4 - 32	16.9	7.9
29	22	24 - 48	42.1	6.7	43	3 - 48	26.8	12.5								
30	19	24 - 48	41.6	6.5	38	0 - 47	29.1	11.0								
31	20	28 - 48	43.7	5.4	39	3 - 48	28.3	12.2	8	8 - 35	19.1	8.9	18	0 - 33	15.7	9.6
32	17	22 - 48	36.7	9.2	40	0 - 47	23.3	12.3	8	11 - 29	20.3	6.7	18	2 - 36	16.9	9.4
33	17	35 - 48	44.0	4.5	36	0 - 48	26.8	13.1								
34																
35	21	19 - 48	41.4	6.9	41	4 - 48	30.3	11.1								
36	21	29 - 48	43.6	5.5	41	8 - 48	30.2	10.7								

Table 6. Descriptive Statistics for Content Analysis-Multiple Choice Measures in District B

	Algebra 1				Algebra 1B				Algebra 1A			
Wk	N	Range	Mean	SD	N	Range	Mean	SD	N	Range	Mean	SD
19												
20												
21												
22					22	0 – 26	14.86	7.08				
23	23	0 – 21	8.13	6.72	21	1 – 31	19.95	8.29				
24	29	0 – 23	9.38	5.85	20	0 – 37	19.35	10.7				
25	27	3 – 26	13.33	5.61	24	2 – 37	22.54	9.69				
26	28	0 – 29	16.25	7.33								
27					20	7 – 41	23.15	9.20				
28	25	1 – 31	14.00	8.80	30	2 – 41	20.00	9.34	4	4 – 10	7.00	2.53
29	25	0 – 32	14.28	9.18	30	5 – 37	19.17	8.80	6	0 – 12	5.67	5.39
30					28	5 – 37	21.32	9.06	6	4 – 20	11.83	5.88
31					29	5 – 44	23.38	10.2	6	2 – 20	13.50	6.78
32	25	6 – 39	21.84	9.78	33	8 – 42	25.64	9.05	6	13 –25	18.50	5.24
33					30	7 – 43	30.8	7.64	44	13 –31	19.75	8.30
34	26	5 – 38	22.96	9.20								
35												
36												

Tables 7 and 8 report ranges, means and standard deviations for the *Basic Skills* measure.

Table 7. Descriptive Statistics for Basic Skills Measures in District A

	Algebra 1B				Algebra 1A			
Wk	N	Range	Mean	SD	N	Range	Mean	SD
19								
20								
21	8	6 - 26	16.38	5.8	14	7 - 21	13.00	4.5
22	8	1 - 24	13.88	7.4	14	3 - 26	13.86	6.9
23								
24								
25	7	3 - 25	15.29	7.1	18	3 - 23	12.22	6.2
26	7	8 - 24	18.00	5.8	18	4 - 27	16.17	6.5
27								
28								
29	8	5 - 26	17.50	7.1	14	6 - 26	15.36`	5.7
30	8	11 - 24	18.25	5.8	14	3 - 24	13.14	5.9
31								
32								
33	7	1 - 26	14.43	9.3	18	2 - 25	13.39	7.6
34	7	5 - 23	13.86	5.7	18	5 - 30	15.11	7.2
35								
36								

Table 8. Descriptive Statistics for Basic Skills Measures in District B

	Algebra 1B				Algebra 1A			
Wk	N	Range	Mean	SD	N	Range	Mean	SD
19								
20								
21								
22	7	10 - 22	12.57	4.2	5	3 - 19	13.00	6.0
23	8	9 - 25	17.13	5.8	6	6 - 17	13.33	4.7
24	8	10 - 22	15.88	4.3	5	6 - 21	14.40	6.4
25	8	9 - 26	17.38	6.0	6	3 - 22	13.83	7.2
26								
27	7	11 - 24	17.57	4.5	6	8 - 17	13.67	3.1
28								
29								
30								
31								
32								
33								
34								
35								
36								

Data on Technical Adequacy

Alternate Form Reliability of Algebra Progress Monitoring Measures. We examined the alternate form reliability of individual probes by computing correlations between scores obtained on consecutive weeks. To account for the variations in teachers' administration schedules (that resulted in variations in the number of students included in each analysis), we conducted the reliability analyses within each district. The results of these analyses are reported in Tables 9 and 10 for the *Content Analysis-Multiple Choice* and the *Basic Skills* measures, respectively. Alternate form reliability estimates for *Content Analysis-Multiple Choice* ranged from .81 to .94 in District A and from .62 to .91 in District B. For the *Basic Skills* measure, reliability coefficients ranged from .49 to .83 in District A and from .70 to .76 in District B. The results the *Content Analysis-Multiple Choice* measure are consistent with previous studies, in which alternate form reliability estimates have generally been in the .70 to .80 range. The present results for the *Basic Skills* measure are somewhat lower than the estimates obtained in previous research, which have generally been in the .80 to .90 range. It is possible that the limited number of class types represented in the *Basic Skills* data (which included only the slower paced classes) may have restricted the range of obtained scores, thus attenuating the correlations.

Table 9. Alternate Form Reliability Coefficients for Content Analysis-Multiple Choice Measures.

	District A		District B	
Week	*N*	*r*	*N*	*r*
19/20	86	.81		
20/21				
21/22				
22/23	62	.86	20	.62
23/24	79	.89	40	.78
24/25	58	.91	47	.78
25/26	57	.88	26	.64
26/27	60	.94		
27/28	83	.91	19	.91
28/29	64	.90	54	.75
29/30	56	.88	32	.81
30/31	57	.92	30	.82
31/32	78	.84	35	.82
32/33	53	.85	34	.85
33/34				
34/35				
35/36	62	.93		

Note. All correlations significant at $p < .01$

Table 10. Alternate Form Reliability Coefficients for Basic Skills Measures.

	District A		District B	
Week	*N*	*r*	*N*	*r*
19/20				
20/21				
21/22	22	.67**		
22/23			11	.70*
23/24			12	.71*
24/25			12	.76**
25/26	25	.71**		
26/27				
27/28				
28/29				
29/30	22	.49*		
30/31				
31/32				
32/33				
33/34	25	.83**		
34/35				
35/36				

* = $p < .05$; ** = $p < .01$

Criterion Validity. We used available data to examine the concurrent and predictive validity of the measures. These data included students' scores on the district-administered achievement measures (ITBS, described previously in the Measures section) and their semester grades in Algebra. To represent students' performance early in the school year, we used students' initial scores on the measures during the study period. Across the districts and classes, these data were collected in Weeks 21 to 23, which fell in late January and early February. To represent students' performance at the end of the semester, we used the last administration in each class, which fell during weeks 33 and 34, in the second half of May. One exception to this general pattern was Teacher 2 in District B, who administered the *Basic Skills* measure for the first half of the semester and the *Content Analysis-Multiple Choice* measure for the second half of the semester. We computed correlation coefficients between the selected "beginning of semester" and "end of semester" probe scores and the criterion measures. The results are reported by district in Tables 11 and 12. Data for concurrent validity represent probe scores and criterion measures that were obtained at the same time period during the semester. For example, the correlation between "end of semester" probe scores and algebra grades are listed under the heading Concurrent. When probe scores gathered at the beginning of the semester were correlated with criterion measures gathered that the end of the semester (e.g., course grade and semester exam scores), these coefficients are reported as evidence of predictive validity.

Table 11. Concurrent and Predictive Validity for the Content Analysis-Multiple Choice Measure.

Criterion Measure	Concurrent				Predictive			
District	A		B		A		B	
	N	*r*	*N*	*r*	*N*	*r*	*N*	*r*
ITBS Math Total	20	ns						
ITED Computation	62	.39**	43	ns				
ITED Prob/Data	62	.36**	43	ns				
Algebra Grade	86	.73**	60	ns	83	.61**	40	ns
Semester Exam	62	.76**	58	.31*	60	.63**	37	ns

Table 12. Concurrent and Predictive Validity for the Basic Skills Measure.

Criterion Measure	Concurrent				Predictive			
District	A		B		A		B	
	N	*r*	*N*	*r*	*N*	*r*	*N*	*r*
ITED Computation	21	ns	13	ns				
ITED Prob/Data	21	ns	13	ns				
Algebra Grade	25	ns			21	ns	13	ns

The criterion validity results for the *Content Analysis-Multiple Choice* measure are similar to estimates obtained in previous research for the standardized test scores, but comparable or higher than previous results for algebra grades and semester exams. It is encouraging that these coefficients are so strong, as they represent more content-specific indicators of algebra proficiency than do the standardized tests of more broad mathematics skills. None of the obtained results for the *Basic Skills* measure were statistically significant. In previous research, we have obtained significant results, but they have often been in a lower range than the criterion validity coefficients obtained for the *Content Analysis-Multiple Choice* measure. We hypothesize that the smaller student samples, drawn entirely from slower-paced algebra classes, produced a restricted range of scores that influenced the criterion validity coefficients.

<u>Growth</u>. We examined students' growth on the measures across the semester by computing an ordinary least squares regression coefficient for each student's weekly data. Readers should note that in District A, this analysis treats the data for two probes gathered in a single week as if they had been gathered in two consecutive weeks. Table 13 reports the ranges, means and standard deviations for the mean slopes for the *Content Analysis-Multiple Choice* and *Basic Skills* measures by district and class type.

Table 13. Descriptive Statistics for Slope on the Algebra Progress Monitoring Measures

	8th Grade Algebra				Algebra 1				Algebra 1B				Algebra 1A			
	N	Range	Mean	SD	N	Range	Mean	SD	N	Range	Mean	SD	N	Range	Mean	SD
CA-MC																
District A	22	0.3 – 1.7	.91	0.4	45	-1.0 – 1.5	.56	0.5	8	-0.9 – 1.9	.47	0.9	18	-0.9 – 1.6	.57	0.7
District B					30	-.04 – 3.3	1.2	0.9	35	-1.4 – 5.4	1.5	1.3	6	1.7 – 5.6	3.5	1.7
BS																
District A									8	-0.2 - 0.3	.05	.22	18	-0.5 - .51	.03	.33
District B									9	-1.5 - 2.1	.80	1.1	6	-0.8 - 1.5	.34	.78

Note. CA-MC = Content Analysis-Multiple Choice; BS = Basic Skills

It is important to note that we have been using a weekly growth rate of .5 as benchmark and goal in our research. We anticipate that in order for algebra progress monitoring measures to be useful to teachers on a practical level, they must be able to expect to see scores grow by at least one point every two weeks (hence a weekly growth rate of .5). The results reported in Table 13 reveal that this threshold was met for the *Content Analysis-Multiple Choice* measure in six of the seven classes participating in the study. The one exception was the Algebra 1B class in District A, where the mean growth rate of .47 points per week was very close to our goal. The results for the *Basic Skills* measure were less positive, with only one of the four studied classes obtaining a mean growth rate in excess of .50. In previous studies, the mean rate of growth for the *Content Analysis-Multiple Choice* measure has generally exceeded the mean growth rates obtained for the *Basic Skills* measure, but the present results for *Basic Skills* are considerably lower than previous findings.

Effects of Teachers' Access to Student Data on Student Performance

In addition to replicating previous research on the technical adequacy of the algebra progress monitoring measures, a primary purpose of this study was to further examine teachers' use of progress monitoring data. In the study described in Technical Report 15 (Foegen & Olson, 2007), we contrasted two levels of teachers' access to student data. That study, which took place in the fall semester of the 2005-06 academic year, compared a "no data" condition (in which students completed four progress monitoring measures each month, but teachers had no access to these data) with a "data" condition (in which students completed algebra progress monitoring measures with the same frequency, but the data were shared monthly with teachers during data conferences with project staff). In the initial study, no significant differences were found between students' algebra achievement in the two conditions.

In the current study, we sought to replicate the design of the fall semester study, but alter the conditions to provide data to teachers in a more timely manner and to encourage higher levels of teacher engagement with the data. Because of our initial agreements with teachers during the recruitment process for Project AAIMS, we were limited in the types of instructional and curricular changes we could ask them to make in response to their students' data. We chose to investigate whether varying rates of engagement with student data would result in differential levels of algebra achievement.

As described in the Method section, we assigned two of each teacher's classes (of the same type) to one of two levels of engagement with the data. In the High Engagement classes, teachers administered and scored their students' algebra progress monitoring probes, entered the data into an electronic spreadsheet that automatically generated graph of each student's data, and shared these graphs with students twice each month. In the Low Engagement classes, teachers administered the algebra progress monitoring measures on the same schedule, but the probes were scored and the data entered into the spreadsheet by Project AAIMS staff. As in the previous study, project staff met with each teacher monthly to share data from his/her Low Engagement class and to discuss the data the teacher had gathered for his/her High Engagement class. The assignment of specific class periods to each condition was reported earlier in Table 4.

We first examined the comparability of the classes at the beginning of the semester by conducting t-tests of the beginning of the semester probes scores (the same values used in the criterion validity analyses). The results revealed no significant differences in initial performance levels for all six pairs of classes.

We next conducted t-tests for each pair of classes, using students' slopes and their end of semester performance levels as the outcome variables. The results of these analyses are reported in Table 14. The teacher in District B who administered the *Basic Skills* class taught two different types of beginning algebra courses, so it was not possible to include her students in these analyses.

Table 14. T-test Results for Comparison Classes

	District	Teacher (Classes)	Mean for HIGH Engagement Class	Mean for LOW Engagement Class	*t*	*p*
CA-MC						
Slope	A	1 (2, 6)	0.60	0.52	.358	.72
		2 (5, 7)	0.40	0.73	-1.05	.31
	B	1 (3, 1)	0.83	1.25	1.79	.09
		3 (4, 3)	1.10	1.34	-.719	.49
EOS	A	1 (2, 6)	29.40	36.45	-1.86	.08
		2 (5, 7)	13.00	20.89	-1.91	.07
	B	1 (3, 1)	30.77	33.29	.612	.55
		3 (4, 3)	23.75	22.29	.403	.69
BS						
Slope	A	2 (5, 7)	0.04	0.03	0.06	.95
	B					
EOS	A	2 (5, 7)	12.67	17.56	-1.50	.15
	B					

The results of the comparisons revealed that no significant differences between the two engagement conditions were observed in students' rates of growth during the semester or final performance levels. We hypothesize several factors may have led to this result. First, the two conditions represent relatively limited efforts to respond to students' progress monitoring data. We initially designed the studies to see if merely providing teachers with the data would prompt actions that might increase student achievement levels. Our results suggest that doing so is not sufficient to result in differential levels of achievement between classes in the two conditions. A second factor, which may have interacted with the first, involved the structure of the research design. Because we had a limited number of teacher participants and we were concerned about teacher effects, we opted to assign both conditions to classes taught by the same teacher. While this provided us with a means to control for teacher effects, it created the potential "contamination" of the Low Engagement condition with data available through the High Engagement condition. In other words, if teachers found specific areas of weakness in student understanding as a result of scoring the algebra progress monitoring measures for students in the High Engagement condition, they were likely to implement any responsive actions across all of their class periods. The teachers raised this issue when the study was initially described to them and we assured them that we did not expect them to withhold any intervention from their students. As a result, it is possible that the teachers' use of data did result in improved student achievement, but not at differential rates among classes assigned to the two conditions. A third factor was raised by the teachers in our discussions about the assignment of different class periods to different conditions. Without exception, teachers of beginning algebra classes perceived that their different class periods had widely varying "personalities" that they found fairly intractable to intervention. We frequently heard comments about "my difficult class" along with concerns expressed about whether the class would show changed levels of achievement. Although these perceptions are difficult to account for within a research design, they represented an important element of the teachers' beliefs about their students.

Summary and Future Research

The present study replicated previous research on the alternate form reliability, criterion validity, and sensitivity to growth of the *Basic Skills* and *Content Analysis-Multiple Choice* algebra progress monitoring measures and investigated the effects of two levels of teacher engagement with student data on student achievement in algebra. The results revealed additional support for the technical adequacy of the measures, with the *Content Analysis-Multiple Choice* measure having somewhat higher levels of criterion validity and substantially higher mean growth rates than the *Basic Skills* measure.

We did not find significant differences in algebra achievement levels based on the level of teacher engagement with the data. Future research should involve larger numbers of teachers to facilitate the use of a design that would preclude the confounding effects potentially observed in the present study when each teacher taught classes in both conditions.

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Appendix

Algebra Progress Monitoring Measures

Basic Skills

Content Analysis-Multiple Choice

Sample Summary of Student Performance

Error Analysis Report for *Content Analysis-Multiple Choice*

Solve: $9 + a = 15$ $a =$	Solve: $10 – 6 = g$ $g =$
Evaluate: $12 + (– 8) + 3$	Simplify: $9 – 4d + 2 + 7d$
Simplify: $2x + 4 + 3x + 5$	Simplify: $5(b – 3) – b$
Solve: $12 – e = 4$ $e =$	Solve: $q \bullet 5 = 30$ $q =$
Simplify: $4(3 + s) – 7$	Evaluate: $8 – (– 6) – 4$
Simplify: $b + b + 2b$	Simplify: $2 + w(w – 5)$
Solve: $\frac{r}{6} = \frac{12}{18}$ $r =$	Solve: 1 foot =12 inches 5 feet = _____ inches
Simplify: $7 – 3(f – 2)$	Simplify: $4 – 7b + 5(b – 1)$
Evaluate: $– 5 + (– 4) – 1$	Simplify: $s + 2s – 4s$
Solve: $63 \div c = 9$ $c =$	Solve: $x + 4 = 7$ $x =$
Simplify: $2(s – 1) + 4 + 5s$	Simplify: $– 5(q + 3) + 9$
Simplify: $8m – 9(m + 2)$	Evaluate: $9 + (– 3) – 8$
Solve: 3 feet = 1 yard _____ feet = 9 yards	Solve: $\frac{12}{2} = \frac{48}{e}$ $e =$
Evaluate: $4 – (– 2) + 8$	Simplify: $y^2 + y – 4y + 3y^2$
Simplify: $2k + 3 – 5(k + 7)$	Simplify: $3(c + 2) – 2c$

Algebra Probe A-1

Solve: $3 \cdot 8 = m$ $m =$	Solve: $\frac{1.5}{3} = \frac{h}{9}$ $h =$
Evaluate: $-9 + 5 + 8$	Simplify: $7b - 4 - 3 - 2b$
Simplify: $x + 2(x - 5) - 3$	Simplify: $2e - 3(e - 4)$
Solve: $d - 5 = 4$ $d =$	Solve: $6 + 7 = v$ $v =$
Simplify: $5(3 + f) - 2f + 6$	Evaluate: $-5 + 6 - 6$
Simplify: $5 - 2b + 4(b + 3)$	Simplify: $4 + 10(1 - r)$
Solve: 4 quart = 1 gallon _____ quarts = 3 ¼ gallons	Solve: 2.5 cm = 1 inch _____ cm = 6 inches
Simplify: $4(y + 1) - 8y$	Simplify: $6a + 2a - 9 + 3a^2$
Evaluate: $14 - 7 + (-3)$	Evaluate: $-1 + 4 + (-7)$
Solve: $\frac{36}{6} = s$ $s =$	Solve: $\frac{500}{j} = \frac{10}{2}$ $j =$
Simplify: $-3w^2 + 5w^2 - 5 + 12$	Simplify: $-3(u + 3) - 2u + 5$
Simplify: $9 - 4(v + 2)$	Simplify: $2c - 3c - c$
Solve: $4r = 28$ $r =$	Solve: $h \div 6 = 8$ $h =$
Simplify: $16 + 2(t - 4) - 3t$	Evaluate: $-2 + (-5) + (-8)$
Simplify: $c - 3(c + 2) + 8$	Simplify: $3z - 8z + 2 + 9$

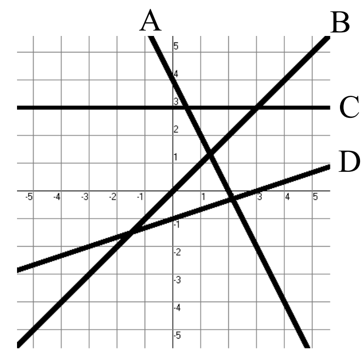
Solve:
$3x + 4 = 19$
$x =$

a) 8
b) 22
c) 15
d) 5

Evaluate $a^2 - b \div 2$ when $a = 4$ and $b = 6$

a) 1
b) 5
c) 10
d) 13

Which line on the graph is $y + 2x = 4$?



a) Line A
b) Line B
c) Line C
d) Line D

Simplify:
$3(m + 2) + 2(m - 1)$

a) $5m + 4$
b) $5m + 1$
c) $6m + 8$
d) $6m - 8$

Evaluate the expression:

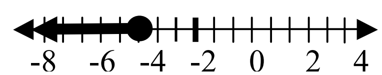
4^{-2}

a) -16
b) $\frac{1}{8}$
c) $\frac{1}{16}$
d) -8

Solve the linear system:
$x - y = 4$
$x + 2y = 19$

a) $(-1, -5)$
b) $(5, 8)$
c) $(-2, 19)$
d) $(9, 5)$

This graph shows the solution for which equation?



a) $x > -3$
b) $2x \leq -6$
c) $-3x > 9$
d) $3x \geq 9$

Write the equation in slope-intercept form if $m = \frac{1}{2}$ and $b = 3$

a) $y = 2x + 3$
b) $y = 3x + \frac{1}{2}$
c) $x = \frac{1}{2}y - 3$
d) $y = \frac{1}{2}x + 3$

Evaluate $d + 3e^2$ when $d = 5$ and $e = 2$ a) 11 b) 23 c) 17 d) 10	Solve: $6c + 4 = -3c - 14$ $c =$ a) $-\frac{10}{3}$ b) -2 c) 2 d) 6	Find the slope of a line through (1, – 1) (5, 2) a) $\frac{1}{5}$ b) $\frac{3}{4}$ c) – 6 d) $-\frac{4}{3}$	Simplify: $6(2b - 3) - 3(2 - b)$ a) $15b - 24$ b) $9b - 9$ c) $9b + 12$ d) $15b + 12$
Simplify the expression: $\frac{a^2}{ab^3} \bullet \frac{b^4}{a^3}$ a) $\frac{a^8}{a^3b^3}$ b) $\frac{ab^8}{a^4b^3}$ c) $\frac{b}{a^2}$ d) $\frac{b}{a}$	Solve the linear system: $-6x + 3y = -6$ $2x + 6y = 30$ a) (6, 3) b) (3, 4) c) (2, 6) d) (4, – 3)	Simplify: $b^2 - 4b + 2b^2 + 7 - 5$ a) $3b^2 - 4b + 2$ b) $2b + 2$ c) $-b^2 - 4b + 12$ d) $3b^2 - 4b + 12$	Write the equation of a line through (5, 3) (4, 9). Use point-slope form. a) $y + 1 = 2(x - 4)$ b) $y + 4 = -6(x - 1)$ c) $y - 3 = -6(x - 5)$ d) $y = -6x + 30$

Content Analysis-Multiple Choice Error Analysis Report								
Teacher:		**Period: 2**	**Probe Number: E-4 to E-7**					
Chapter	**“Big Idea”**	**Samples**	**% (3)**	**% (2)**	**% (1)**	**% (0)**	**% (G)**	**% (B)**
1 *Connections to Algebra*	E1 Evaluate expressions that include exponents and order of operations with given values	Evaluate $a^2 - b \div 2$ when $a = 4$ and $b = 6$	**38**	5	17	12	12	17
			29	0	17	0	12	**43**
			70	2	9	4	7	9
		(2 items)	**76**	9	9	2	0	4
2 *Properties of Real Numbers*	E2.1 Simplify expressions that include integers and combination of like terms	Simplify: $9r + 3r - 3 + r^2 + 2$	**62**	5	0	5	10	19
			29	0	5	19	14	**33**
		(2 items)	**74**	4	0	0	4	17
			65	0	0	0	4	30
	E2.2 Simplify expressions that include integers and combination of like terms and application of the distributive property (1 addition, 1 subtraction)	Simplify: $4(n - 2) + 2(n + 6)$	**69**	5	10	2	7	7
			62	0	2	2	5	29
			76	0	0	2	2	20
		(1 item)	**80**	2	0	4	2	11
3 *Solving Linear Equations*	E3.1 Solve linear equations with 2 steps	Solve: $3x - 4 = 20$ (1 item)	19	10	19	14	5	**33**
			95	0	0	0	5	0
			96	0	0	0	4	0
			96	0	0	0	0	4
	E3.2 Solve equations with variables on both sides	Solve: $5z + 4 = -3z - 12$ (1 item)	14	0	5	5	19	**57**
			24	0	0	10	5	**62**
			65	0	4	13	4	13
			52	0	9	4	4	30
4 *Graphing Linear Equations & Functions*	E4.1 Identify a line on a graph	Which line on the graph is $y = 2$?	29	0	14	14	5	**38**
			57	0	0	14	24	5
		(1 item)	35	0	0	4	17	**43**
			17	0	0	22	17	**43**
	E4.2 Find the slope of a line through 2 points	Find the slope of a line through (1, 3), (2, 5) (1 item)	24	0	0	24	**29**	24
			86	0	5	0	10	0
			43	0	0	4	4	48
			52	0	4	0	4	39
5 *Writing Linear Equations*	E5.1 Slope-intercept form	Write the equation in slope-intercept form: $m = \frac{1}{2}$ $b = 3$ (1 item)	29	0	0	14	14	**43**
			43	10	10	5	5	29
			70	0	0	0	4	26
			83	4	0	0	4	9

Chapter	"Big Idea"	Samples	% (3)	% (2)	% (1)	% (0)	% (G)	% (B)
	E5.2 Write equation for line through 2 points	E5.2a Write the equation of a line through (5, 3) (4, 9). Use point-slope form.	24	0	5	0	10	**62**
		E5.2b Write the equation of a line through (4, 2) (6, 3). Use slope-intercept form.	24	0	0	10	14	**52**
			9	4	**39**	13	0	35
		(1 item)	17	0	13	13	9	**48**
6 *Solving & Graphing Linear Inequalities*	E6 Interpret a graph of an inequality	This graph shows the solution for which equation?	33	5	5	5	10	**43**
			67	0	5	0	5	24
			30	0	0	13	17	**39**
		(1 item)	26	0	0	17	13	**43**
7 *Systems of Linear Equations & Inequalities*	E7.1 Solve linear system by substitution	Solve the linear system: $x - y = 4$ $x + 2y = 19$	24	0	29	0	5	**43**
			14	0	0	19	10	**57**
			48	13	9	0	13	17
		(1 item)	**39**	13	0	0	9	**39**
	E7.2 Solve linear system by linear combination	Solve the linear system:	**71**	0	0	0	10	19
		$-6x + 3y = -6$	**38**	19	0	5	5	33
		$2x + 6y = 30$	26	0	4	9	13	**48**
		(1 item)	35	0	4	4	9	**48**
8 *Exponents & Exponential Functions*	E8.1 Evaluate expressions with negative exponents	Evaluate the expression: 4^{-2}	**62**	0	24	0	5	10
			86	0	10	0	5	0
			61	0	0	13	13	13
		(1 item)	**61**	0	0	13	17	9
	E8.2 Simplify expressions with exponents	Simplify the expression:	**38**	5	14	0	10	33
		$\frac{a^2}{ab^3} \bullet \frac{b^4}{a^3}$	33	0	19	0	10	**38**
			52	0	13	0	0	35
		(1 item)	**43**	13	9	0	4	30