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**Teacher Practices and Student Growth
In Mathematics:
Grades 6-8**

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Abstract

Schools and districts across the United States have adopted response to intervention (RTI) as a means for both identifying and intervening with students at risk for low achievement. The validity of RTI rests largely upon teachers making appropriate instructional decisions based on students' responses to a given practice. This study was designed to explore how teachers' instructional practices relate to progress monitoring data in math in Grades 6 and 7. A total of eight teachers participated (five in Grade 6, three in Grade 7). They administered an easyCBM Common Core State Standards (CCSS) Math measure to their students monthly and provided information on their instructional practices for each student at least three times (fall, winter, and spring). Analyses included: (a) textual analyses of teachers' self-reported instructional practices, (b) multilevel growth analyses of students' math data, and (c) ordinal regression analyses of students' intercept and slope predicting the number of interventions the student received. Results indicate that self-report methods may not be sufficient to adequately address the relation between teacher practices and students' growth. Nonetheless, in Grade 6, a relation was found between students' average growth in math performance and the likelihood that they would be administered multiple interventions.

Teacher Practices and Student Growth in Mathematics: Grades 6-8

Within a response to intervention (RTI) framework, all students are administered interim benchmark screening assessments, typically seasonally (fall, winter, and spring). Students performing below a specified normative percentile on these benchmarks are provided educational interventions designed to “boost” their achievement (Deno et al., 2009). The overall purpose of RTI is to identify students who are at-risk for low-achievement, so that targeted interventions can be provided and students can “catch-up” with their peers. Regular progress-monitoring probes are administered to evaluate the effect of interventions. For example, an intervention may have a large positive effect for Student A, as evidenced by an immediate change in the student’s achievement level and/or a rapid increase in his or her slope of improvement. Student A may then be exited from the intervention and placed back in general instruction. Student B, in contrast, may receive the same intervention, but not adequately respond as evidenced by no or little change in the student’s level of academic achievement *and* no substantial increase in the student’s rate of learning. In this example, Student B might require a more intensive intervention (e.g., more time in the intervention, or perhaps a different intervention entirely) to bridge the achievement gap between his or her performance and that of peers.

Data obtained through RTI offer a rich source of information from which educational decisions can be based. However, recent research suggests that the decision-making process may not be as straightforward as the aforementioned scenario may suggest (Tindal, Alonzo, Nese, & Sáez, 2012). The purpose of this study was to explore teachers’ instructional practices in the field relative to student data. All teachers participating in the study administered monthly mathematics progress-monitoring measures to all students in their classes and entered the corresponding

instructional information for each student into an online system. Instructional information could then be evaluated relative to the observed trends in the data. Specifically, we planned the study to address the following three research questions:

- 1) What is the average rate and shape of students' mathematics growth occurring during the school year?
- 2) What types of instructional decisions did teachers make for students?
- 3) Which students were selected for mathematics intervention, and what intervention practices were used?

Ideally, we would find that students generally made positive growth, and see that teachers intervened with students who began the year with lower achievement levels and/or made below-average growth. This is certainly the premise of RTI. It was our hope that the instructional information provided by the teachers might then inform the observed growth patterns, providing insight into teachers' actual practice and a link between student performance data and teacher instructional decisions. However, if seemingly erratic decisions were made, similar to those seen in previous research (Tindal et al., 2012), or inadequate growth occurred on average to sufficiently target students progressing below the norm, then the link between student performance data and teacher instructional decisions becomes more muddled. This study sought to investigate these issues through a year-long study in two school districts with a history of RTI implementation.

Methods

Participants and Procedures

A total of eight teachers from two schools in two districts participated in this study. School A was located in the Pacific Northwest and included six of the eight participating teachers—three sixth grade teachers and three seventh grade teachers. School B was located in the Mountain West and included the remaining two teachers—both sixth grade teachers. To ensure the data were collected with fidelity, we contracted with a math coach from School A to help facilitate the study and stay in regular contact with the six teachers at her site. Although no district contact was hired for School B, the lead author kept in regular email contact with both teachers. The study included a total of 714 students, with 489 students in Grade 6 and 225 in Grade 7. On average, each teacher instructed 89 students ($SD = 31.33$). Student demographic information was unavailable.

There were two primary components of the study. First, teachers assessed all their students once per month for the duration of the school year using the easyCBM© Common Core State Standards (CCSS) Math progress-monitoring measures. Second, teachers entered instructional information into an online database for each student they instructed three times during the year (during seasonal benchmark testing). Teachers were also asked to enter instructional information into the online database each time an instructional change was made for an individual student (e.g., student moved from Tier 1 to Tier 2, or from Tier 2 back to Tier 1, etc.); however, this was not explicitly required. All teachers began testing students with form #1 of the CCSS Math progress monitoring measure and moved to the subsequent measure each month.

Measures

The easyCBM CCSS Math measures in grades 6 and 7 were used in this study. For a complete report on the development of the measures, see Anderson, Irvin, Patarapichayatham, Alonzo, and Tindal (2012). All items were scaled with a Rasch model and forms were constructed to be of equivalent difficulty. Universal design for assessment components were used during assessment development, informing the item design, presentation, and interface (see Thompson, Johnstone, & Thurlow, 2002). An alignment study conducted by Anderson, Irvin, Alonzo, and Tindal (2012) suggested strong alignment with the CCSS. For an investigation into the reliability of the test forms, see Anderson, Alonzo, and Tindal (2013a).

Teachers used the same online system to both administer the tests and enter instructional information (See Figure 1 for an example of the instructional intervention interface). Teachers selected a student, entered text about the instruction the student was receiving, and then selected all other students who were receiving the same instruction (all names in Figure 1 are pseudonyms). Figure 2 displays a hypothetical example of how instructional information was presented to teachers via time-series graphs. Note the vertical black line indicating the onset of new instruction (i.e., an intervention). The text the teacher entered in the intervention interface in Figure 1 is displayed below the time-series graph. These time-series graphs are intended to help teachers quickly examine the impact of their instructional practices on students' growth.

Instructional Data

Data from each teacher contained idiosyncrasies that required analysis on an individual teacher basis. However, there were commonalities. For all teachers, we found numerous instances of redundant interventions (i.e., the same intervention entered twice, but with

grammatical differences, marginally different descriptions, etc.). During our data cleaning process, all duplicates were collapsed, and all non-math interventions were discarded. Frequency counts of the number of students receiving $0 \dots n$ interventions were then calculated, as well as the number of students within each unique intervention. When available, data on the intensity, frequency, and duration of the intervention were extracted. Because, as we had requested, teachers entered instructional information for all students, including those receiving only general instruction, there were times when it was not clear whether the instruction was truly an intervention or if it was part of general core instruction. During data cleaning, all ambiguous cases were coded as interventions. Unless denoted otherwise, interventions were assumed to continue through the duration of the school-year post-implementation.

Analyses

To explore students' mathematics growth, hierarchical linear modeling (HLM) was employed, with separate models fit for each grade. All analyses were conducted with the R statistical software (R Core Team, 2013) with the lme4 package (Bates, Maechler, Bolker, & Walker, 2013). Statistical tests of individual parameter estimates were obtained with the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2013). Prior to analysis, functional form was examined by visual inspection. All plots were produced using the ggplot2 package (Wickham, 2009). Figure 3 plots the mean of each time point for each grade. The red line indicates a quadratic, curvilinear function fit to the data, while the blue line indicates a linear fit.

Note that for Grade 7, the mean for the fifth time-point (test Form 5) was markedly lower (~2-3 points) than all other time points. The discrepancy led us to speculate about a possible form effect, particularly given that Anderson et al. (2013a) found that the reliability of some CCSS Math test forms for Grade 7 were functioning below optimal levels (e.g., Cronbach's

alpha < .7). These forms have since been revised, but the original forms were used in the current study. However, in addition to the mean for this test form being notably lower for the full sample, it was roughly equivalently so for each individual teacher. That is, student scores on Form 5 were approximately 2-3 points lower than their scores on all other forms for students in each teacher's class (see Figure 4). Given the replicated effect across teachers, and known issues related to the original forms' reliability, we opted to remove this time point prior to growth analysis. Thus, only time points 1-4, 6, and 7 were included in the Grade 7 analyses.

In multilevel designs statistical power is primarily driven by the number of units at the highest level (Raudenbush & Liu, 2000; Snijders, 2005). Our design included only five teachers in grade 6 and three teachers in grade 7. Power estimates indicated that, despite the relatively large n size (number of students), power was insufficient (< .20) for a three-level model given the small j size (number of teachers). Thus, the growth analyses were restricted to two-level models: repeated measurement *occasions* nested within *students*. Restricting the analysis to a two-level design resulted in observed power of 0.99 for Grade 6 and .80 for Grade 7, for an effect size of .4 and alpha set at .05.

Our unconditional growth model was defined as

$$\begin{aligned}
 Score_{ti} &= \pi_{0i} + \pi_{1i}(Months) + \pi_{2i}(Months)^2 + e_{ti} \\
 \pi_{0i} &= \beta_{00} + r_{0i} \\
 \pi_{1i} &= \beta_{10} + r_{1i} \\
 \pi_{2i} &= \beta_{20} + r_{2i}
 \end{aligned}
 \tag{1}$$

where $Score_{ti}$ represents the score at time t for student i on the CCSS Math measures. Our time variable was coded as the number of months elapsed between measurement occasions, represented in fractional form to account for the specific number of days between assessment time points.

The quadratic term was included to test for functional form, given that visual inspection revealed a possible curvilinear trend (see Figure 3). To explore how students' achievement varied across teachers, we entered students' teacher as an effect coded covariate at Level 2 as a predictor of students' intercept and both linear and quadratic slopes. Effect coding allowed us to test whether the mean intercept and slope values for a particular teacher were significantly different from the mean of the group means (i.e., the unweighted grand mean). The full conditional model was defined as

$$\begin{aligned}
 Score_{ti} &= \pi_{0i} + \pi_{1i}(Months) + \pi_{2i}(Months)^2 + e_{ti} \\
 \pi_{0i} &= \beta_{00} + \mathbf{TeacherEC}_{01} + r_{0i} \\
 \pi_{1i} &= \beta_{10} + \mathbf{TeacherEC}_{11} + r_{1i} \\
 \pi_{2i} &= \beta_{20} + \mathbf{TeacherEC}_{21} + r_{2i}
 \end{aligned} \tag{2}$$

where $\mathbf{TeacherEC}_{ti}$ represents a matrix of effect coded teacher covariates. Note that all terms at Level 1 were initially set to vary randomly across students (Level 2). Theoretically, we expected students to begin at different levels and progress at different rates. We used a backward elimination procedure, by which we first included all terms (as shown), systematically fixed non-significant random effects, and then eliminated non-significant fixed effects. As suggested by Hox (2010), we first fixed non-significant random effects before removing non-significant fixed effects, given that the fixed effects may become significant when an average value is set for all units. Likelihood ratio tests of the model deviance were used as the primary criterion for such elimination. However, Pseudo R^2 was also investigated to explore whether changes were large enough to be substantively meaningful in addition to being statistically significant. When decisions were ambiguous, the more parsimonious model was preferred.

To address Research Question 3, we used as our criterion the number of interventions students received. We then examined instructional practices relative to this criterion. That is, were students who were receiving multiple interventions receiving substantively different

instruction than students who were receiving zero or one? Further, we conducted an ordinal regression analysis to explore whether students' initial achievement (i.e., intercept) and rate of improvement (i.e., slope) predicted the number of interventions they received over the school year. Intercept and slope values were extracted from the growth model described above.

Results

In this section we first describe the results of our overall HLM and ordinal regression models. We then report our descriptive textual analysis of instructional practices by teacher, and describe how the achievement of students for each teacher differed (if at all) from the mean of the group means, as well as how the likelihood of students being provided multiple interventions changed by teacher. Instructional information was not entered into the analyses, but rather was intended to supplement the growth model results.

Growth Model

Complete HLM growth modeling results are displayed in Table 1. For each grade, the results are displayed for the full model, as shown in Equation 2, and a reduced model that more parsimoniously describes the data.

For Grade 6, *Teacher* was not a significant predictor of the quadratic term, with the exception of Teacher 3. The quadratic term also varied little between students. The model including teacher as a predictor of students' quadratic slope fit the data significantly better than the model without, $\chi^2(7) = 15.54, p = .03$; however, pseudo R^2 suggested the addition of teacher predictors to the quadratic slope resulted in less than 1% (0.84%) additional variance explained. Further, AIC was virtually indistinguishable between the models, while BIC suggested the more parsimonious model fit the data better. Consistent with our *a priori* rules for

prioritizing parsimony, we opted for the simpler model with teacher only predicting students' intercept and linear slope. The quadratic variance component was also fixed. A plot of the fixed effects for the final model is displayed in Figure 5. Note that significantly more variability existed in the mean initial achievement of students by teacher than in the mean linear growth.

The results of the final Grade 6 model suggested that students scored, on average 12.70 points correct at the beginning of the study, which varied between students with an *SD* of 2.56. With the exception of Teacher 3, the average initial achievement for students was significantly different than the unweighted grand mean for the intercept. Students progressed, on average, at a rate of 0.23 points correct per month (*SD* = 0.25), with an accelerating curvilinear trend of .05 points per month squared. The mean of the linear slope for Teachers 1 and 5 were significantly lower than the unweighted grand mean for the linear slope, while the mean for Teacher 2 was significantly higher. The mean linear growth slope for Teachers 3 and 4 were not significantly different from the unweighted grand mean.

For Grade 7, no parameters with the exception of the intercept were significant. The model was reduced to the simplest form that adequately explained the data – an unconditional linear growth model. The unconditional linear growth model fit the data significantly better than the unconditional means model (i.e., random intercepts only, with no time variable).

Interestingly, students' average growth was not statistically different from zero, and the 95% CI for the linear slope variance components contained 0, suggesting the linear slope did not vary significantly between students. However, the model with the linear slope varying between students did fit significantly better than the model with the linear slope fixed

$\chi^2(2) = 40.79, p < .001$. Given that the linear growth term itself was not significant, teachers by definition could not be a significant predictor of students' growth. The finding that students

were not progressing at a rate distinguishable from zero (i.e., flat) was surprising. Possible explanations for this finding are examined in the Discussion section.

Ordinal Regression

The results of the ordinal regression analysis are displayed in Table 2. Students' intercept was a significant predictor of the number of interventions a student received across both grades, while slope was significant only in Grade 7. Both intercept and slope were negatively related to the number of interventions the student received, indicating that as students' initial achievement, or their rate of growth increased, their likelihood of being provided additional interventions decreased. These results align with expectations within an RTI framework of instruction and assessment. In Grade 6, students instructed by Teacher 1 received significantly fewer interventions than the mean of the group means, while students instructed by Teacher 4 were over 8 times more likely to receive an intervention. The teacher factor was not significant in Grade 7, indicating students were equally likely to receive an intervention regardless of the teacher providing the instruction.

Results by Teacher: Grade 6

Table 3 displays the number of interventions students received by teacher. Proportions are displayed in parentheses. Note that for a few teachers the number of students not receiving any interventions was zero, or close to zero. All such teachers included their students in an intervention termed "Flex Friday", during which students from across classrooms were grouped by common instructional needs. Thus, even if students were performing at or even above expectations, they still technically received an intervention and were coded as such.

Teacher 1. Teacher 1 instructed 131 sixth-grade students. These students began, on average, scoring 15.74 points (~75th percentile), which was 3.04 points higher than the

unweighted grand mean and was statistically significant ($t = 9.43, p < .001$). Our theory that students who began the school year at a higher than normal achievement level would receive fewer targeted interventions was supported by these results: only 25% of these students received an intervention. The proportion of students receiving an intervention aligns well with general RTI recommendations (Fuchs & Fuchs, 2006) assuming the teacher was using local norms. The ordinal regression analysis indicated that students were, on average, less likely to be administered multiple interventions than students in other sixth grade classes ($OR = .10, p < .05$). Students' average linear growth was -0.04 , which was 0.27 points lower than the unweighted grand mean, and was also statistically significant ($t = -4.71, p < .001$). All sixth-grade students also made significant accelerating curvilinear growth, at 0.05 points per month squared ($t = 3.84, p < .001$). Thus, although students instructed by Teacher 1 began the year with a higher than average achievement level, they progressed at a substantially lower rate and were less likely to receive multiple interventions than the average sixth grade student in the average class. For example, students instructed by the average teacher would have been predicted to make, on average, 1.14 points of growth after three months. However, students instructed by Teacher 1 would be predicted to have made 0.03 points of growth over the same three months.

Teacher 1 used six categories to label instructional practices: (a) *general instruction*, (b) *general instruction with accommodations*, (c) *double general instruction*, (d) *leveled general instruction*, (e) *independent coursework*, and (f) *classroom interventions*. Approximately 97% of students received *general (core) instruction* based on the CCSS, with approximately 4-5% receiving *general instruction with accommodations*. In addition to the core curriculum, 12 instructional categories were identified through textual analysis. Table 4 displays the identified instructional categories intended to supplement the more general categories Teacher 1 provided.

Five of the instructional practices provided by Teacher 1 appear largely characterized by additional exposure to the core curriculum (e.g., extended time). Four practices appeared to instructionally “go beyond” the core curriculum in some manner (e.g., independent acceleration, Tier 2 or Tier 3 instruction, and remedial skills practice). Two practices involved moving students to smaller groups. Daily peer tutoring was also implemented for a few students.

Teacher 2. Teacher 2 instructed 80 sixth-grade students. These students began, on average, scoring 11.21 points, which was about 1.5 points lower than the unweighted grand mean and was statistically significant ($t = -3.19, p = .001$). However, students progressed at a rate of 0.50 items correct per month, on average, which was a significantly higher rate than the unweighted grand mean ($t = 3.26, p = .001$). Indeed, students instructed by Teacher 2 progressed, on average, at a faster rate than students instructed by any other teacher in the study.

Teacher 2 labeled instructional practices by *General Instruction*, *Pre-Algebra*, and five different *Math Academy* instructional practices: (a) knowing fractions, (b) understanding fractions, (c) place value, (d) rational numbers, and (e) an unspecified global “Academy” intervention/instructional practice. Table 5 provides a description of each instructional label, as provided by Teacher 2, as well as the number and percentage of students within each group. Note that Teacher 2 used a general label *Academy* that appeared to correspond to the *Flex Friday* label used by other teachers in the same district. Of the 80 students instructed by Teacher 2, 64 were coded into either the *General Instruction* group or the *Academy* group. An additional five students were coded into both groups. The remaining 11 students were all coded as receiving each of the three more specific *Math Academy* interventions, with the exception of one student who was coded as receiving *Pre-Algebra*. All coded instructional information was academic in nature.

Teacher 3. Teacher 3 instructed 82 sixth-grade students. These students began and progressed at a level that was not significantly different from the unweighted grand mean of 12.70 and 0.23 points correct per month, respectively.

Teacher 3 indicated four instructional practices (Table 6): (a) 50 minutes of math help Monday through Thursday, (b) pre-teaching, (c) 140 minutes of math help on Fridays, and (d) 120 minutes a week of work-based fractions. Teacher 3 also indicated student participation in three *Math Navigator* units: (a) knowing fractions, (b) understanding fractions, and (c) place value. Students received zero (38 students, 46%) to six (1 student, 1%) interventions, with most receiving just one (22 students, 27%).

Approximately 73% of students who were administered one intervention were assigned work-based fractions as part of the *Math Navigator* unit. Approximately 14% of students received math help Monday through Thursday, while 9% were assigned to the place value unit of *Math Navigator*. Approximately 12% of students received two interventions. These students were assigned work-based fractions 90% of the time, with 70% of students also receiving math help on Fridays, and 20% receiving math help Monday through Thursday. The four students receiving three interventions all received math help on Fridays, as well as participating in the work-based fractions intervention. Three of the students in this group also received math help on Monday through Thursday. The remaining student in this group received a pre-teaching intervention. Of the six students receiving four interventions, all received work-based fractions and also pre-teaching. Approximately two-thirds participated in the place value unit of *Math Navigator*.

Teacher 4. Teacher 4 instructed 55 sixth-grade students. These students began, on average, scoring 8.73 points, which was nearly 4 points lower than the unweighted grand mean

and was statistically significant ($t = -6.13, p < .001$). The low initial achievement of students (average being slightly below the 20th percentile) would seem to suggest that many students were in need of additional academic attention. Students instructed by Teacher 4 were over 8 times as likely as students instructed by the “average” teacher to receive multiple interventions ($OR = 8.04, p < .05$). Students’ average linear growth was not statistically different from the unweighted grand mean ($t = 1.77, p = .076$).

Teacher 4 did not include any general instruction label, which made interpretation difficult because all students were represented in a single instructional group; thus, it was unclear whether all students received some sort of intervention in addition to core instruction, or if one of the instructional labels represented core instruction. The eight instructional grouping labels, along with a detailed description and the specific number of students represented within each group, are represented in Table 7. Based on the proportion of students represented in each instructional group, and information coded by other teachers within the same school, it would appear that *Flex Friday* was the closest grouping related to general instruction. Teacher 4 described *Flex Friday* as “a pre-teach/re-teach model for students who are just below standard in their regular gen-ed math class. The focus is on using equivalent fraction understanding to find common denominators for adding/subtracting fractions and for simplifying fractions.”

Approximately 89% of Teacher 4’s students received *Flex Friday* intervention.

Almost all students who were coded as receiving only one intervention received *Flex Friday*. The exceptions were two students who were coded in an *Enrichment* program – presumably an accelerated instructional program. Students coded as receiving two interventions generally also received *Flex Friday*, along with one of the *Math Academy* interventions. Two students were coded as also receiving *Enrichment*, while three were coded as receiving

Intervention. A similar pattern was observed for students who received three interventions, with students generally receiving one extra *Math Academy* intervention. Finally, almost all students receiving four interventions received *Flex Friday* and all three *Math Academy* interventions: Knowing Fractions, Place Value, and Understanding Fractions.

Teacher 5. Teacher 5 instructed 143 sixth-grade students. These students began the year scoring, on average, 15.84 points out of the 25 possible (~75th percentile). This beginning achievement level was over three points higher than the unweighted grand mean, and was statistically significant ($t = 9.73, p < .001$). Given the high initial achievement, we would theoretically expect fewer students to receive additional instructional attention. Yet, the ordinal regression analysis did not suggest students instructed by Teacher 5 were any less likely to be administered an intervention than students in other classes ($OR = .94, p < .05$). Students instructed by Teacher 5 made, on average, 0.09 points of linear growth per month, which was significantly lower than the unweighted grand mean linear slope ($t = -2.30, p = .02$).

Teacher 5 used two labels for instructional practices: *general instruction* and *peer tutoring*. Multiple instructional practices were also described without a label assigned by Teacher 5. These were analyzed and given 12 researcher-identified labels, as displayed in Table 8. It should be noted that Teacher 5 indicated not all students received general math (core) instruction based on the CCSS (135 of 143 students). Though the possibility exists that these eight students did not receive core curriculum, it appears more likely that this was a data entry error based on the instruction/intervention information indicated for them. For example, Teacher 5 indicated that two of these eight students received *preferential seating* and *out-of-class help sessions*. It seems unreasonable that these two students would receive these particular interventions without having also received core instruction in math.

Six of the twelve researcher-identified instructional practices appeared largely academic in nature, including one “industry packaged” math intervention, *Moby Math*, and four teacher-created interventions. *Moby Math* is an online math intervention offered by MobyMax that is designed to align with the CCSS and provide students extra practice in targeted skill areas (MobyMax, 2013). Teacher 5 indicated that five students received the Moby Math intervention one day per week for at least three weeks. The short duration of this intervention indicates that perhaps these students were struggling in one or more math skills, and thus, Teacher 5 supplemented CCSS core curriculum with Moby Math to improve specific skills. The remaining five interventions indicated as being implemented by Teacher 5 appeared as variations of extra instructional time, the most implemented of these being *peer tutoring*. Teacher 5 indicated that 33 students received daily peer tutoring in math for an average of 10 minutes per day. Other academic interventions included: *one-to-one instruction* ($n = 9$) for approximately 10 minutes over four days per week, and *out-of-class help session* ($n = 4$) implemented as a stand-alone intervention ($n = 2$) or in concert with another intervention (e.g., peer tutoring, parental communication).

In addition to academic information, five academic and/or behavioral-focused practices were also recorded. The most frequently implemented of these was *preferential seating* ($n = 77$). Additional intervention of this nature was generally a variation of *parental communication*. Six students received parental communication as a standalone intervention, while three additional students received it in concert with another intervention (e.g., out-of-class help sessions, positive reinforcement).

Results by Teacher: Grade 7

As mentioned previously, seventh grade students, on average, did not make growth significantly distinguishable from zero (i.e., flat). Further, neither this lack of growth, nor the odds of students being administered multiple interventions varied by teacher. That is, the *teacher* factor in the ordinal regression analysis was not significant for any individual teacher. Below, we describe the instructional practices for each of the three Grade 7 teachers included in the study, but do not discuss the average growth occurring within each classroom.

Teacher 6. Teacher 6 instructed 82 seventh-grade students who were coded as having received between 0 and 6 interventions. The following instructional labels were provided: (a) *General Instruction*, (b) *Flex Friday*, (c) *Progress-Monitoring*, and (d) *Math Academy*. The *Math Academy* label had both a general label, as well as three specific labels: (a) *Measurement*, (b) *Operations and Word Problems*, and (c) *Rational Numbers*. Full descriptions of each of these instructional labels, as well as the number of students receiving each, are provided in Table 9.

Twenty students, or approximately 24%, were coded as having only received *General Instruction*. Students coded as receiving two interventions generally received *General Education* along with *Flex Friday*, although five students received *Progress Monitoring*. Students coded with three labels were generally assigned to all three of these practices, while students coded as receiving more than three interventions were also assigned to one or multiple *Math Academy* interventions.

Teacher 7. Teacher 7 instructed 84 seventh-grade students and provided three instructional practice labels: (a) *Special Education for math*, (b) *Pre-Algebra*, and (c) *Flex Friday*, described as “a pre-teach/re-teach model for students performing just below standard in general education math classes”. During *Flex Friday*, teachers divided students based on their

educational needs to provide targeted instruction. Teacher 7 also indicated student participation in four *Math Academy* units: (a) measurement, (b) rational numbers, (c) understanding fractions, and (d) operations/word problems. Students received zero ($n = 7$ students, 8%) to four ($n = 11$ students, 13%) interventions, with the majority receiving only one ($n = 39$ students, 45%). Full descriptions of the instructional labels and the number of students receiving each, are provided in Table 10.

Approximately 54% of students who received one intervention were assigned to *Flex Friday*, with 41% to pre-algebra. The remaining 5% were assigned to either the measurement or the operations and word problems unit of *Math Academy*. The 21 students receiving two interventions were assigned to *Pre-Algebra* 57% of the time, with 48% of students participating in *Flex Friday*. Approximately 43% of students were assigned to the measurement portion of *Math Academy*, 19% to rational numbers, 14% to operations and word problems, and 5% to understanding fractions. In addition, 14% of students received *Special Education in math*. All six students receiving three interventions during the year were assigned to the measurement portion of *Math Academy*, four also participated in *Flex Friday*, three participated in *Math Academy* for rational numbers, three participated in *Pre-Algebra*, and one received an understanding fractions and operations and word problems intervention. All 11 students who received four interventions participated in the measurement portion of *Math Academy*, as well as *Flex Friday*. Eight were assigned to the operations and word problems portion of *Math Academy*, seven to understanding fractions, four to rational numbers, and three to *Pre-Algebra*.

Teacher 8. Two clear interventions were indicated for the 63 seventh-grade students instructed by Teacher 8: (a) *Special Education*; and (b) *Flex Friday*, described as “a pre-teach/re-teach model for students performing just below standard in general education math classes”.

Some students received *Flex Friday* for the whole year; others for two-month intervals. Teacher 8 also indicated students participated in five different *Math Academy* units: (a) measurement, (b) place value, (c) rational numbers, (d) understanding fractions, and (e) operations/word problems. Students received 0 ($n = 1$ student, 2%) to 4 ($n = 5$ students, 8%) interventions, with the majority receiving one ($n = 26$ students, 41%). Full descriptions of each of these instructional labels, as well as the number of students receiving each, are provided in Table 11.

The majority of students receiving only one intervention were assigned to either full year *Flex Friday* (42%), or to a two-month *Flex Friday* segment (31%). The same was largely true for the 19 students receiving two interventions. *Special Education* was coded as an intervention for six students (~32%). The 12 students receiving three interventions during the year were frequently assigned to full year *Flex Friday* (67%) and the measurement portion of *Math Academy* (67%). Roughly a third participated in a two-month *Flex Friday* segment. In the *Math Academy* intervention, an additional 42% of students received the place value component and/or the understanding fractions component, while roughly a third participated in the operations and word problems component. In the final group of five students receiving four interventions, all participated in the measurement portion of *Math Academy*, as well as some form of *Flex Friday* (40% full-year, 40% two two-month periods, 20% one two-month period).

Discussion

The purpose of this study was to explore students' mathematics growth on the easyCBM© CCSS Math measures in Grades 6 and 7, along with teachers' instructional practices. Specifically, we aimed to describe the average shape and rate of students' growth within each grade, explore general instructional decisions, and attempt to identify patterns in students identified for additional instructional support. Below, each item is discussed in turn.

Growth Modeling

The average rate and shape of students' growth was substantially different between the two grades. For Grade 6, an accelerating curvilinear trend best modeled the observed data. For Grade 7, a linear model best fit the observed data. Students' overall growth trajectories resulted in modest gains in both grades. In Grade 6, students were predicted to gain approximately one item correct per season (3 months), while in Grade 7 students did not, on average, make growth significantly different from 0. In Grade 6, the initial linear portion of the trajectory varied between students, but the curvilinear portion did not. In Grade 7, only the intercept varied significantly between students. Finally, in Grade 6, students made, on average, significantly different growth depending on the teacher by whom they were instructed. In Grade 7, students' slope did not vary between students, rendering an analysis of teacher effects untenable due to lack of variance in student scores.

The overall modest growth observed in the Grade 6 sample and the lack of any observed growth on average for Grade 7, likely relates to multiple factors. First, the measures themselves were found, in a previous study, to be functioning at less than ideal levels of reliability (e.g., $< .70$; Anderson et al., 2013a). Although students in Grade 7 exhibited, on average, flat growth, it is possible that some of this lack of growth was due to unreliability in measurement. Subsequent revisions to the measures have been made (Anderson, Alonzo, & Tindal, 2013b), and future studies using the easyCBM CCSS Math measures are anticipated to have more success in modeling students' growth with greater precision. Second, a growing body of research seems to suggest that the overall rate of mathematics acquisition, particularly in the upper grades, may simply be shallower than growth observed in other domains or grade levels (Foegen, Jiban, &

Deno, 2007; Irvin, Anderson, Saven, Alonzo, & Tindal, 2013; Saven, Anderson, Nese, Alonzo, & Tindal, 2013).

Alternative methods for scaling the measures (outside of raw scores) may help make the measures more sensitive to detecting changes in students' abilities. However, the challenge for teachers to use students' growth in mathematics within decision-making frameworks such as RTI will likely remain given that the "true" rate of acquisition in math conceptual understanding is modest when compared to early developmental skills (e.g., number recognition fluency and reading fluency). Third, this study was conducted with measures specifically written to align with the CCSS. However, the schools in which the study took place were all in their first year of implementing CCSS-based instruction. It is possible that students did not have adequate opportunity to learn the content prior to testing. As Burkhardt and Schoenfeld (2003) noted, "it takes a long time for a collaborative team [i.e., teachers] to discover and document the complexities of large-scale implementation" (p. 11). It is quite possible that the low growth observed was due, in part, to implementation effects associated with the transition to the Common Core.

General Instructional Practices

This study was conducted in two schools in two western states. Part of the challenge of evaluating instructional practices from a limited sample is that school or district policies will likely create common practices across teachers. Such was the case in this study. For instance, many teachers, who worked in the same school and likely shared students, coded *Flex Friday* as an instructional practice. This study also was conducted with teachers entering instructional information into an online repository, rather than having teachers' practices observed and coded by trained researchers. Although the online interface was convenient, the lack of depth of

information led us to be unable to achieve our initial goal – including instructional practices as covariates in growth analyses. Rather, the instructional information acquired supplemented the growth analyses. Yet even here, the information was not coded with sufficient detail to enable in-depth understanding of why differential rates of student growth might have occurred.

Teachers 1 and 2 had the largest difference in terms of students' average growth, with students instructed by Teacher 2 making approximately half a point of growth more per month, on average, than students instructed by Teacher 1. We were hopeful that the teacher-provided instructional information would supplement our results to help explain these discrepancies. Unfortunately, many questions remain. Although Teacher 2's students made significantly greater improvement relative to other teachers in this study, the coded instructional information was quite similar to Teachers 3 and 4, for whom average student growth was not significantly different than the mean of the group means. It is therefore unclear what Teacher 2 did instructionally different (if anything) from Teachers 3 and 4 that might account for his or her students progressing at a faster than average rate.

The overarching question of our study—how teacher instructional practices relate to student growth—remains largely unanswered. Future research should employ direct observation of teacher practices in addition to self-report techniques. Were more accurate data available, instructional practices could be entered directly into growth models so the effect of specific interventions might be observed. These analyses would then represent, essentially, an interrupted time series design in which the effects of interventions would be observable in direct relation to changes in student growth. Further, if students were administered interventions at different time periods, a multiple baseline design could be paired with the interrupted time series design. The

research design would then have strong internal validity, leading to greater confidence in any observed effects

Students Identified as In Need of Additional Support

Little information was available regarding why specific students were administered multiple interventions when others were not. The results of our ordinal regression analysis suggested that students' initial achievement was a consistent and quite strong predictor of the likelihood that students would be provided multiple interventions. Students' rate of improvement was a significant predictor in Grade 7, but not Grade 6. Teachers were not a significant predictor in Grade 7, but were the most important predictor (i.e., resulted in the greatest change in likelihood of receiving multiple interventions) in Grade 6.

The differences in the likelihood of students receiving additional interventions by teacher in Grade 6 was likely related to teachers in Grade 6 coming from two different schools in two different states, with different school-wide RTI policies, and serving different student populations. However, it also may have been the result of two teachers—Teacher 1 and Teacher 4—being quite discrepant in the number of interventions they provided from all other teachers. Follow-up comparisons were not conducted to examine, for instance, if the likelihood differed between Teacher 2 and Teacher 3. On the whole, however, teachers were different in the rate at which they provided interventions. It is also worth noting that Teacher 1 and Teacher 4 did, in fact, teach in different schools. The likelihood of students receiving an intervention in Teacher 1's classroom was significantly less than average, while the likelihood was significantly more in Teacher 4's classroom.

Clearly, more work needs to be completed to better understand how these decisions are being made. While the ordinal regression analysis showed some of the predictive power of

intercept and slope, there are surely other factors that come into consideration when determining *how many* and *which* interventions a student should receive (e.g., resource allocation, other academic performance indices). This study did little to address the specific types of interventions students received. Future research should focus specifically on these teacher decision-making aspects, as the validity of RTI rests on such decisions.

Conclusion

Although RTI has been adopted at an astounding rate across the country (Castillo & Batsche, 2012), its promises may be unfruitful if (a) teachers are not identifying the correct students for intervention, and/or (b) the intervention does not sufficiently increase students' achievement beyond what core instruction would otherwise provide. More research relating teachers' practices with students' growth is needed. The efforts of this study also suggest that self-report mechanisms for collecting intervention or instructional data may be insufficient. Accurate data requires not only precise coding of practices, but also specific dates from which the onset of instruction occurred. Such data were largely missing from our sample. Our study can therefore only be considered a preliminary analysis for future research.

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Table 1
Hierarchical Linear Growth Modeling Results

Parameter	Grade 6				Grade 7			
	Full	Final	Final 95% CI		Full	Final	Final 95% CI	
Fixed effects								
Intercept, β_{00}	12.73*	12.70*	12.14	13.25	12.73*	12.91*	12.46	13.36
Teacher 1, β_{01}	3.30*	3.04*	2.41	3.68	-	-	-	-
Teacher 2, β_{02}	-2.65*	-1.49*	-2.40	-0.57	-	-	-	-
Teacher 3, β_{03}	-2.00*	-0.73	-1.48	0.02	-	-	-	-
Teacher 4, β_{04}	-1.71	-3.97*	-5.24	-2.70	-	-	-	-
Teacher 5, β_{05}	3.05*	3.14*	2.51	3.77	-	-	-	-
Teacher 6, β_{06}	-	-	-	-	-0.29	-	-	-
Teacher 7, β_{07}	-	-	-	-	0.05	-	-	-
Teacher 8, β_{08}	-	-	-	-	0.24	-	-	-
Linear, β_{10}	0.20	0.23*	0.01	0.45	0.22	0.00	-0.10	0.09
Teacher 1, β_{11}	-0.60*	-0.27*	-0.39	-0.16	-	-	-	-
Teacher 2, β_{12}	0.87	0.27*	0.11	0.44	-	-	-	-
Teacher 3, β_{13}	0.54	-0.07	-0.20	0.05	-	-	-	-
Teacher 4, β_{14}	-0.78	0.21	-0.02	0.45	-	-	-	-
Teacher 5, β_{15}	-0.03	-0.14*	-0.25	-0.02	-	-	-	-
Teacher 6, β_{16}	-	-	-	-	0.36	-	-	-
Teacher 7, β_{17}	-	-	-	-	-0.28	-	-	-
Teacher 8, β_{18}	-	-	-	-	-0.08	-	-	-
Quadratic, β_{20}	0.06*	0.05*	0.02	0.08	-0.03	-	-	-
Teacher 1, β_{21}	0.05	-	-	-	-	-	-	-
Teacher 2, β_{22}	-0.07	-	-	-	-	-	-	-
Teacher 3, β_{23}	-0.06*	-	-	-	-	-	-	-
Teacher 4, β_{24}	0.10	-	-	-	-	-	-	-
Teacher 5, β_{25}	-0.02	-	-	-	-	-	-	-
Teacher 6, β_{26}	-	-	-	-	-0.05	-	-	-
Teacher 7, β_{27}	-	-	-	-	0.05	-	-	-
Teacher 8, β_{28}	-	-	-	-	0.00	-	-	-
Variance components								
Intercept, r_{0i}	2.50	2.56	2.31	2.83	3.04	2.74	2.36	3.16
Linear, r_{1i}	0.25	0.25	0.11	0.92	0.61	0.45	-0.34	0.20
Quadratic, r_{2i}	0.01	-	-	-	0.09	-	-	-
Residual, e_{ti}	2.44	2.45	2.38	2.53	2.69	2.73	0.34	0.57
Model Fit								
AIC	14246		14247		5869		5779	
BIC	14376		14336		5949		5809	
Deviance	14202		14217		5837		5767	

Note. Variance components reported in standard deviation units. No statistical test of variance components was performed. Confidence intervals computed from deviance profiling, and are displayed in the following format: lower bound estimate | upper bound estimate.

* $p < .05$

Table 2
Ordinal Regression Results

Parameter	Estimate	SE	95% CI: Est		Odds Ratio	95% CI: OR	
			Lower	Upper		Lower	Upper
Grade 6							
Intercept	-0.45*	0.09	-0.63	-0.27	0.64	0.53	0.77
Slope	-1.54	1.16	-3.82	0.73	0.21	0.02	2.08
Teacher 1	-2.33*	0.24	-2.83	-1.87	0.10	0.06	0.15
Teacher 2	0.08	0.20	-0.31	0.47	1.09	0.74	1.60
Teacher 3	0.22	0.20	-0.17	0.61	1.25	0.84	1.84
Teacher 4	2.08*	0.23	1.64	2.54	8.04	5.14	12.73
Teacher 5	-0.06	0.16	-0.39	0.26	0.94	0.68	1.30
Grade 7							
Intercept	-0.36*	0.06	-0.48	-0.24	0.70	0.62	0.78
Slope	-1.14*	0.43	-1.99	-0.31	0.32	0.14	0.73
Teacher 6	-0.09	0.18	-0.44	0.26	0.92	0.65	1.30
Teacher 7	-0.15	0.17	-0.49	0.19	0.86	0.61	1.20
Teacher 8	0.24	0.18	-0.12	0.60	1.27	0.89	1.82

* $p < .05$

Table 3

Number of Interventions students received, by teacher

<i>n</i> Interventions	Teacher							
	Grade 6				Grade 7			
	1	2	3	4	5	6	7	8
0	98 (.75)	31 (.39)	38 (.46)	0 (.00)	67 (.47)	20 (.24)	7 (.08)	1 (.02)
1	24 (.18)	29 (.36)	22 (.27)	30 (.54)	31 (.22)	2 (.02)	39 (.46)	25 (.40)
2	7 (.05)	10 (.13)	10 (.12)	8 (.14)	24 (.17)	11 (.13)	21 (.25)	20 (.32)
3	1 (.01)	10 (.13)	4 (.05)	6 (.11)	14 (.10)	19 (.23)	6 (.07)	12 (.19)
4	1 (.01)	0 (.00)	6 (.07)	12 (.21)	5 (.04)	17 (.21)	11 (.13)	5 (.08)
5	0 (.00)	0 (.00)	0 (.00)	0 (.00)	1 (.01)	6 (.07)	0 (.00)	0 (.00)
6	0 (.00)	0 (.00)	1 (.01)	0 (.00)	1 (.01)	7 (.09)	0 (.00)	0 (.00)
Total	131	80	82	56	143	82	84	63

Note. Proportion displayed in parentheses. Proportions not summing to 1.0 represent rounding error.

Table 4
Identified Instructional Practices: Teacher 1

Instructional Label	<i>N</i>	Time (minutes)	Freq (days/week)	Duration
Core Instruction (CCSS)	127	48-58	5	year
Core Instruction (CCSS) w/ Extended Time	2	48-58+	5	year
Core Instruction (CCSS) w/ Extended Time and Reader	1	48-58+	5	year
Core Instruction (CCSS) w/ Extended Time and Reader, Paper/pencil colored-paper testing	1	48-58+	5	year
Double Core Instruction (CCSS) w/ Extended Time and Reader	1	96-116+	5	year
Double Core Instruction (CCSS) w/ Peer Tutoring, Colored Paper	1	96-116+	5	year
Independent Accelerated	6	48-58	5	year
One-to-one Instruction	1	-	3	year
Peer Tutoring	1	10	5	year
Preferential Placement (morning)	1	48-58	5	year
Preferential Placement (smaller class)	1	48-58	5	year
Teacher Conferencing	6	10	1	year
Tier 2, 3 Instruction (CCSS)	11	48-58	5	year

Note. *N* counts across individual instructional label categories does not preclude an individual student from being in more than one category. *Year* is an assumed duration based on the date given for initiation of a given intervention and Teacher 1's instructional/intervention description.

Table 5

Instructional Descriptions: Teacher 2

Instructional label	Description	<i>n</i>	Percent
Academy (Flex Friday)	Flex Friday is an intervention designed as a pre-teach/re-teach model for students who are just below standard in their regular gen-ed math class. The focus is on fraction and decimal competencies throughout the year	10	12.5
Math Academy: Place Value	Students fill gaps on Place Value, rounding, reading and writing problems, fraction and decimal equivalents with denominators in tens	10	12.5
Math Academy: Understanding Fraction	180 minutes per week, Students fill gaps on fraction understanding using rulers and equivalent fractions. They explore connections between division and fractions and solve word problems involving length. Students order common and decimal fractions using area models, number lines, and both fraction and decimal notation.	11	13.8
Math Academy: Knowing Fractions	180 minutes per week. Student is enrolled in a math intervention class 180 minutes/week. 180 minutes per week, Math Navigator Unit: Knowing Fractions. Students use a ruler to measure and understand fractional amounts, then move to number lines to understand that a fraction represents a part over a whole. They find that rulers are fixed lengths but number lines are not. Students learn that fractional parts must have an equal area but their shapes may vary and that the size of fractions depends on the whole. When given the part, they can find the whole. Students learn that the whole can be a collection of objects as they gain fluency with different representations.	12	15.0
Math Academy: Rational Numbers	180 minutes per week. Students match visual representations with number line and area models to compare size of fractions and order them. They interpret both as a fraction and as a division problem. They convert fractions to decimals and learn to estimate decimal size of a given fraction. They work on fraction equivalency to understand adding and subtracting fractions, using diagrams to add meaning. They find meaning for multiplying and dividing fractions and search for common misconceptions.	1	1.3
Pre-Algebra	160 minutes per week. This is an accelerated class to prepare students for the rigor of Algebra as an 8th Grader. This intervention class contains an introduction and practice of 8th grade standards.	1	1.3
Measurement	180 minutes per week. Uses standard and metric units to determine length, perimeter, and area of polygons.	1	1.3

Table 6

Instructional Descriptions: Teacher 3

Instructional label	Description	<i>n</i>	Percent
50 Min Math Help M-H	Student receives 50 minutes of math help on Monday - Thursday.	12	7.5
Preteaching	Preteaching program: Circles, Algebra, Integers, and Surface Area.	4	2.5
Math Help 140 Min Friday	Student receives 140 minutes of math help on Fridays	17	10.6
Work Based Fractions	120 minutes of math Intervention a week. Work based fractions: Addition, subtraction, simplifying, and equivalents.	37	23.1
Math Navigator: Knowing Fractions	180 minutes per week. Students use a ruler to measure and understand fractional amounts, then move to number lines to understand that a fraction represents a part over a whole. They find that rulers are fixed lengths but number lines are not. Students learn that fractional parts must have an equal area but their shapes may vary and that the size of fractions depends on the whole. When given the part, they can find the whole. Students learn that the whole can be a collection of objects as they gain fluency with different representations.	5	3.1
Math Navigator: Place Value	180 minutes per week. Students fill gaps on Place Value, rounding, reading and writing problems, fraction and decimal equivalents with denominators in tens	8	5
Math Navigator: Understanding Fractions	180 minutes per week. Students fill gaps on fraction understanding using rulers and equivalent fractions. They explore connections between division and fractions and solve word problems involving length. Students order common and decimal fractions using area models, number lines, and both fraction and decimal notation.	6	3.8

Table 7

Instructional Descriptions: Teacher 4

Instructional Grouping label	Description	<i>n</i>	Percent
Flex Friday	An intervention designed as a pre-teach/re-teach model for students who are just below standard in their regular gen-ed math class. The focus is on: (a) using equivalent fraction understanding to find common denominators for adding/subtracting fractions and for simplifying fractions, (b) solving problems using fractions and decimals, using word problems, including surface area and volume questions, (c) background skills for algebraic thinking: factoring, exponential notation, Distributive Property, and solving equations, and (d) geometry [composite figures and volume of polyhedrons] and percentages [sales, discounts and tax].	49	89.1
Math Academy (MA)	Direct instruction math program. Basic computation skills.	2	3.6
MA: Knowing Fractions	Students use a ruler to measure and understand fractional amounts, then move to number lines to understand that a fraction represents a part over a whole. They find that rulers are fixed lengths but number lines are not. Students learn that fractional parts must have an equal area but their shapes may vary and that the size of fractions depends on the whole. When given the part, they can find the whole. Students learn that the whole can be a collection of objects as they gain fluency with different representations.	16	29.1
MA: Place Value	Students fill gaps on Place Value, rounding, reading and writing problems, fraction and decimal equivalents with denominators in tens.	15	27.3
MA: Understanding Fractions	Students fill gaps on fraction understanding using rulers and equivalent fractions. They explore connections between division and fractions and solve word problems involving length. Students order common and decimal fractions using area models, number lines, and both fraction and decimal notation.	16	29.1
MA: Measurement	Students determine measures of lengths using English and metric measurements. They can calculate area and perimeter of rectangular and nonrectangular shapes as well as produce reasonable estimates. They identify appropriate measurement labels/ notation and can determine elapsed time in context.	1	1.8
Enrichment	2 step equations, graphing Toothpick bridge building	3	5.5
Intervention	Students determine measures of lengths using English and metric measurements. They can calculate area and perimeter of rectangular and nonrectangular shapes as well as produce reasonable estimates. They identify appropriate measurement labels/ notation and can determine elapsed time in context.	7	12.7

Table 8
Identified Instructional Practices: Teacher 5

Instructional Label	<i>N</i>	Time (minutes)	Freq (days/week)	Duration
Core Instruction (CCSS)	135	50	5	year
Peer Tutoring	33	10	5	year
Moby Math	5	60	1	three weeks
One-to-one instruction	9	10	4	year
Out-of-class Help Session	2	-	2.5	-
Out-of-class Help Session, one-to-one instruction, parental communication w/ peer tutoring	1	-	-	-
Extended instruction	1	15	1	-
Parental communication	6	-	1	-
Parental communication w/ Out-of-class Help Session	1	-	1	-
Parental communication w/ Positive reinforcement	1	-	5	-
Positive reinforcement	2	-	5	year
Preferential Seating	77	-	5	year

Note. *N* counts across individual instructional label categories does not preclude an individual student from being in more than one category. For example, the same student may receive *preferential seating, parental communication, one-to-one instruction, and core instruction.*

Table 9

Instructional Descriptions: Teacher 6

Instructional Grouping label	Description	<i>n</i>	Percent
General Instruction	330 minutes of grade level mathematics instruction	82	100.0
Flex Friday	100 minutes of extra math instruction re-teaching and pre-teaching appropriate topics.	57	69.5
Math Academy	Monday - Thursday extra math for 45 minutes.	29	35.4
Math Academy: Measurement	180 minutes per week: Understanding Fractions	5	6.1
Math Academy: Operations and Word Problems	Students interpret the meaning of multiplication and division operations with symbols, diagrams and words. They investigate commutative property and estimate solutions for problems using all operations. Students study problem structures to recognize relationships and find mistakes in one-step problems. They recognize and use inverse relationships for problem solving.	16	19.5
Math Academy: Rational Numbers	Students match visual representations with number line and area models to compare size of fractions and order them. They interpret a/b both as a fraction and as a division problem. They convert fractions to decimals and learn to estimate decimal size of a given fraction. They work on fraction equivalency to understand adding and subtracting fractions, using diagrams to add meaning. They find meaning for multiplying and dividing fractions and search for common misconceptions	10	12.2
Progress Monitoring	easyCBM monthly progress check.	53	64.6

Table10

Instructional Descriptions: Teacher 7

Instructional Grouping label	Description	<i>n</i>	Percent
Flex Friday	100 Minutes per week Flex Friday is an intervention designed as a pre-teach/re-teach model for students who are just below standard in their regular gen-ed math class	68	81.0
Math Academy: Measurement	180 minutes per week. Students determine measures of lengths using English and metric measurements. They can calculate area and perimeter of rectangular and nonrectangular shapes as well as produce reasonable estimates. They identify appropriate measurement labels/ notation and can determine elapsed time in context	27	32.1
Math Academy: Operations and Word Problems	180 minutes per week. Students interpret the meaning of multiplication and division operations with symbols diagrams and words. They investigate commutative property and estimate solutions for problems using all operations. Students study problem structures to recognize relationships and find mistakes in one-step problems. They recognize and use inverse relationships for problem solving.	13	15.5
Math Academy: Rational Numbers	180 minutes per week Students match visual representations with numberline and area models to compare size of fractions and order them. They interpret both as a fraction and as a division problem. They convert fractions to decimals and learn to estimate decimal size of a given fraction. They work on fraction equivalency to understand adding and subtracting fractions using diagrams to add meaning. They find meaning for multiplying and dividing fractions and search for common misconceptions..	11	13.1
Math Academy: Understanding Fractions	180 Minutes per week Math Navigator Unit: Understanding Fractions. Students fill gaps on their understanding of fractions and basic operations.	9	10.7
Pre-Algebra	160 minutes per week. This is an excellerated class to prepare students for the rigor of Algebra as an 8th Grader. This intervention class contains an introduction and practice of 8th grade standards	34	40.5
Regular Math Instruction	330 Minutes per week of regular grade level instruction.	82	97.6
SPED Math	180 Minutes per week This is a SPED math support class	3	3.6

Table 11

Instructional Descriptions: Teacher 8

Instructional label	Description	<i>n</i>	Percent
Flex Friday	100 minutes/week. Flex Friday is an intervention designed as a pre-teach/re-teach model for students who are just below standard in their regular gen-ed math class. The focus for Jan-Feb is on understanding scale factors with similar polygons and part-to-part and part-to-whole ratios. Focus for Mar-Apr has gone from decimal/fraction equivalents to surface area and volume of cylinders cones and pyramids to data analysis with stem-and-leaf plots to probability. May-June includes data-statistics and probability. More algebra equation work has been added.	58	92.1
Math Academy: Measurement	180 minutes per week Math Navigator Unit: Measurement. Students determine measures of lengths using English and metric measurements. They can calculate area and perimeter of rectangular and nonrectangular shapes as well as produce reasonable estimates. They identify appropriate measurement labels/ notation and can determine elapsed time in context.	22	34.9
Math Academy: Place Value	180 minutes per week Math Navigator Unit: Place Value Decimals to Billions. Students fill gaps on place value rounding reading and writing problems fraction and decimal equivalents with denominators in tens.	11	17.5
Math Academy: Rational Numbers	180 minutes per week, Math Navigator Unit: Rational Numbers. Students match visual representations with number line and area models to compare size of fractions and order them. They interpret both as a fraction and as a division problem. They convert fractions to decimals and learn to estimate decimal size of a given fraction. They work on fraction equivalency to understand adding and subtracting fractions, using diagrams to add meaning. They find meaning for multiplying and dividing fractions and search for common misconceptions	5	7.9

Table 11 (continued)

Instructional Descriptions: Teacher 8

Instructional label	Description	<i>n</i>	Percent
Math Academy: Understanding Fractions	180 minutes per week Math Navigator Unit: Understanding Fractions. Students fill gaps on fraction understanding using rulers and equivalent fractions. They explore connections between division and fractions and solve word problems involving length. Students order common and decimal fractions using area models number lines and both fraction and decimal notation	12	19.0
Operations and Word Problems	180 minutes per week Math Navigator Unit: Measurement. Students determine measures of lengths using English and metric measurements. They can calculate area and perimeter of rectangular and nonrectangular shapes as well as produce reasonable estimates. They identify appropriate measurement labels/ notation and can determine elapsed time in context.	6	9.5
SPED Math	180 Minutes per week This is a SPED math support class	7	11.1

Intervention

Student Name: **Example Student**

Date:

Subjects: Reading
 Math
 Spanish

Label:

Description:

[Add this same intervention for other students?](#)

<input type="checkbox"/> Adalberto Ball	<input type="checkbox"/> Marcene Fairfax	<input checked="" type="checkbox"/> Franklyn Stice
<input checked="" type="checkbox"/> Alaina Bernier	<input type="checkbox"/> Perry Leiser	<input type="checkbox"/> Example Student
<input type="checkbox"/> Janett Bohman	<input checked="" type="checkbox"/> Rusty Macy	<input type="checkbox"/> Margurite Wake
<input type="checkbox"/> Mary Cupp	<input type="checkbox"/> Reatha Nelson	<input checked="" type="checkbox"/> Marvis Wiebe
<input type="checkbox"/> Bobbie Dimauro	<input type="checkbox"/> Ross Pitcher	<input type="checkbox"/> Chi Wilde
<input type="checkbox"/> Darline Engstrom	<input type="checkbox"/> Christopher Poore	

Figure 1. Interface teachers used to enter instructional information. All names are pseudonyms. Note that the teacher selects the subject area for the instruction the student received, the date the instruction began, provides a label and description of the instruction, and selects all other students receiving the same instruction.

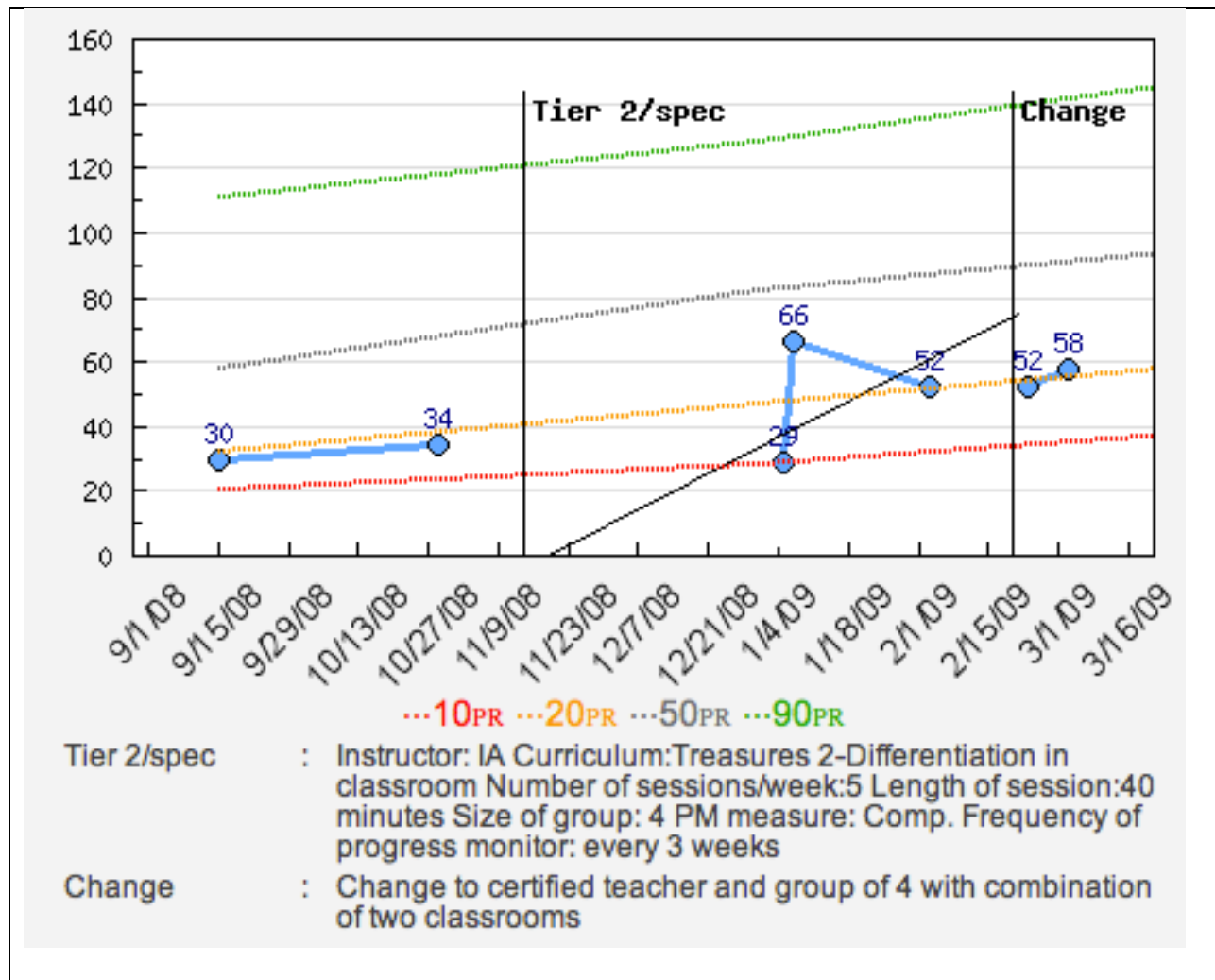


Figure 2. Hypothetical time-series graph with instructional information. Note that the slope of the improvement line (black line) is not calculated until three time points are available. Further, the slope stops after new instructional information is provided, so that teachers can see how the slope changes pre- and post-intervention (or instructional change).

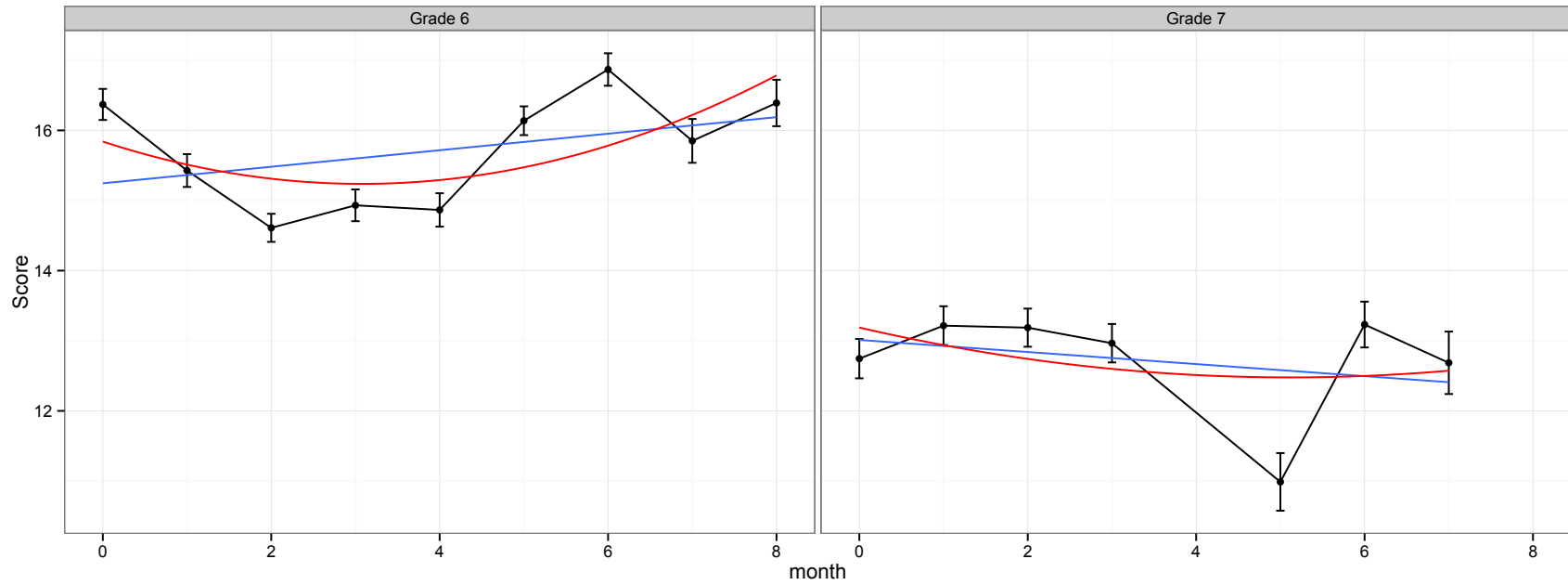


Figure 3. Means by Grade. The plot for each grade shows a quadratic, curvilinear fit to the data (red line) and a linear fit to the data (blue line).

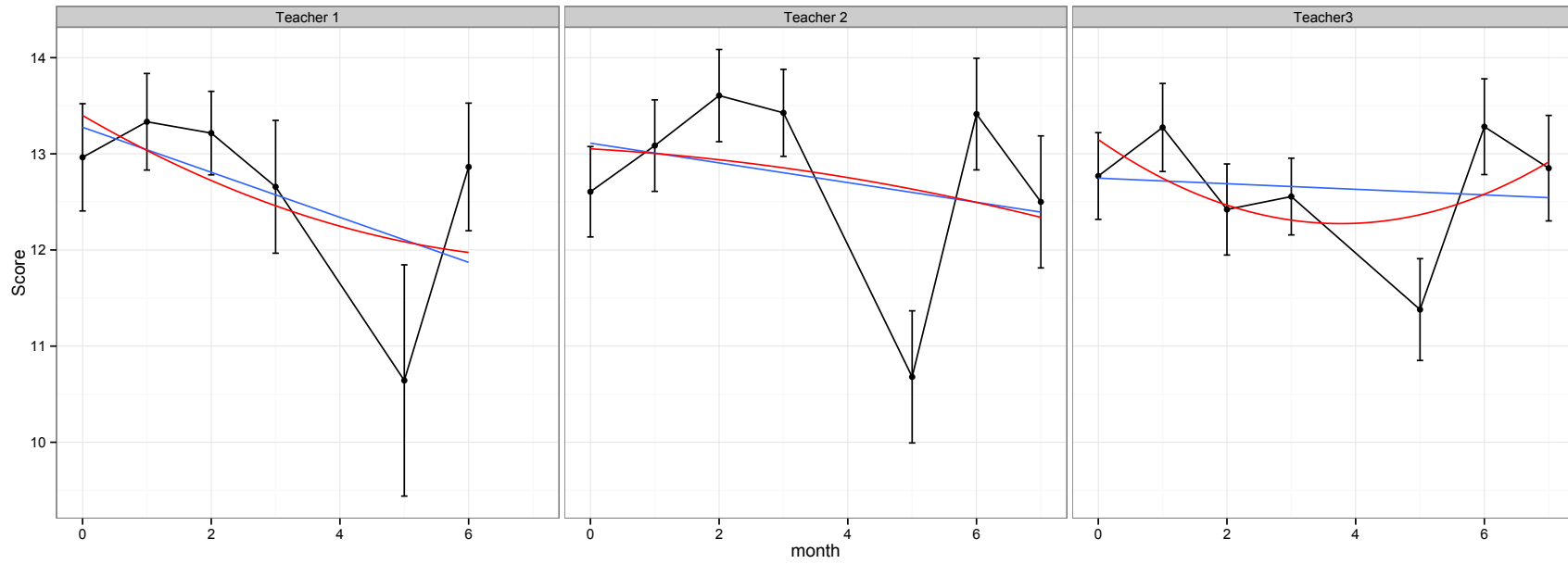


Figure 4. Means by Grade 7 Teachers. The plot for each grade shows a quadratic, curvilinear fit to the data (red line) and a linear fit to the data (blue line). Note that a similar drop occurs coincident with the fifth time point across all three teachers.

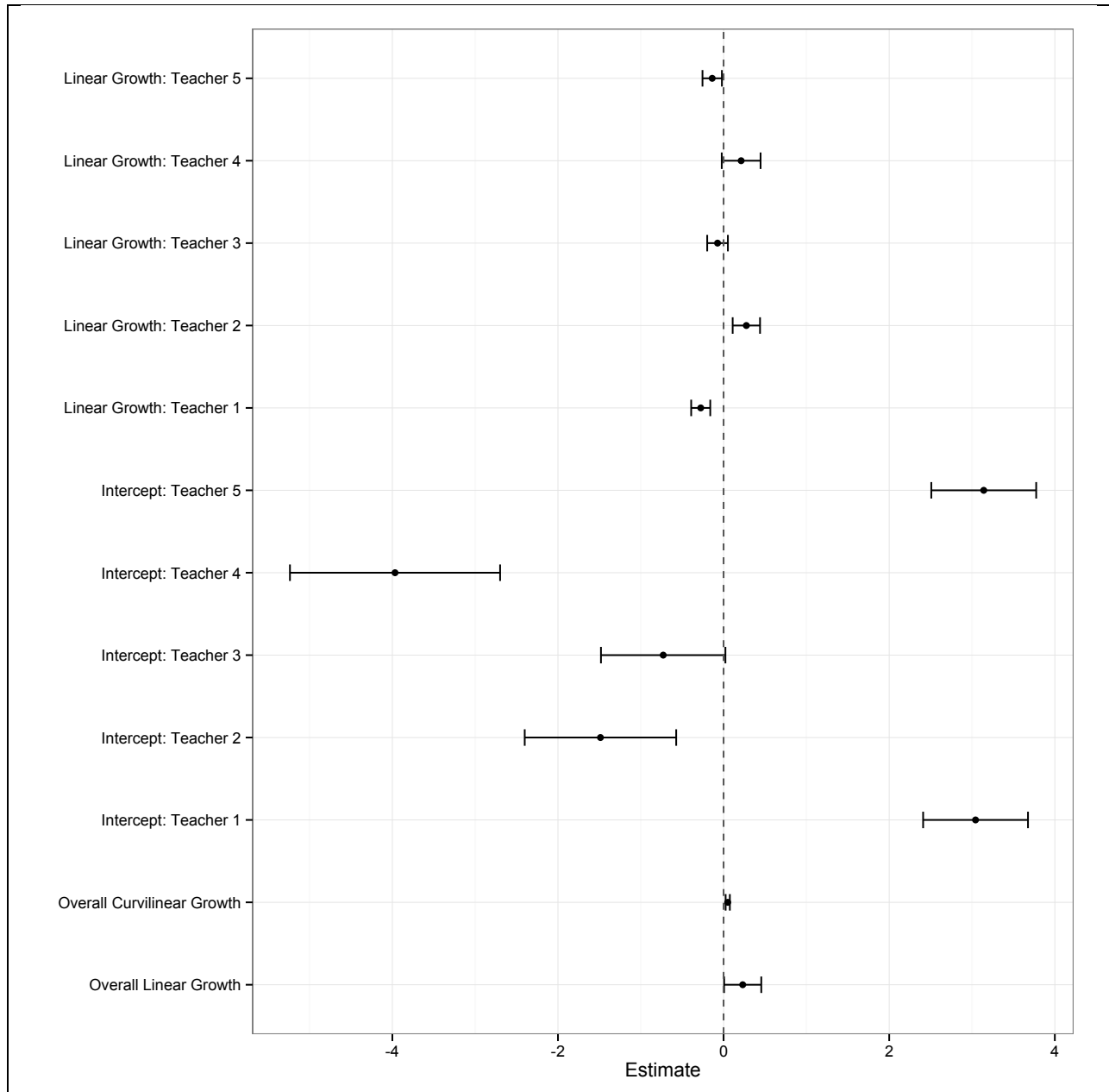


Figure 5. Grade 6 fixed effects coefficients. Note that the intercept is not represented, but was estimated with a value of 12.14. Values are representative of the linear model, so fixed effect linear growth estimates for teachers are relative to the overall linear growth (displayed at the bottom of the figure).