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## The Effect of Constructivist Mathematics on Achievement in Rural Schools

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# The Effect of Constructivist Mathematics on Achievement in Rural Schools

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*International assessment data indicate American students are not competing with their counterparts in other countries. The mathematics curriculum and pedagogy are not preparing students to compete in a global economy. This study compared student achievement using sixth grade mathematics results from the Illinois Standards Achievement Test. Specifically, the study compared the results of students in three different rural school districts, all of whom were receiving instruction in three different mathematics curricula. In one district, students received seven years of the K-6 Everyday Mathematics curriculum which was compared with students who received seven years of instruction using a traditional mathematics curriculum in the second district and in the third district scores were compared with students who were taught using a traditional mathematics curriculum supplemented with Mountain Math. The results of this study indicate the constructivist K-6 elementary mathematics curriculum did not lead to higher levels in math achievement when compared with the traditional methods of instruction.*

**Key words:** mathematics curriculum; student achievement; constructivist curriculum; traditional methods of instruction

In recent years national and international assessments have spurred America's educational and political leadership into action. Mediocre results from the 2003 and 2007 *Trends in International Mathematics and Science Study* (TIMSS) as well as results from the 2003, 2006, and 2009 *Program for International Student Assessment* (PISA) have brought intense criticism on the United States public education system to change, specifically mathematics instruction, so that students can compete with their peers from other countries. The 2011 report published by the National Center for Education Statistics Institute of Education Sciences on the National Assessment of Educational Progress (NAEP) for fourth and eighth graders showed the average scores for fourth graders in 2011 did not show significant change from 2009. The scores of the eighth graders did show an upward trend with a 1 point increase from 2009 and a 3 point increase from 2007. Despite this trend, 32 states and jurisdictions showed no significant change at either the fourth or eighth grade. In 2008, the National Mathematics Advisory Panel declared the delivery system in mathematics education in the United States as broken and

must be fixed. The panel recommended instruction be varied and not solely student-centered or teacher-directed (U.S. Department of Education, 2008).

Despite this call, theorists have not been able to agree on a particular approach to the teaching of mathematics. Ellis and Berry (2005) point out the lack of consensus that exists in the U.S. about how to improve mathematics education. Since the 1980's, two schools of thought have been used to address the performance short-comings: the procedural-formalist curriculum and a constructivist curriculum; more recently referred to as the cognitive-cultural curriculum by Ellis and Berry (2005). The procedural-formalist curriculum is synonymous with a more traditional approach to mathematics instruction, which emphasizes a set of logically organized facts, skills, and procedures that are perfected over time. Within this traditional approach to teaching, students practice these skills and procedures repeatedly until a minimum level of competence is attained. Assessment of learning is structured around the belief there is only one way to solve a mathematics problem. Some researchers view

the traditional, procedural-formalist curriculum approach to learning as a passive process of learning facts, skills, and procedures (Stigler & Heibert, 1997; Ellis & Berry, 2005). Fifteen years ago Stigler and Heibert (1997) asserted the typical eighth-grade mathematics lesson in the United States was organized around this passive form of instruction.

The constructivist approach to mathematics instruction views learning as an active process. Cobb (1988) suggested that constructivism challenges the assumption that meanings reside in words, actions, and objects independently of an interpreter. Teachers and students are viewed as active meaning-makers who continually give contextually based meanings to each other's words and actions as they interact. Von Glaserfeld (1989) provided the following definition of constructivism.

Constructivism is a theory of knowledge with roots in philosophy, psychology, and cybernetics. It asserts two main principles whose application has far-reaching consequences for the study of cognitive development and learning as well as for the practice of teaching, psychotherapy, and interpersonal management in general. The two principles are: (a) knowledge is not passively received but actively built up by the cognizing subject; and (b) the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality. (p. 162)

One program, *Everyday Mathematics*, developed by the University of Chicago School Mathematics Project and based on constructivist principles, is being used by 2.8 million students in 175,000 classrooms (What Works Clearinghouse, 2007). Several studies have examined the effects of *Everyday Mathematics* on student achievement. Carroll (2001) conducted a longitudinal study of children using the *Everyday Mathematics* curriculum. The study compared Japanese, Chinese, traditionally taught U. S. students, and U.S. students taught *Everyday Mathematics*. The *Everyday Mathematics* first grade students performed higher than both the Chinese and the traditionally taught U.S. first graders, but below the Japanese students. This improvement in scores relative to the Chinese group indicated a positive effect of the curriculum (Carroll, 2001).

Briars and Resnick (2000) examined the way *Everyday Mathematics* narrowed the achievement gap between African American and Caucasian students on the New Standards

Mathematics Reference Exam (NSMRE). In their study, the Pittsburgh Public School System adopted the *Everyday Mathematics* curriculum in grades K – 5. To assess the effect of this curriculum, the study examined NSMRE data from 1995 to 1998. The results of the study showed a significant improvement in student skills, concepts, and problem solving. The percent of students in the lowest scoring category in problem solving declined from 23 percent in 1996 to 7 percent in 1998. The study found that some teachers did a better job of implementing the curriculum than other teachers. In the classrooms where the implementation of *Everyday Mathematics* was strong, virtually no students scored in the lowest levels of the NSMRE in the areas of concepts, skills, and problem solving. African American students in classrooms with a strong implementation of *Everyday Mathematics* outperformed Caucasian students in classrooms with a weak implementation of *Everyday Mathematics*.

Similar results were found by the ARC Center Tri-State Student Achievement Study (2001). The study examined the effects of three purported constructivist math curricula, *Everyday Mathematics*, Math Trailblazers, and Investigations in Number, Data, and Space. The study examined the standardized test performance (ISAT, MCAS, ITBS, and WASL) of students in Illinois, Massachusetts, and Washington State. The results showed students using *Everyday Mathematics*, Math Trailblazers, or Investigations in Number, Data, and Space outperformed traditionally taught students. The results were consistent across all grade levels and all mathematical strands, regardless of social economic status and ethnicity. The study concluded these curricula improved student performance in all areas of elementary mathematics, including basic skills and higher-level processes (ARC Center, 2001).

Riordan and Noyce (2001) extended the finding of the ARC study by examining the impact *Everyday Mathematics* had on fourth grade elementary students' mathematics achievement. Riordan and Noyce hypothesized students in schools with *Everyday Mathematics* would score significantly higher on the Massachusetts statewide math test. Schools in this study were matched on the previous year's Massachusetts Educational Assessment Program (MEAP) test prior to the implementation of *Everyday Mathematics* and by the percentage of students eligible for the free and reduced lunch program. The results of the quasi-experimental

design of matched comparison groups showed the students using *Everyday Mathematics* outscored their counterparts from 2.5 to 5.7 points on an 80 point scale. Furthermore, the study showed *Everyday Mathematics* was effective for all students, regardless of race or socioeconomic status.

Waite (2000) conducted research comparing the effects of *Everyday Mathematics* versus a more traditional approach on student achievement of third, fourth, and fifth graders in a large, urban, North Texas school district. The two groups studied were similar in socioeconomic status, ethnicity, gender, and grade makeup. Prior mathematical achievement was assessed using the Iowa Test of Basic Skills to determine if there was a statistical difference between the control (2,704 students) and experimental (732 students) groups. No difference was found. The research found there was a significant difference in student achievement on the Texas Assessment of Academic Skills math scores for the students taught using *Everyday Mathematics* over the more traditional approach. Students using *Everyday Mathematics* scored on average 3.9 points higher than the traditionally taught students.

Not all researchers believe that *Everyday Mathematics* should be the curriculum of choice. Wang (2001) claims the curriculum omits skills and topics that are detrimental to students, leaving them unprepared for higher level mathematics topics taught in middle school, high school, and college. In response to Wang (2001), Ysseldyke, Spicuzza, Kosciolk, and Boys (2003) conducted a study comparing 157 fourth and fifth graders using *Everyday Mathematics* along with Accelerated Math against a control group of 61 students receiving only *Everyday Mathematics*. Accelerated Math is a computer program that allows a teacher to manage multiple instructional tasks like matching instruction to an individual student's skill level, providing appropriate practice, monitoring student progress, and giving corrective feedback. The rationale behind using Accelerated Math in conjunction with *Everyday Mathematics* was to address the lack of practice on basic math facts that critics claim. The Northwest Achievement Levels Test, which measures students' basic skills in mathematics, and the STAR Test, which also measures basic skills in mathematics, were used to determine the effect of the treatment on the control group. The results of the study indicated students receiving *Everyday*

*Mathematics* and Accelerated Math together demonstrated more growth than the students receiving only *Everyday Mathematics*.

Despite the mixed results outlined above, proponents of constructivist approaches such as *Everyday Mathematics* consider it to be a superior mathematics curriculum. School districts all over the United States have adopted it as their primary method of mathematics instruction, especially in the K-6 curriculum. Unfortunately, few studies have examined the impact of the constructivist *approaches* instruction in rural settings, nor have they compared constructivist approaches with methods rural schools currently use to address student performance needs at the elementary school level. This is not surprising given recent findings by ACCLAIM (Appalachian Collaborative Center for Learning, Assessment, and Instruction Mathematics) which showed that until 2001 "no specifically relevant empirical literature could be said to exist that addressed rural mathematics education" (Howley, Howley, & Huber, 2005, p. 2). To help rural schools improve instructional practice, comparative studies examining rural school mathematics approaches are particularly important at this time given the tendency for rural communities to value more traditional methods over alternative, reform based methods (Howley, 2003; Howley, Larson, Adrianaivo, Phodes, & Howley, 2007).

The purpose of the current study was to compare *Everyday Mathematics* with traditional programs of mathematics instruction. The study was guided by the following research question, what effect does *Everyday Mathematics* instruction have on the performance of students in rural schools? More specifically, the study compared the performance of rural school students taught with a K-6 *Everyday Mathematics* curriculum to the performance of students taught using a more traditional math curriculum.

## Method

The present study was designed to compare the effects of *Everyday Mathematics* curriculum with a more traditional mathematics curriculum. To make the comparison, the performances of students in three northern Illinois rural schools were examined. The three schools were selected based on the length of time students had been exposed to the school's curriculum; each school had been using the same method of instruction in grades K through 6. The two schools using a

more traditional approach were select because their textbook series encourage teachers to follow a traditional lesson sequence consistent with the procedural formalist paradigm. During the lessons teachers show students how to solve a particular problem, students then practice similar problems either alone or in groups while the teacher monitors their progress. Additional problems are then assigned as independent practice. One of the schools also supported student learning by using a supplemental review program called *Mountain Math*. The supplemental review program emphasizes repetition and was used to support daily lessons.

### Participants

The study compared the Illinois Standards Achievement Test (ISAT) math scores for two cohort groups from the three schools: 2006 and 2007. The 2006 cohort group consisted of the following: a) 116 sixth grade students from School A who received the *Everyday Mathematics* curriculum from kindergarten through sixth grade, b) 73 sixth grade students from School B who were taught mathematics traditionally, and c) 213 sixth grade students from School C who were taught mathematics traditionally and supplemented with *Mountain Math*. The 2007 cohort groups consisted of: a) 94 students from School A, b) 91 students from School B, and c) 176 students from School C.

School A is located in a rural, north-central Illinois town with a population of approximately 9,800 citizens. It uses the K-6 *Everyday Mathematics* curriculum and houses grades six through eight with an enrollment of 576 students. Sixty-six percent of the students are Caucasian, 28 percent Hispanic, four percent multi-racial, and two percent African American. School A's mobility rate is 22.6 percent and 29.7 percent were low income. The students receive 58 minutes of math instruction each day and are not ability grouped.

School B is located in a rural, north-central Illinois town of approximately 7,300 citizens. School B uses the Silver/Burdett textbook series. It is considered to be a traditional approach to mathematics instruction because it encourages teachers to use a direct instruction approach. The first page of every section includes a discussion of the topic to be learned. This is followed by a step-by-step process of instruction which includes lecturing, modeling the process by solving example problems, guided practice, independent practice and homework. School B

houses grades four through eight and has an enrollment of 752 students. Sixty-seven percent are Caucasian, 30 percent Hispanic, 1 percent multi-racial, 1 percent African American, and about 1 percent Asian. Forty-six percent of the students are low income, and the mobility rate is 18.9 percent. The elementary and middle school students in this district received between 45 and 50 minutes of daily mathematics instruction. Overall, the students are not grouped by achievement or ability; however, fifth grade students identified as gifted in math are allowed to be accelerated into the sixth grade mathematics curriculum.

School C is located in rural, north-central Illinois in a town with a population of 15,300 citizens. It uses the Houghton/Mifflin Math textbook series along with *Mountain Math*, a supplemental program, at the K-2 level to reinforce daily math lessons. The Houghton/Mifflin series is also considered to be a traditional approach to mathematics instruction because it uses a direct instruction approach to learn new math concepts and solving problems. Each teaching lesson introduces an objective and provide teachers with a step-by-step process for introducing and developing a concept followed by guided and independent practice monitored by the teacher, and a lesson quiz to assess student understanding.

School C houses grades six through eight with an enrollment of 711 students. Seventy percent of the students are Caucasian, 20 percent Hispanic, 7 percent multi-racial, 2 percent African American, and 1 percent Asian. Thirty-seven percent of the students are low income, and the mobility rate is 11 percent. At the kindergarten through second grade levels, students receive 50 minutes of math instruction each day along with an additional 15 to 20 minutes of *Mountain Math*. *Mountain Math* was used to support daily lessons. Students are not grouped by achievement or ability during kindergarten through second grade. Beginning in third grade level, student showing advanced achievement are advanced one grade level. Fifth grade students are grouped by achievement in mathematics.

The dependent variables in the study, based on Illinois Standards Achievement Test (ISAT) data, include test scores of number sense, measurement, algebra, geometry, and probability, as well as a general mathematics scale score. The mathematics assessment contains 65 multiple choice questions, two short-constructed-response questions, one extended-

response question, and seven field-test questions. The results are reported in terms of percent of items answered correct.

### Results

To determine the effect of the *Everyday Mathematics* curriculum on the performance of students in rural schools, the 2006 and 2007 sixth grade ISAT math scores were analyzed. The results reported here reflect data for students who attended schools A, B, and C from Kindergarten through 6<sup>th</sup> grade. The findings show comparisons of general mathematics scale scores along with a comparison by ethnicity, gender, special education status. The report also includes a comparison by the ISAT math subtests.

### Overall Math Scale Scores

Table 1 shows the means and standard deviations for 2006 and 2007 sixth grade ISAT mathematics scale scores. The 2006 data indicate the mean scale score for the K-6 *Everyday Mathematics* curriculum was the lowest of the three schools and the Traditional+ curriculum's mean scale score was the highest. A one-way ANOVA using the 2006 data indicate there was no significant difference in sixth grade ISAT mathematics scales scores among the three schools,  $F(2, 399) = 2.14$ ,  $p > .05$ . The 2007 data also indicate the mean scale score for the K-6 *Everyday Mathematics* curriculum was the lowest of the three schools.

**Table 1**  
*Means and Standard Deviations for 2006 and 2007 Sixth Grade ISAT Mathematics Scale*

<i>Scores</i>			
School	N	Mean	Standard Deviation
2006			
Everyday Mathematics	116	246.48	23.40
Traditional Mathematics	73	248.21	28.97
Traditional+ Mountain Math	213	252.03	22.99
2007			
Everyday Mathematics	94	246.72	25.81
Traditional Mathematics	91	253.13	25.50
Traditional+ Mountain Math	176	252.47	22.97

The Traditional curriculum had the highest mean scores. The one-way ANOVA results indicated there was no significant difference in sixth grade ISAT mathematics scales scores among the three schools,  $F(2, 358) = 2.11$ ,  $p > .05$ ,  $\eta^2 = .01$ .

### Ethnicity

A two-way ANOVA was used to analyze differences among the scale scores of the three schools using two years of data, 2006 and 2007 Sixth Grade ISAT mathematics. Because some ethnic groups had a small sample size (e.g., Asian, multi-racial), ethnicity was collapsed into two groups: Caucasian and Non-Caucasian. Table 2 shows the means and standard deviation for the Caucasian and non-Caucasian groups. The 2006 data indicated that the mean scale

score for Caucasian students was lowest for the K-6 *Everyday Mathematics* curriculum and highest for Traditional+ curriculum. For non-Caucasian students, the Traditional+ curriculum had the highest mean scale score and the Traditional curriculum had the lowest mean scale score. Two-way ANOVA results indicated no school by ethnicity effect in the 2006 sixth grade ISAT mathematics scale scores,  $F(2, 396) = .50$ ,  $p > .05$ .

The 2007 data indicate that for Caucasian and for non-Caucasian students in the three schools the mean scale score was the lowest for the K-6 *Everyday Mathematics* curriculum and highest for the Traditional curriculum. The two-way ANOVA results indicate no school by ethnicity effect in the 2007 sixth grade ISAT mathematics scale scores,  $F(2, 355) = .69$ ,  $p > .05$ .

**Table 2**  
2006 and 2007 Mean ISAT Mathematics Scale Scores for Three School by Ethnicity

School	Ethnicity	2006			2007		
		N	Mean	SD	N	Mean	SD
Everyday Mathematics	Caucasian	73	250.81	23.65	60	249.03	26.24
	Non-Caucasian	43	239.14	21.27	34	242.65	24.88
Traditional Mathematics	Caucasian	51	253.47	30.07	64	257.55	25.81
	Non-Caucasian	22	236.00	22.40	27	242.67	21.78
Traditional + Mountain Math	Caucasian	138	255.76	23.76	111	255.66	23.67
	Non-Caucasian	75	245.17	19.89	65	247.03	20.78

**Gender**

The 2006 and 2007 means and standard deviations for the ISAT scale scores for each school by gender are reported in Table 3. The 2006 data show the mean scale score for the K-6 *Everyday Mathematics* curriculum was the lowest of the three schools for both male and female students, and the Traditional+ curriculum had the highest mean scale score for both males and females. The two-way ANOVA results

indicate no school by gender effect,  $F(2, 396) = .04, p > .05$ . The 2007 data show the mean scale score for the K-6 *Everyday Mathematics* curriculum was the lowest of the three schools for both male and female students. The Traditional+ mathematics curriculum had the highest mean scale score for females and the Traditional curriculum had the highest mean scale scores for males. The two-way ANOVA results indicate no school by gender effect,  $F(2, 355) = .36, p > .05$ .

**Table 3**  
2006 and 2007 Mean ISAT Mathematics Scale Scores for Three Schools by Gender

School	Ethnicity	2006			2007		
		N	Mean	SD	N	Mean	SD
Everyday Mathematics	Female	62	245.8	20.47	46	244.50	21.62
	Male	54	247.2	26.55	48	248.85	29.34
Traditional Mathematics	Female	38	247.4	27.66	37	249.73	24.08
	Male	35	249.0	30.72	54	255.46	26.39
Traditional + Mountain Math	Female	115	251.9	23.23	95	252.14	22.70
	Male	98	252.1	22.82	81	252.86	23.42

**Special Education Status**

Means and standard deviations for the ISAT scale scores are reported for each school by special education status in Table 4. The 2006 data show the mean scale scores were lowest for the K-6 *Everyday Mathematics* curriculum among the three schools for non-IEP students.

The mean score were highest for the Traditional+ curriculum. The Traditional+ curriculum had the highest mean scale scores for IEP students and the Traditional mathematics curriculum had the lowest mean scale scores. Two-way ANOVA results indicated no school by special education status effect among the three schools,  $F(2, 396) = 1.12, p > .05$ .

**Table 4**  
*2006 and 2007 Mean ISAT Mathematics Scale Scores for Three Schools by Special Education Status*

School	Special Ed. Status	2006			2007		
		N	Mean	SD	N	Mean	SD
Everyday Mathematics	IEP	14	225.64	25.18	12	228.92	27.10
	No-IEP	102	249.34	21.76	82	249.33	24.72
Traditional Mathematics	IEP	9	218.00	15.47	15	229.93	19.38
	No-IEP	64	252.45	27.93	76	257.71	24.11
Traditional + Mountain Math	IEP	33	234.58	17.38	23	229.52	13.51
	No-IEP	180	255.23	22.49	153	255.92	22.12

The 2007 data show the mean scale score for the K-6 *Everyday Mathematics* curriculum was the lowest of the three schools for both IEP and non-IEP students, and the Traditional mathematics curriculum had the highest mean scale scores,  $F(2, 355) = .53, p > .05$ .

**ISAT Mathematics Subtests**

Means and standard deviations for each of the five subtests for each school are presented in Table 5 (2006 results) and Table 6 (2007 results). The data in Table 5 indicate the school using the K-6 *Everyday Mathematics* curriculum had the lowest mean scale score for number sense ( $M = 58.65$ ) with the Traditional

curriculum having the highest ( $M = 62.66$ ). The school using the K-6 *Everyday Mathematics* curriculum also had the lowest mean scale score for measurement with the Traditional+ curriculum having the highest score. The school using the Traditional mathematics curriculum had the highest mean scale score in number sense, but the lowest mean scale scores in algebra, geometry, and probability. The school using the Traditional+ mathematics curriculum had the highest mean scale scores in measurement, algebra, geometry, and probability. Results from a one-way MANOVA indicate scores from all the different subtests did not differ significantly among schools, Wilk's Lambda  $F = 1.84, p > .05$ .

**Table 5**  
*Means and Standard Deviations for the 2006 Sixth Grade ISAT Mathematics Scale Scores for each Subtest by School*

	Everyday Mathematics (N=116)		Traditional Mathematics (N=73)		Traditional + (N=213)	
	Mean	SD	Mean	SD	Mean	SD
Number Sense	58.65	21.08	62.66	24.42	61.69	18.94
Measurement	70.78	22.77	71.51	21.06	73.24	19.53
Algebra	61.58	22.30	60.71	22.44	63.92	20.99
Geometry	69.00	17.46	66.53	21.02	72.71	17.50
Probability	53.72	24.39	52.04	23.76	57.44	22.66

The 2007 data in Table 6 indicate the school using the K-6 *Everyday Mathematics* curriculum had the lowest mean scale score for number sense, measurement, algebra, geometry, and probability. The school using the Traditional mathematics curriculum had the highest mean scale scores in measurement, geometry, and probability. The school using the Traditional+ mathematics curriculum had the highest mean scale scores in number sense and algebra.

MANOVA results for the 2007 data indicate there was a difference among the scores on the five subtests, Wilk's Lambda  $F = 4.51, p < .05$ . Follow-up ANOVA tests were conducted to find out which test was responsible for the difference on the MANOVA. Results indicate the difference was found in the algebra subtest  $F_{\text{algebra}} = 6.03, p < .01$ . Post hoc tests were performed on the algebra subtest to determine which scores were significantly different.

Bonferroni procedure was used for the post hoc test because it is a more conservative test (Fielding, 2006). Results indicate the school using the K-6 *Everyday Mathematics* curriculum

had a significantly lower subtest score in algebra ( $M = 61.23$ ) than the school using the Traditional+ curriculum ( $M = 70.25$ ).

**Table 6**  
*Means and Standard Deviations for the 2007 Sixth Grade ISAT Mathematics Scale Scores for each Subtest by School*

	Everyday Mathematics (N=94)		Traditional Mathematics (N=91)		Traditional+ (N=176)	
	Mean	SD	Mean	SD	Mean	SD
Number Sense	63.98	18.71	64.78	19.87	68.58	18.10
Measurement	65.27	23.31	71.53	22.62	68.12	20.85
Algebra	61.23	21.31	65.29	20.11	70.25	20.86
Geometry	67.90	19.61	75.68	18.93	69.96	17.11
Probability	57.02	21.64	63.52	21.93	61.14	19.82

### Discussion and Implications

There is little doubt the world we live in is becoming more complex and competitive. Mathematics skills are a vital necessity for rural students to compete in the global economy. Finding the best mathematics curriculum to educate rural school students in the United States has been difficult and much debated, and until recently very little research focused on mathematics education in the rural context. During the past several decades, two approaches to math instruction have been documented: a traditional procedural-formalist approach and a constructivist approach. The overarching question of the current study was to what effect does seven years of *Everyday Mathematics* instruction have on the performance of students in rural schools? The study specifically compared the performance of rural school students taught with a K-6 *Everyday Mathematics* curriculum to the performance of students taught using more traditional math curricula. Examination of the data suggests there is no significant difference in the performance levels of students taught with the *Everyday Mathematics* curriculum as compared to students taught with a more traditional approach. The pattern was consistent for all areas examined in the study (i.e., ethnicity, gender, SES, and special education status). There was no significant difference in achievement for rural students on the state math assessments, with one exception: the algebra subtest results. In which case, students taught using *Everyday Mathematics* performed lower than their peers who were taught with a traditional approach supplemented with *Mountain Math*. These findings are inconsistent with previous studies of

*Everyday Mathematics* (ARC, 2001; Briars and Resnick, 2000; Riordan and Noyce, 2001; and Waite, 2000).

Much of the past research indicated students who were exposed to the *Everyday Mathematics* curriculum outperformed students taught using a traditional mathematics curriculum. Wood and Sellers (1997) found fourth grade elementary students receiving two years of problem-centered mathematics instruction outperformed traditionally taught fourth graders on standardized tests. Waite (2000) studied two groups of third, fourth, and fifth grade students from a large, urban Texas school district; one which taught using *Everyday Mathematics* and the other traditionally taught. The *Everyday Mathematics* students outperformed the traditionally taught students on the TAAS.

The ARC Center Tri-State Student Achievement Study (2001) and Riordan and Noyce (2001) found students taught using *Everyday Mathematics* outperformed traditionally taught students regardless of socioeconomic status or ethnicity. The ARC Center Study's sample included students across all elementary grade levels, from three different states, Illinois, Massachusetts, and Washington, and used the ISAT, MCAS, ITBS, and WASL to measure student achievement, while Riordan and Noyce utilized the Massachusetts State-wide test. Also, both studies examined only one year of data, which could also explain the differences in their findings.

While the current study found no significant differences with the comparison group of students, the study was limited by several factors that could be investigated in future research. The first area of research needs to address the implementation effect and possible biases by

teachers. No measures were taken to verify that the *Everyday Mathematics* curriculum was implemented appropriately and consistently at each grade level. Other factors which should be considered are: quality of professional development offered to teachers before the initial year of implementation, during implementation and annual follow-up professional development. In addition, there is a crucial “buy in” factor by teachers which is paramount to the successful implementation of the *Everyday Mathematics* curriculum. If the program was dictated by the central office administration, “buy in” could be a concern in terms of the fidelity of implementation.

Another aspect of the study that needs future research are the areas of subject level and grade level acceleration, and grouping of students by mathematical achievement. One of the rural schools that utilized the traditional approach to teaching mathematics allowed subject level acceleration for students who demonstrated advanced mathematical achievement in the fifth grade. The rural school offering a traditional mathematics curriculum supplemented with

*Mountain Math* in kindergarten through second grade also advanced students one grade level (subject level acceleration), beginning in the third grade, if they demonstrated advanced mathematical achievement. This rural school also grouped student by mathematical achievement in the fifth grade. Based on the findings, it appears traditional instruction in conjunction with other strategies (supplemental practice, subject level acceleration, and achievement grouping) are viable alternatives to adopting the *Everyday Mathematics* curriculum.

The current study adds to our understanding regarding the use of the *Everyday Mathematics* curriculum in rural settings. Our findings indicate a more traditional approach used with other methods may be as good as the *Everyday Math* curriculum in rural schools. Finally, the study adds to the body of rural research on K-6 *Everyday Mathematics* curriculum by examining the effects of the program after seven years of instruction. To date no other study has attempted to examine the cumulative effect of the program.

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