

*Changing Mathematics and Reading Achievement
with Direct Instruction:
Kment Elementary School in Roseville, Michigan*

Technical Report 2015-1



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Executive Summary

This report examines changes in mathematics and reading skills of students in a Michigan elementary school after instruction with the Direct Instruction programs *Connecting Math Concepts: Comprehensive Edition (CMCCE)* and *Reading Mastery Signature Edition (RMSE)*. Mathematics skills were measured by the AIMSweb curriculum-based measures and the Michigan Educational Assessment Program (MEAP). Reading skills were measured with MEAP data. Analyses with all measures and grades indicated that students who were exposed to the DI programs had significantly higher scores than those without such exposure. Almost all of the associated effect sizes were substantially larger than the criterion typically used to denote educationally significant results.

Changing Mathematics and Reading Achievement with Direct Instruction: Kment Elementary School in Roseville, Michigan¹

This report examines changes in mathematics and reading skills of students in Kment Elementary School in Roseville, Michigan after the Direct Instruction programs *Connecting Math Concepts: Comprehensive Edition (CMCCE)* and *Reading Mastery: Signature Edition (RMSE)* were adopted. The first section examines changes in mathematics scores and the second examines changes in reading scores. The data provide consistent and strong evidence that Kment students had improved skills in both math and reading after using these Direct Instruction programs.

Changes in Mathematics Skills

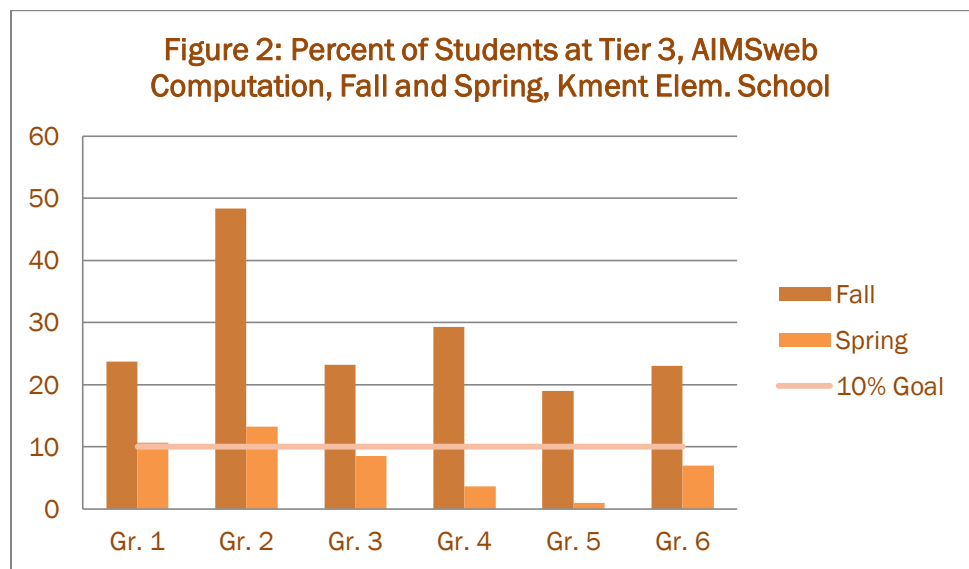
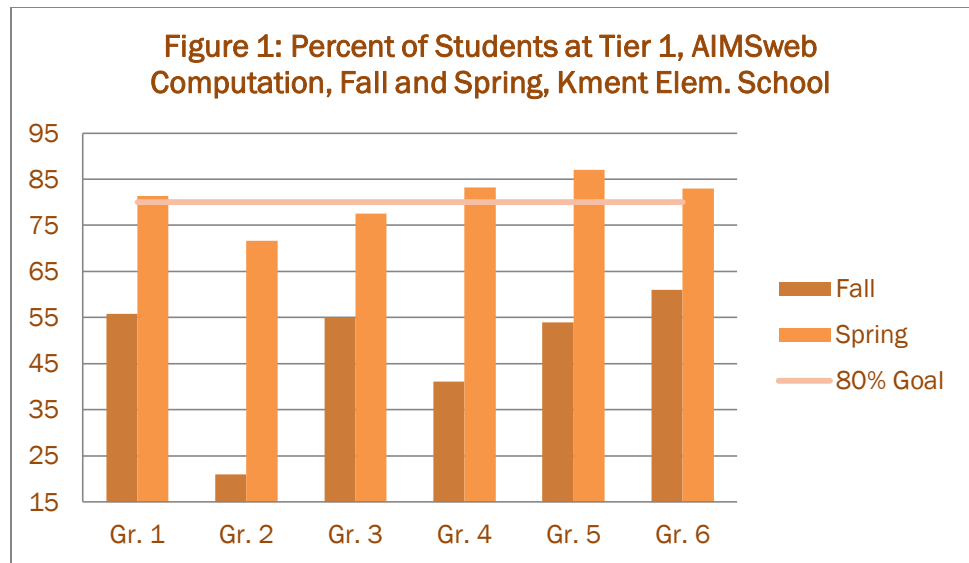
Kment Elementary uses the AIMSweb system for measuring students' progress in mathematics. The results of the test inform teachers and administrators which students are at grade level, called Tier 1; those that need some supplemental instruction, called Tier 2; and those that need intensive assistance if they are to catch up to grade level, called Tier 3. Guidelines suggest that schools should strive to have 80 to 90 percent of their students at Tier 1 and no more than 10 percent at Tier 3.

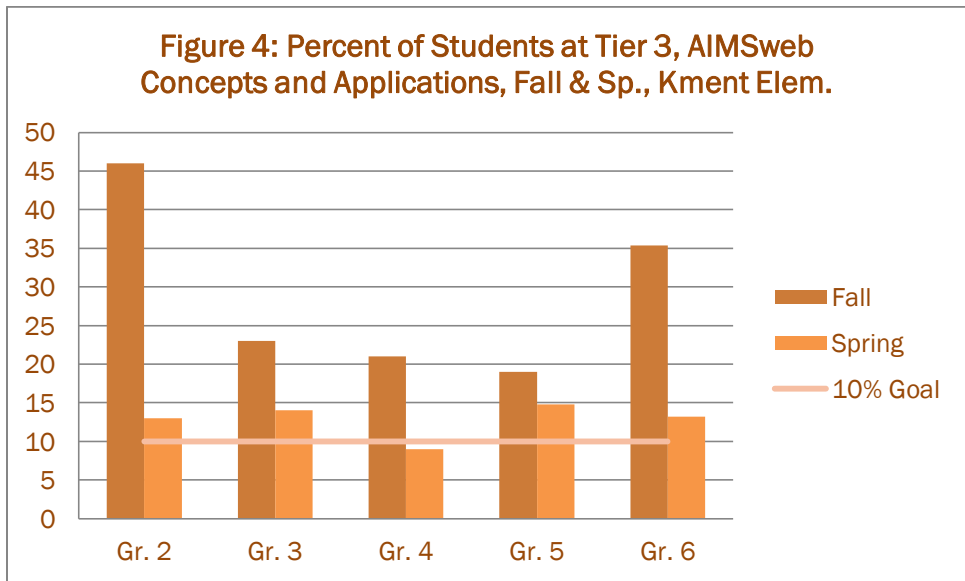
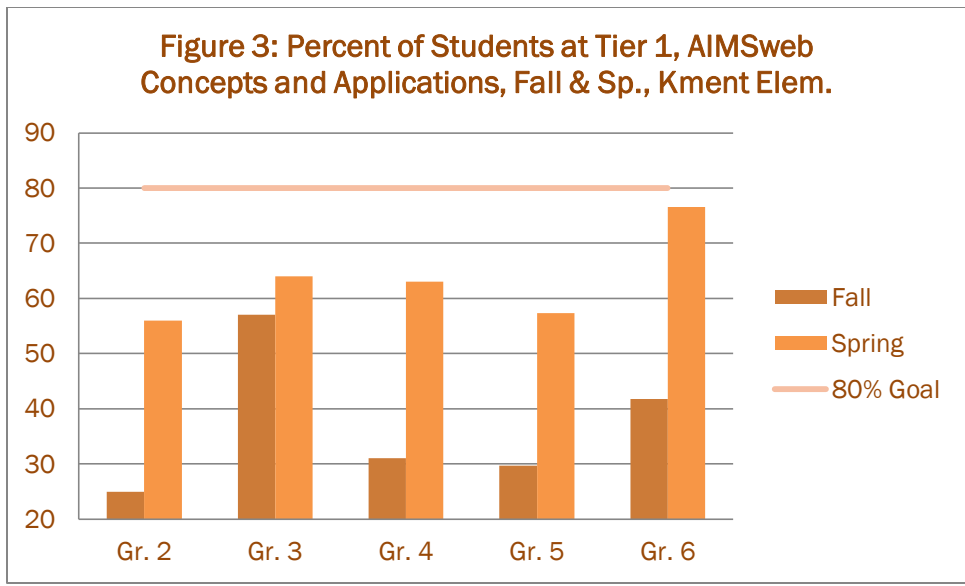
Kment began using *CMCCE* in the fall of 2013. At that time, only 48% of the students scored at the Tier 1 level on the AIMSweb measure of Computational Skills (COMP) and even fewer (37%) were at this level on the measure of Concepts and Applications (CAP). By the spring of 2014, after one year of instruction with *CMCCE*, 80% of the students were in Tier 1 on the measure of Computations and 62% were in Tier 1 on the measure of Concepts and Applications. As students were moving into Tier 1, they were also moving out of Tier 3 and the need for intensive extra assistance. In the fall of 2013, 28% of the students were in Tier 3 on COMP and 29% in Tier 3 on CAP. By the spring, these numbers had dropped to 8% and 13%, respectively.

The dramatic changes appeared at all grade levels and with both measures. Figures 1 and 2 illustrate the changes in the measure of computational skills for Tier 1 and Tier 3, while Figures 3 and 4 show the changes in the measure of concepts and applications. In each figure the darker bar shows the percentage in the fall and the lighter bar shows the

¹ The author gratefully acknowledges the helpful comments of Leigh Brougher, Christina Cox, and Bryan Wickman on earlier drafts. All conclusions and opinions in this document are, however, the sole responsibility of the author.

percentage in the spring. The line going across each figure shows the typical goal for each tier: 80% or more of the students in Tier 1 and 10% or fewer students in Tier 3. It is clear that the school was much closer to meeting these goals by the spring of 2014 than it was in the fall before starting work with CMCCE. Substantially more students were at grade level and substantially fewer students were in need of intensive special assistance.





Statistical analyses regarding the changes are in Table 1. All of the changes over time were statistically significant. Policymakers and statisticians often use a measure of effect size to describe the magnitude of change when an intervention is introduced. Traditionally, an effect size of .25 or greater has been deemed educationally important. The average effect size was .68, more than twice the magnitude seen as educationally significant. Only two of the 22 effect sizes calculated were smaller than the .25 value. Figures 5 and 6 show the effect sizes associated with the changes over time for both AIMSweb measures and each grade level. The darker bar shows the effects for changes in Tier 1 placement, the lighter bar shows the effects associated with changes in Tier 3 placement, and the line shows the level defined as educationally significant.

Table 1

Percentage of Students at Tier 1 Fall, Winter, and Spring by Grade and AIMSweb Test, Significance Tests and Effect Sizes Associated with the Change from Fall to Spring, Kment Elementary

<u>Grade and Test</u>	<u>Fall %</u>	<u>Winter %</u>	<u>Spring %</u>	<u>Z (Fall to Spring)</u>	<u>prob.</u>	<u>Effect Size</u>
Grade 1 Comp	56	51	81	12.90	<.001	0.64
Grade 2 CAP	25	55	56	15.01	<.001	0.78
Grade 2 Comp	21	56	72	24.50	<.001	1.27
Grade 3 CAP	57	53	64	3.33	<.001	0.18
Grade 3 Comp	55	68	78	10.71	<.001	0.56
Grade 4 CAP	31	60	63	14.70	<.001	0.80
Grade 4 Comp	41	66	83	19.34	<.001	1.05
Grade 5 CAP	30	62	57	11.83	<.001	0.69
Grade 5 Comp	54	81	87	14.14	<.001	0.83
Grade 6 CAP	42	53	77	11.91	<.001	0.87
Grade 6 Comp	61	70	83	7.53	<.001	0.55

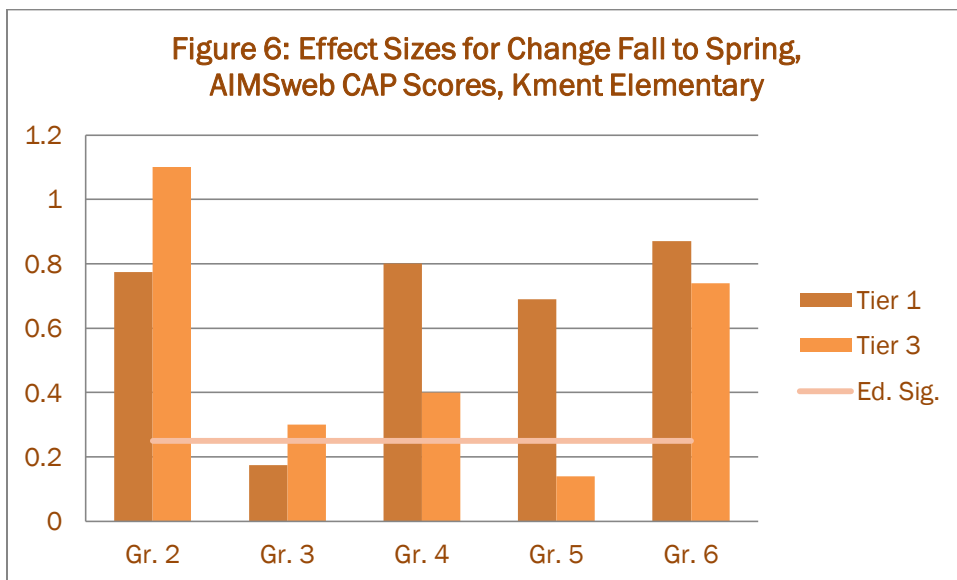
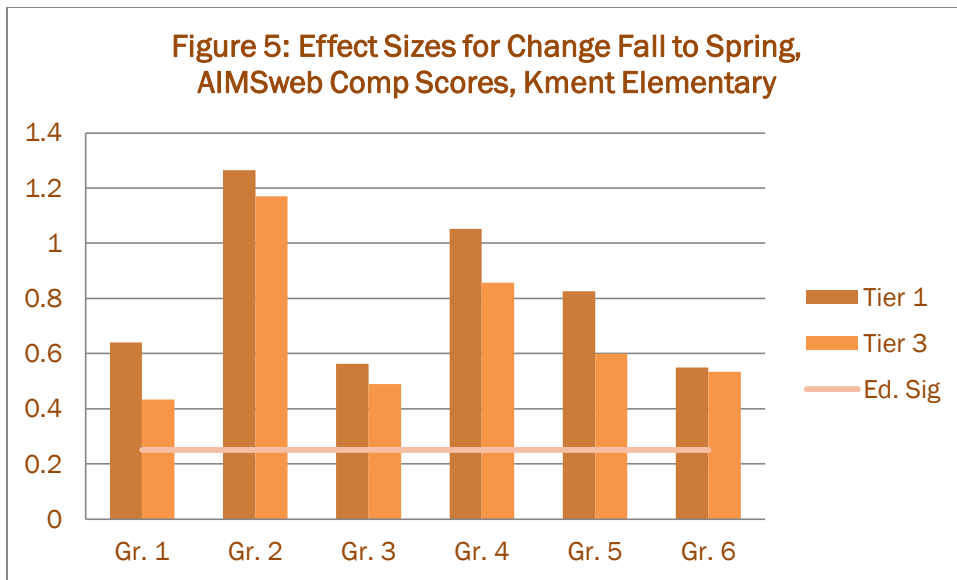
Note: The Z-scores are testing the null hypothesis that there was no change in the percentage at Tier 1 from fall to spring. The effect sizes reflect the magnitude of the change from fall to spring.

Table 2

Percentage of Students at Tier 3 Fall, Winter, and Spring by Grade and AIMSweb Test, Significance Tests and Effect Sizes Associated with the Change from Fall to Spring, Kment Elementary

<u>Grade and Test</u>	<u>Fall %</u>	<u>Winter %</u>	<u>Spring %</u>	<u>Z (Fall to Spring)</u>	<u>prob.</u>	<u>Effect Size</u>
Grade 1 Comp	24	25	11	11.65	<.001	0.43
Grade 2 CAP	46	17	13	28.40	<.001	1.10
Grade 2 Comp	48	23	13	30.21	<.001	1.17
Grade 3 CAP	23	19	14	7.62	<.001	0.30
Grade 3 Comp	23	17	9	12.44	<.001	0.49
Grade 4 CAP	21	4	9	9.80	<.001	0.40
Grade 4 Comp	29	4	4	20.98	<.001	0.86
Grade 5 CAP	19	12	15	3.20	<.001	0.14
Grade 5 Comp	19	6	1	13.71	<.001	0.60
Grade 6 CAP	35	13	13	13.51	<.001	0.74
Grade 6 Comp	23	13	7	9.74	<.001	0.53

Note: The Z-scores are testing the null hypothesis that there was no change in the percentage at Tier 3 from fall to spring. The effect sizes reflect the magnitude of the change from fall to spring.



Similar changes also appeared in scores on the Michigan Educational Assessment Program (MEAP), an examination given to all students in the state in grade 3 and higher. Figure 7 shows the percentage of students scoring at the proficient level or higher on the mathematics portion of the MEAP for the 2012-13 year, before exposure to CMCCE, and for the 2013-14 school year, after exposure for one year. On average, only 20 percent of the students were at the proficient level before exposure to CMCCE. But, after one year of exposure, almost double that percentage (39 percent) were at this level. The positive changes occurred at each grade, all of the associated effect sizes were larger than the

educationally significant threshold (see Figure 8), and all of the changes were statistically significant (see Table 3).

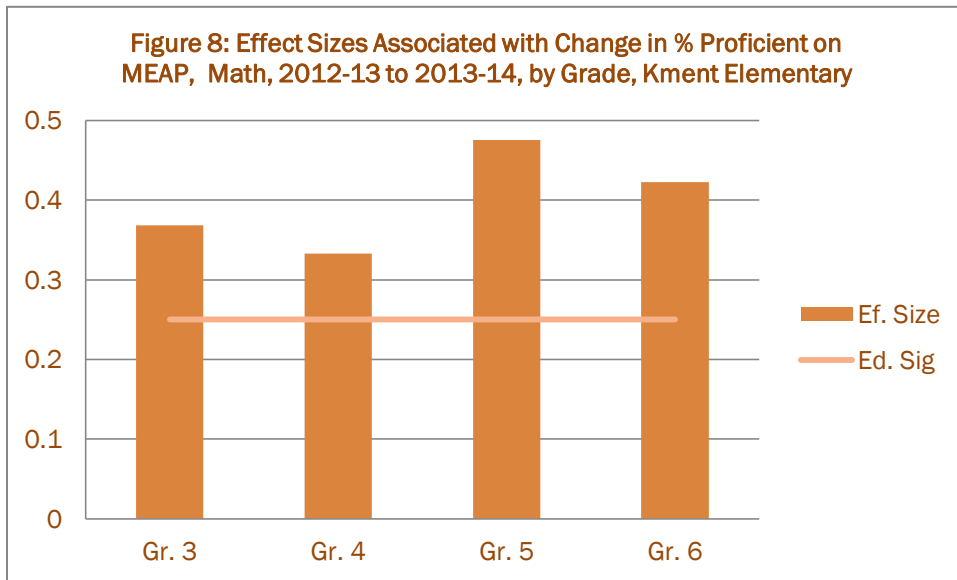
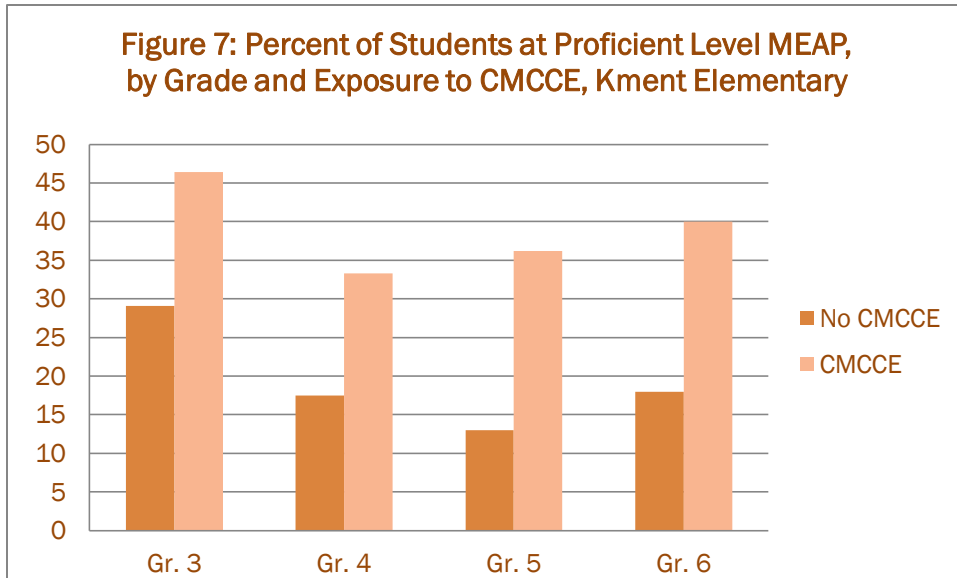


Table 3

Percent of Students Scoring at Proficient Level on Michigan Educational Assessment Program (MEAP), 2012-13 and 2013-14, Mathematics, Kment Elementary and State of Michigan and Associated Effect Sizes and Tests of Significance

<u>Grade</u>	<u>2012-13</u>		<u>2013-14</u>		<u>Effect Size</u>	<u>Z</u>
	<u>State</u>	<u>School</u>	<u>State</u>	<u>School</u>		
Gr. 3	40.9	29.1	40.1	46.4	0.37	5.67***
Gr. 4	46.1	17.5	45.3	33.3	0.33	4.86***
Gr. 5	45.7	13	45.2	36.2	0.48	6.48***
Gr. 6	40.2	18	41.5	40	0.42	4.63***

Note: Sample size information obtained from the AIMSweb reports. The effect sizes and tests of significance report the change at the school relative to the change in the state as a whole. Statistics were calculated using the method described in J. Stockard (2013) "Merging the Accountability and Scientific Research Requirements of the No Child Left Behind Act: Using Cohort Control Groups," *Quality and Quantity: International Journal of Methodology*, 47, pp. 2225-2257.

Changes in Reading Skills

The school began using the Direct Instruction program *Reading Mastery: Signature Edition (RMSE)* for students in kindergarten through grade 2 in the fall of 2012. At the same time they also began using the Direct Instruction program *Corrective Reading (CR)* with fourth, fifth, and sixth graders who were struggling in the subject. In the fall of 2013, all students in grades 3 and 4 began to use *Reading Mastery*, while, in fifth and sixth grade, the struggling readers continued to use *CR*.

Figure 9 shows the percentage of third to sixth grade students who scored at the proficient level on the reading portion of the MEAP in 2012-13 and 2013-14. Given the way in which the introduction of the Direct Instruction programs varied over the years, each of the comparisons in the figure is slightly different in nature. For the third grade cohorts, none of the students had *RM* in the first year (2012-13), but all would have been exposed in the second year (2013-14). In addition, because they would have had *RMSE* in second grade, their cumulative exposure to the program in the second year was two years of instruction in *RMSE*. For the fourth, fifth and sixth grade cohorts, struggling readers would have had exposure to *DI* programs in the first year. In the second year all fourth graders would have had *RMSE*, while the fifth and sixth graders who continued to struggle with reading would have the Direct Instruction program *Corrective Reading*. In short there are three types of comparisons in Figure 9: 1) a cohort where no students had *DI* compared to a cohort where all had *DI* for two grades (grade 3), 2) a cohort where only struggling readers had *DI* compared with a cohort where all students had *DI* (grade 4), and 3) cohorts where struggling readers had one year of exposure to *DI* versus a cohort where struggling readers had two

years of exposure (grades 5 and 6), but, in both cohorts, none of the other, non-struggling students had DI programs.

Despite these variations in “dosage,” all of the comparisons in Figure 9 show strong differences between the 2012-13 and 2013-14 cohorts. At all grades the proportion of students scoring at the proficient level on the Reading MEAP was higher in 2013-14 than in 2012-13, and all of the comparisons were statistically significant (See Table 4). While all effect sizes were positive, only the effects associated with changes for grades 3 and 6 surpassed the level generally used to denote educational significance.

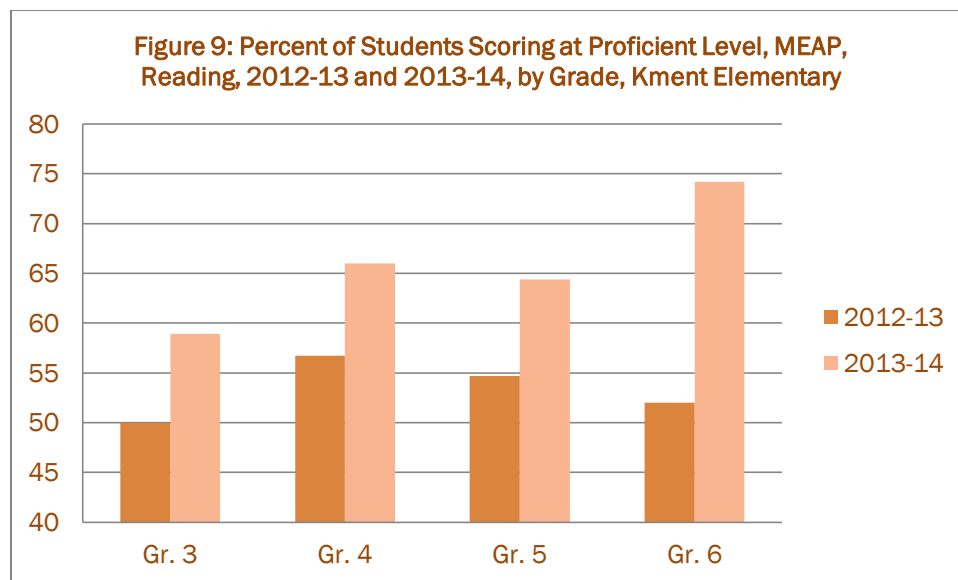


Table 4

Percent of Students Scoring at Proficient Level on Michigan Educational Assessment Program (MEAP), Reading, 2012-13 and 2013-14, Kment Elementary and State of Michigan and Associated Effect Sizes and Tests of Significance

Grade	2012-13		2013-14		Effect Size	Z
	State	School	State	School		
Gr. 3	66.5	50.0	61.3	58.9	0.30	4.73***
Gr. 4	68.1	56.7	70.0	66.0	0.16	2.48***
Gr. 5	70.4	54.7	71.7	64.4	0.18	2.72***
Gr. 6	68.2	52.0	71.5	74.2	0.41	4.79***

Note: Sample size information used to calculate the z-values was obtained from the AIMSweb reports for mathematics and reported in the first section of this document. The effect sizes and tests of significance report the change at the school relative to the change in the state as a whole and were calculated as described for Table 3. See the text for further explanation of the exposure of the cohorts to Direct Instruction.