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The Effects of Reform Mathematics Curriculum on Student Achievement

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THE EFFECTS OF REFORM
MATHEMATICS CURRICULUM ON
STUDENT ACHIEVEMENT

By

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August, 2001

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Mark Roger Brown
**Table of Contents**

**CHAPTER ONE: THESIS PROPOSAL**
- Problem Statement ................................................................. 1
- Background of the Study .......................................................... 1
- Importance and Rationale of Study ............................................. 2
- Statement of Purpose ............................................................... 3

**CHAPTER TWO: LITERATURE REVIEW**
- Introduction ............................................................................... 4
- Constructivism ........................................................................... 4
- Everybody Counts ....................................................................... 5
- The NCTM Standards .................................................................. 6
- The TIMSS Results ...................................................................... 8
- Connected Mathematics ............................................................. 9
- Summary .................................................................................... 10

**CHAPTER THREE: THESIS DESCRIPTION**
- Subjects .................................................................................... 11
- Data Collection .......................................................................... 12
- Data Analysis ............................................................................ 14
- Summary of Results ................................................................... 14
- Discussion .................................................................................. 16
- Conclusions ............................................................................... 18
- Limitations of the Study ............................................................ 20
- Recommendations and Dissemination ......................................... 21

**APPENDICES**
- Table 1-Mean Percent Correct by Process Strand ....................... 23
- Table 2-Analysis of MEAP Test Results for Fremont Public Schools Vs. Grant Public Schools.............................................. 24
- Table 3-Analysis of MEAP Test Results for Grant Public Schools .......................................................... 25
- Table 4-Analysis of MEAP Test Results for Fremont Public Schools .......................................................... 26
- Figure 1-Overall Percent of Correct Responses on the MEAP Test For Fremont and Grant for 1998, 1999, and 2000 ....................... 27
- Permission Letters ...................................................................... 27

**REFERENCES** ........................................................................... 28

**DATA FORM** ............................................................................. 30
Abstract

Middle school mathematics instruction is in need of reform. In response to this call for reform, school districts across the country are adopting curriculum based on the National Council of Teachers of Mathematics standards.

This thesis studies the impact of the use of a reform curriculum on student achievement. The study looks at two districts in Western Michigan, one of which uses a reform curriculum and one that uses a traditional curriculum. The study compares the results of the districts on the Michigan Educational Assessment Program mathematics assessment to determine if students using the reformed curriculum materials scored significantly higher than students using the traditional materials did. The study found that the use of reform curricular materials led to no significant increase in student achievement as measured by this assessment.
Chapter 1

Problem Statement

The purpose of this study will be to determine if the use of a Standards-based curriculum in middle level mathematics significantly improves student achievement as measured by the Michigan Educational Assessment Program (MEAP) seventh grade assessment. These curricula were designed in response to the call for reform in middle level mathematics instruction nationwide. Therefore assessment of the effectiveness of these materials is needed to determine if the proposed reforms significantly increase student performance in mathematics. The MEAP assessment used as a measurement tool in this study is the primary tool used by the Michigan Department of Education to assess the effectiveness of curriculum in the state.

Background of the Study

Within the circle of mathematics teachers in Michigan, much is being made of how much impact reformed curricula are having on middle level mathematics achievement. Educators maintain that the poor performance on the Third International Mathematics and Science Study (TIMSS) in 1998 by middle level students reflects a lack of conceptual understanding of mathematics by students in the United States (Johnson & Phillips, 1998). Critics state that these results reflect the dependence many “traditional” texts have on rote memorization and imitation at the expense of deeper understanding of mathematics (O’Brien, 1999).

The Curriculum and Evaluation Standards for School Mathematics first released by the National Council of Teachers of Mathematics (NCTM) in 1989, advocated a shift in focus in mathematics teaching in the United States from rote memorization and

The problem for mathematics educators was that the recommended shift in instruction from direct instruction to more active student involvement in class has caused different interpretations of how to create such a learning environment (Kohn, 1997). The lack of true Standards-based curriculum packages based on student engagement with mathematics through collaboration, hands-on exploration, and the use of multiple representations has added to this problem. Programs that were described as “Standards-based” often were not constructed around the core ideas presented in the Standards (Goldsmith & Mark, 1999), and were often modifications of existing traditional texts.

Within the last three years, due in large part to research funded by the National Science Foundation, true Standards-based materials have become available (U.S. Department of Education, 1999). These materials have been designed specifically around the core ideas of the Standards, using active student exploration of concepts to foster understanding.

Importance and Rationale of the Study

Evaluation of the Standards-based programs with regard to their effectiveness in improving mathematics achievement by middle grade students is understandably somewhat limited due to the recent release dates of these materials. The TIMSS results pointed to where the weaknesses were in the traditional approach to mathematics.
education. These areas of weakness have been reaffirmed in Michigan by the Michigan Educational Assessment Program (MEAP) mathematics test in seventh grade. However, true evaluation of the Standards-based approach is still lacking.

Statement of Purpose

In light of these facts, the purpose of this study will be to determine if the use of a Standards-based curriculum will significantly increase middle level mathematics achievement in Newaygo County as measured by the seventh grade MEAP assessment.

The next section of this document will more closely define the components of a Standard-based curriculum by a review of past research in mathematics reform.
Chapter 2

Introduction

This section will examine the background of the middle level mathematics reform movement over the past fifteen years. It will begin with an overview of constructivism, the major educational philosophy driving the reform movement. It will then look at the findings in *Everybody Counts*, which first pointed to the deficiencies in middle level mathematics in the United States, and the response of American mathematics teachers in establishing curricular goals to resolve these problems. It then will conclude with a discussion of the development of the curriculum materials specifically designed around the proposed curricular goals.

Constructivism

Many trends have come and gone in mathematics education in the United States, including progressive movements, essentialist movements, movements that centered instruction on the teacher instead of the student, drill and practice, discovery learning, and many others (Cuban, 1993). In his study Cuban found that teachers changed very little in the way that they teach in spite of this variety of proposed instructional methods. He speculated that the reason for this was that many times these movements have never become widely accepted, as teachers often did not buy into the new ideas. Although teachers may use the new methods for a time, they tended to fall back on the traditional methods of instruction due to lack of support and training.

Many theories are behind the current middle level mathematics reform movement, but it is the use of constructivist teaching methodology that marks the biggest departure from traditional instructional methods. Constructivism is the belief that all knowledge is
the product of a student’s own cognitive acts (Ward, 2001), which means that students build their understanding of concepts based on their own prior experiences. This implies that knowledge is “constructed” by students in a way that is unique to them, and that educational activities need to be built around active student exploration of concepts before these are formalized. In this way students are able to develop an understanding of the topic being taught in their own terms first, which according to constructivist theory allows them to more easily understand the formal concept later. By expanding on what is already known constructivists maintain that students come to grasp concepts better, and can move from simply memorizing and imitating routines to deeply understanding the ideas presented.

The key behind the constructivist approach is that it is centered on the student, which means that the teacher is often put in the position of having to interpret student construction of concepts that are different than their own. In addition, this process requires far more communication between teacher and student than traditional methods, as students often will need to explain individually how they reached a conclusion to the teacher to make it clear, again a byproduct of differing constructs. Constructivists believe that this process also promotes critical thinking, which allows students to use concepts across disciplines, to represent ideas in various forms, and to justify, defend, and reflect upon concepts.

**Everybody Counts**

The current reform movement in mathematics started with the publication of *Everybody Counts* in 1989 (National Research Council, 1989). The goal of this study was to establish the educational needs of students in the twenty-first century. The study
envisioned a practitioner of mathematics in this age as being more likely to solve equations by computer-generated graphs than algebraic manipulations, more in need of the use of statistics in areas such as social research, and as being rooted more deeply in creativity and adaptation. In addition, the study found that students learn best by the use of constructivist teaching methods, which ran contrary to the use of rote memorization and imitation present in most mathematics classrooms at the time. The study found that it was the use of these traditional methods of instruction that led to the loss of half of American students from mathematics education at each higher level. This was characterized as shutting out a wide range of career opportunities for these students in the world of the twenty-first century.

The NCTM Standards

The goals set forth in Everybody Counts called for a national consensus on objectives and standards that would require the efforts of the educational community and a strong coordinated effort by national leadership within the community of mathematicians at large. The study pointed to the then upcoming release of the Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989) to outline the processes that needed to be followed to reach the objectives set forth in Everybody Counts. The Standards called for a shift in not only curricular topics, but also in how students in the classroom of the future experienced learning.

The key component of the Standards was the call for a shift from the practice of rote memorization to a constructivist teaching style emphasizing discourse, worthwhile mathematical tasks, and learning through problem solving (Battista, 1999). The structure
of the proposed standards in problem solving, reasoning and proof, connections between content strands, communication, and multiple representations of problems that crossed all content strands reflected this thinking. The method of instruction was to shift from teacher lectures and rote memorization to the use of collaborative groups and hands-on manipulative activity to foster student learning (NCTM, 1991). Assessment was to shift from dependence on quizzes and tests to the use of multiple assessments including writing, questioning (both in writing and oral), and observation to not only measure student progress, but to also assess how well the curriculum itself was being implemented (NCTM, 1995). Clearly, this was a call for a fundamental shift in the way that mathematics education was structured in the United States.

The problem the Standards posed for mathematics educators was the lack of materials and training available to implement this kind of program. Programs designed from the outset to embody the mathematical approaches and principles advanced by the Standards were not available at the time (Goldsmith & Mark, 1999). Often the programs that described themselves as “Standards-based” were not constructed around the core idea of a rigorous, constructivist-based mathematical environment, and were merely modifications of traditional texts. This led in turn to sporadic and inconsistent implementation of the Standards (O’Brien, 1999). Evidence of this problem fully came to light in 1998, a full nine years after the publication of the Standards, with the publications of the results of the Third International Mathematics and Science Study (TIMSS) (Johnson & Phillips, 1998).
The TIMSS Results

The content of the TIMSS test reflected closely the type of mathematics education background called for in the Standards, as many of the test items were conceptual in nature. For example, on a traditional standardized assessment a question might require a student to find the circumference of a circle, given its radius. The student answering this question only needed to know the formula for circumference, where to substitute the value for the radius into the formula, and then how complete the computation. This approach inherently assumes that the student understands the relationship between the circumference and radius. In reality the student need only know how to use a formula to correctly respond to this question, a task that requires no deep understanding of the concept involved.

On a test which is conceptual in nature, students might be asked to complete this same type of computation, but in addition would have to justify how they know the end result is correct. By adding this additional step into the process the student is forced to demonstrate conceptual understanding of the topic, as the justification would normally have to include some discussion of the relationship between the circumference and radius of the circle to be complete. In this way the TIMSS test assesses not only whether students know how to complete computations, but also if they understand the concepts behind what they are doing.

Constructed in 1995, TIMSS was the largest, most comprehensive, and most rigorous international study of schools and student achievement ever conducted. This international project involved the testing of more than a half million students in
mathematics and science at several grade levels in 41 countries. For the middle level in
the United States, eighth grade students were given the test.

The results of the test were startling. U.S. students were found to lag behind those
in most of the industrialized world (National Research Council, 1999). Fifty-four percent
of the students in Michigan were estimated to be in the upper fifty percent of those tested
worldwide, but this still placed them behind most of the industrialized nations of Europe
and Asia. Many leading educators interpreted this poor showing as evidence of the
continued need for reform as called for in the Standards (Kohn, 1997).

Connected Mathematics

Soon after the release of the TIMSS results came the release of the Connected
Mathematics Project (CMP) (Dale Seymour Publications, 1998). Developed as part of a
five year National Science Foundation, the CMP was aimed at developing a complete
mathematics curriculum for grades six through eight (Thomas, 1999). The materials
reflected the constructivist philosophy, as the learning activities included were student
centered, emphasized independent group exploration of concepts, and allowed for
multiple solutions to the problems presented. The problems were based on "real world"
situations, intended to allow students to more readily build on existing knowledge. For
example, a unit on Pythagorean Theorem included problems requiring students to find the
distance between building on the campus of Michigan State University, leading them to
determine an optimal route. Each level of the curriculum contained the content strands of
algebra, geometry, and probability and statistics, with a heavy emphasis on the standards
of problem solving, reasoning and proof, connections, and communication which crossed
all the content strands as proposed by NCTM. The CMP was recognized by the U.S.
Department of Education in 1999 as an exemplary mathematics program based on research conducted by the Expert Panel of Mathematics and Science (U.S. Department of Education, 1999), and was the only middle level program to receive such recognition.

Summary

Much research has been done on the need for reform in mathematics education. Although some signs of progress are being identified, more research is needed to show that true reform is being made. This study will attempt to establish what effect the use of Standards-based curricular materials has on middle level mathematics achievement by establishing the following hypothesis: the use of Standards-based curricular materials will significantly increase student achievement in mathematics.
Chapter 3

Subjects

The participants in this causal-comparative study will be two school districts in the Newaygo County Intermediate School District (NCISD), Grant Public Schools and Fremont Public Schools. The two districts were selected because of similarities in population, socio-economic status, per pupil spending, and pupil/teacher ratio, and also because the districts use common middle level mathematics curriculum standards created by NCISD from the Michigan Essential Goals and Objectives for Mathematics (Michigan Department of Education, 1988). The study will determine if the use of Standards-based mathematics curricular materials significantly impacts student achievement.

The Fremont Public Schools are located in central West Michigan in the city of Fremont, population 14,076 (Fremont Public Schools, 1999). The district operates six buildings, with a total K-12 enrollment in 1998 to 1999 of 2,660 students. The district had total revenue per pupil in that year of $6,416 per student, with a pupil/teacher ratio of 22.9 (Michigan Department of Education, 1999). The Fremont Middle School has a student population of 615 students in grades six through eight. The staff consists of one principal, one assistant principal, and sixty professional and support personnel.

The Grant Public Schools are located in central West Michigan in the city of Grant, population 8,589 (Grant Public Schools, 1999). The district operates five buildings, with a total K-12 enrollment in 1998 to 1999 of 2,229 students. The district had total revenue per pupil in that year of $6,133 per student, with a pupil/teacher ratio of 22.6 (Michigan Department of Education, 1999). The Grant Middle School has a
student population of 734 students in grades five through eight. The staff consists of one principal, one assistant principal, and sixty-nine professional and support personnel.

Fremont and Grant use a common mathematics curriculum developed by the Newaygo County Intermediate School District (Newaygo County Intermediate School District, 1995). The curriculum was based on the *Michigan Essential Goals and Outcomes for Mathematics* (Michigan Department of Education, 1988), with assessments created by teachers using a variety of sources including the MEAP assessments and the NCTM standards.

**Data Collection**

In 1998, Fremont Middle School implemented use of the Connected Mathematics Project materials published by Dale Seymour (Dale Seymour Publications, 1998). As described in the previous chapter, the CMP was designed around the NCTM Standards, and require the use of constructivist teaching methodology. The district sent its entire mathematics staff to specialized training in how to use the materials, which included instruction in how to teach using constructivist methods. The 1998 results reflect approximately one half year of instruction using the CMP, the 1999 results one and one half years, and the 2000 results two and one half years.

Grant Middle School used a traditional mathematics curriculum published by Silver Burdett (Silver Burdett Ginn, 1995). The curriculum is teacher centered, and includes extensive drill and practice exercises emphasizing rote memorization and imitation. There was some inclusion of problem solving and cooperative learning exercises in the materials, but the large majority of the exercises did not include such
activities. The staff was given no formalized training in reform mathematics materials or teaching techniques during the course of this study.

The instrument used to collect data in this study was The Michigan Educational Assessment Program (MEAP) mathematics assessment for the years 1998, 1999, and 2000. The test is based on the *Michigan Essential Goals and Objectives for Mathematics* (Michigan Department of Education, 1988), and was first administered in 1991 (Michigan Department of Education, 2001). For the seventh grade version of the mathematics assessment, the Michigan Department of Education reported a reliability coefficient for the test given in 1998 to 1999 of .962 using Cronbach's Coefficient Alpha (Michigan Department of Education, 2001). During the scoring of the tests, if two scorers on the constructed response portion disagreed by more than one point on this test, a third scorer was used. The percentage of the time this occurs is called the "resolution reading" by the State of Michigan. For the 1998 to 1999 seventh grade mathematics test the resolution reading rate was an average of 1.78%. Based on this data, the test was deemed to be technically sound. The MEAP test for seventh grade mathematics is normally administered in early February each year over the course of two to three days, and consists of roughly 140 questions. The test is given in the students' mathematics class, usually within the time frame of the normal class period of about 50 minutes.

The MEAP test reports cumulative results for the assessment, as well as an item analysis that breaks the test annually for each district down on an item-by-item basis. This analysis identifies each question by which content strand it applies to: whole numbers and numeration, fractions, decimals and percent, measurement, geometry, statistics and probability, algebraic ideas, or problem solving and logical reasoning. Each
item is also identified by which process strand it applies to: conceptualization, mental arithmetic, estimation, computation, or applications and problem solving. For example, if a student on the test was asked to mentally compute the sum of one half and one fourth, the answer the student gives would be reported under the content strand of fractions and under the process strand of mental arithmetic. The test in its present form places a heavy emphasis on computation, and less emphasis on conceptual understanding of topics tested by the student.

**Data Analysis**

The cumulative results for each district's MEAP test was analyzed at the .05 level using a t-test for each of the three years. The purpose was to determine if any statistically significant changes existed between the test scores within each district, as well as determining if scores in the Fremont Public Schools were significantly higher than those in the Grant Public Schools. Separate analyses were made for each year, as well as comparisons between the years 1998 and 2000. Subgroups analyses were made for the process strands of conceptualization, mental arithmetic, estimation, computation, and applications and problem solving, as these mapped most closely to the NCTM process strands of problem solving, reasoning and proof, communication, connections, and representation (NCTM, 2000). This will allow for analysis of the overall performance of students on the MEAP test across all content strands.

**Summary of Results**

On the 1998 MEAP test, the students in Fremont outscored the students from Grant not only overall (See Figure 1), but also in each of the individual process strands (See Table 1). All of these were significant at the .05 level (See Table 2).
In 1999, the students from Grant matched the overall performance of the students from Fremont, who by this time had one and one half years of instruction using the *Connected Mathematics* materials. The overall results showed the students from Grant correctly answered 67.64% of the questions, while the students from Fremont correctly answered 66.59% of the questions, which was statistically similar at the .05 level (See Table 2). The students from Grant also outscored the students from Fremont in conceptualization, mental arithmetic, computation, and applications and problem solving, although at the .05 level all of these were statistically similar.

The 2000 test results again showed the students from Fremont outscoring the students from Grant overall, which was statistically significant at the .05 level. Fremont's students answered correctly on 68.55% of the questions, while the students from Grant answered correctly on 63.65% of the questions (See Figure 1). Although Fremont's students outscored Grant's in the process strands of mental arithmetic, estimation, and computation, these results were statistically similar at the .05 level. Fremont's students were statistically superior to Grant's at the .05 level only in the conceptualization and applications and problem solving process strands.

The analysis of Grant's overall results shows statistically significant changes in the overall percentage of correct responses each year of the study (See Table 3). Grant's percentage of correct responses increased by 11% from 1998 to 1999, but decreased 6.48% from 1999 to 2000 (See Table 1), which was statistically significant at the .05 level for both cases (See Table 3). However, Grant still showed a significant increase in the overall percent of correct responses from the beginning of the study in 1998 to the end in 2000 (See Table 1, Table 3). This pattern continued in the process strands of
conceptualization and application and problem solving (See Table 3). In mental arithmetic and estimation, the students at Grant posted significant increases each year of the study, and showed an increase from 1998 to 1999 in computation (See Table 3). Overall and in each process strand, the students in Grant showed statistically significant increases in the number of correct responses from 1998 to 2000 (See Table 3).

The analysis of Fremont’s overall results shows a no statistically significant difference at the .05 level in the overall percentage of correct (See Table 4). Fremont’s overall percentage of correct responses increased by .04% from 1998 to 1999 and 1.96% from 1999 to 2000 (See Figure 1). In the individual process strands, Fremont’s students showed significant increases in mental arithmetic and estimation (See Table 4). The students also showed slight increases from 1998 to 2000 in the areas of computation and application and problem solving, although these were not statistically significant at the .05 level. In the area of conceptualization, the students in Fremont showed a slight decrease, which was not statistically significant at the .05 level. In sum, Fremont’s MEAP test results show no statistically significant changes overall, and showed statistically significant improvement in two out of the five process strands.

Discussion

The results of the data analysis seem to indicate that the use of the Connected Mathematics materials by Fremont Public Schools yielded no notable improvements on the MEAP test. The overall results of the test by students in the district remained steady during the three years examined, which would also seem to indicate that the new materials at least maintained the level of competency the students previously had.
The students in Grant posted noteworthy gains not only overall on the MEAP assessment during this time, but also in each content strand at some point during the course of the study. However, these results tended to be more erratic, as the students in the district posted statistically significant gains in the areas of conceptualization and applications and problem solving from 1998 to 1999, only to see significant decreases the following year in the same areas (See Table 1, Table 3). These two areas are both emphasized by the reform movement, and receive little emphasis by traditional texts. As different groups of students were taking the test each year, this could indicate a weakness of the traditional texts in meeting the needs of students in these areas. During the same time period, students in Fremont maintained their level of competency on the assessment in these areas.

One possible reason for the gains on the test by students in Grant relative to the students in Fremont is that the MEAP examination itself is based on traditional instructional methods, and might not reflect well the shift to a constructivist setting experienced by the students in Fremont during this time. The majority of the questions are multiple choice, which require no explanation. The structure of the test does not allow for multiple solutions to problems, nor does it require students to justify solutions. Because of this, it is possible that the students in Fremont have made gains that would not be reflected on the MEAP assessment due to its structure. Likewise, the improvements on the assessment made by the students in Grant may reflect an improvement in rote memorization and imitation skills, when in reality little real improvement in conceptual understanding being realized.
Another possibility is that the students in Fremont realized no significant gains in ability by using the *Connected Mathematics* materials as opposed to using traditional texts. During the course of the study, the students in Grant made significant gains overall and in each content area when the results from the beginning of the study in 1998 are compared with the results at the end of the study in 2000. Again, Fremont's students maintained the previous level of achievement during this period. It is possible that Fremont's students could have made similar gains in achievement using the traditional materials, and thus the reformed materials hampered their progress. This brings to light the possibility that the use of the reformed mathematics materials may actually be detrimental to student achievement.

**Conclusions**

The implementation of the Connected Mathematics curriculum materials in Fremont public schools yielded no statistically significant increases in student achievement on the MEAP test during the years 1998 to 2000 ($t=.36, \alpha=.05$). Although the district showed slight increases in the overall percentage of correct responses, these were within the range that can be attributed to normal variation. Compared to the students at Grant Public Schools, the students at Fremont scored significantly better at both the beginning of the study ($t=0.00, \alpha=.05$), and at the end of the study ($t=.05, \alpha=.05$). However, the results also show that the students attending Grant Public Schools, using a traditional mathematics curriculum, showed greater gains in the number of correct responses on the MEAP test than the students at Fremont Public Schools. This seems to indicate that the implementation of the reformed mathematics curriculum used, the *Connected Mathematics* materials, had no effect on student achievement as measured
by the MEAP test, whereas the traditional curriculum led to significant increases in overall student achievement. However, in looking at the overall results, the students at Fremont seemed to be more consistent in their level of achievement than the students in Grant. This seems to indicate that the use of the reformed curricular materials yielded more consistent results than the use of the traditional materials.

In the individual content strands, this trend continued. The students attending Grant, using the traditional curriculum, showed significant increases from 1998 to 2000 in every content strand (Table 3). However, these students decreased significantly in both conceptualization and applications and problem solving from 1999 to 2000, again indicating somewhat erratic performance. Fremont over the same period of time showed significant gains in mental arithmetic and estimation (Table 4), but no significant increases or decreases in any of the other strands. This seems to indicate that the reformed curriculum had little significant effect on student achievement in these subgroups, as again the students being taught with the traditional showed more significant gains (Table 1). However, it again seems to indicate more consistent achievement by students using reformed materials than those using traditional materials.

As there was no significant gain in student achievement by students using the Standards-based mathematics curriculum over the course of this study and significant gains in achievement being made by students using the traditional curriculum, it must be concluded that the results of this study are inconclusive regarding the use of a reformed curriculum in improving student achievement in mathematics. Although the students using the reformed curriculum posted no significant gains, their performance was more consistent when compared to the students using the traditional texts. The probable reason
for this is the design of the MEAP assessment, as it was built around traditional teaching methods and did not allow for the multiple solutions or explanations so central to the constructivist methodology utilized in Connected Mathematics. Thus, the students were not assessed in a manner consistent with the instructional methodology used, yielding the inconclusive results.

Limitations of Study

There are some significant limitations to this study, first being the makeup of the sample. The two districts chosen have similar characteristics and are from the same geographic area. Therefore the results of this study should not be extended to the general student population of Michigan, as these demographics might not reflect accurately the performance of students in districts which do not have these characteristics.

Furthermore, it was not possible to document specific validity data for the MEAP assessment for the study. It is possible that the validity for this sample may be different than that for the statewide population the test was designed for, as the demographics of these relatively suburban districts differs from other districts in the urban or rural areas of Michigan.

It was not possible to control for individual teacher methodology in the classroom. Although teachers in the CMP group were trained to use their materials, it is possible that there may be difficulties with actual implementation, especially during the first year of use. It is also possible that teachers in the non-CMP group may have used some of the methods and techniques called for in the Standards although their actual curriculum materials are traditional in nature. In addition, the use of materials designed specifically to increase student performance on the current MEAP assessment may have
been used, which may lead to increases in student achievement not directly related to the type of curriculum used.

Finally, it should be noted that Grant Middle School began restructuring how instruction was delivered in 1998, when it began to use teaming. This structure divides students up into teams, which then receive all their instruction from a given set of teachers. The teachers in this system have a smaller amount of students to instruct, which in theory allows them to know and understand the individual students' strengths and weaknesses better. It also allows for flex scheduling, easier student remediation, and thematic teaching more readily than in a non-teamed environment. One of the main aims of this approach is to increase student achievement. Here again, an intervention designed to increase student achievement other than curricular materials may have impacted the student performance on the MEAP test used for this study.

Recommendations and Dissemination

The major question that remains unanswered by this study is how students will perform when tested using a more balanced assessment tool. The MEAP assessment used as the measurement tool for this study was based on the 1988 *Essential Goals and Objectives for Mathematics* (Michigan Department of Education, 1988). As a result of this, the MEAP assessment itself measures student performance in a more traditional manner, with an emphasis on rote memorization and imitation. Although students from Grant and Fremont both took the TIMSS assessment in the spring of 2000, the test results were not made available for this study.

The change in emphasis on the MEAP mathematics assessment starting in the spring of 2000 may provide an opportunity to answer this question (Babcock, 2001). The
new assessment will measure student achievement in a manner more aligned with the
NCTM Standards, as it will measure student understanding as it is currently measured by
the TIMSS assessment. Therefore, the new assessment should provide a more accurate
picture of the effectiveness of the reform curriculum than the present test as it will
measure student achievement in the same manner as the instruction is delivered. In
addition the test will also be administered in the eighth grade instead of seventh, which
should give a better picture of student ability at the end of the middle school experience
than the previous test.

It was the intent of this study to be used by the two districts involved, Fremont
Public Schools and Grant Public Schools, for analysis of the impact of not only the
curriculum being used by both districts, but also of the curriculum materials being
utilized. It is not intended to reflect on the quality of instruction offered by either district,
nor is it intended to imply that one district is superior to the other. Copies of this study
are to be forwarded to the curriculum directors in both districts, as well as the library at
Grand Valley State University.
### Table 1
Mean Percent Correct by Process Strand on the MEAP test for Fremont Public Schools vs. Grant Public Schools

<table>
<thead>
<tr>
<th>Process Strand</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fremont</td>
<td>Grant</td>
<td>Fremont</td>
</tr>
<tr>
<td>Conceptualization</td>
<td>70.97</td>
<td>59.31</td>
<td>68.48</td>
</tr>
<tr>
<td>Mental Arithmetic</td>
<td>70.50</td>
<td>56.00</td>
<td>75.43</td>
</tr>
<tr>
<td>Estimation</td>
<td>59.68</td>
<td>45.55</td>
<td>61.83</td>
</tr>
<tr>
<td>Computation</td>
<td>62.71</td>
<td>49.36</td>
<td>62.25</td>
</tr>
<tr>
<td>Applications and Problem Solving</td>
<td>66.16</td>
<td>55.86</td>
<td>66.18</td>
</tr>
</tbody>
</table>
Table 2

Analysis of MEAP Test Results for Fremont Public Schools vs. Grant Public Schools

<table>
<thead>
<tr>
<th>Strand</th>
<th>df</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>100</td>
<td>0.00**</td>
<td>0.63</td>
<td>.05**</td>
</tr>
<tr>
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<td>35</td>
<td>0.01**</td>
<td>0.61</td>
<td>0.16**</td>
</tr>
<tr>
<td>Mental Arithmetic</td>
<td>5</td>
<td>0.01**</td>
<td>0.91</td>
<td>0.90</td>
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<tr>
<td>Estimation</td>
<td>18</td>
<td>0.01**</td>
<td>0.85</td>
<td>0.49</td>
</tr>
<tr>
<td>Computation</td>
<td>14</td>
<td>0.03**</td>
<td>0.96</td>
<td>0.68</td>
</tr>
<tr>
<td>Application and Problem Solving</td>
<td>40</td>
<td>0.02**</td>
<td>0.65</td>
<td>0.23**</td>
</tr>
</tbody>
</table>

Note. Values followed by double asterisks indicate results that are statistically significant.
Table 3

Analysis of MEAP Test Results for Grant Public Schools

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>120</td>
<td>.00**</td>
<td>.11**</td>
<td>.00**</td>
</tr>
<tr>
<td>Conceptualization</td>
<td>40</td>
<td>.01**</td>
<td>.13**</td>
<td>.31</td>
</tr>
<tr>
<td>Mental Arithmetic</td>
<td>8</td>
<td>.00**</td>
<td>.71</td>
<td>.04**</td>
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<tr>
<td>Estimation</td>
<td>20</td>
<td>.00**</td>
<td>.82</td>
<td>.03**</td>
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<tr>
<td>Computation</td>
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<td>.78</td>
<td>.42**</td>
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<tr>
<td>Application and Problem Solving</td>
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<td>.00**</td>
<td>.30**</td>
<td>.42**</td>
</tr>
</tbody>
</table>

Note. Values followed by double asterisks indicate results that are statistically significant.
Table 4

Analysis of MEAP Test Results for Fremont Public Schools

<table>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>120</td>
<td>0.97</td>
<td>0.39</td>
<td>0.36</td>
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<tr>
<td>Conceptualization</td>
<td>40</td>
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<td>0.70</td>
<td>0.75</td>
</tr>
<tr>
<td>Mental Arithmetic</td>
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<td>0.41**</td>
<td>0.69</td>
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<td>20</td>
<td>0.67</td>
<td>0.47</td>
<td>0.23**</td>
</tr>
<tr>
<td>Computation</td>
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<td>0.94</td>
</tr>
<tr>
<td>Application and Problem Solving</td>
<td>40</td>
<td>1.00</td>
<td>0.48</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Note. Values followed by double asterisks indicate results that are statistically significant.
Figure 1. Overall percent correct on the MEAP test for Fremont (n=115) and Grant (n=115) for the years 1998, 1999, and 2000.
References


May 10, 2001

Mrs. Dee Korson
Principal, Grant Middle School

Dear Mrs. Korson:

May I receive permission to conduct my master’s thesis study using Grant Public Schools curriculum materials, summary data obtained from students using results from the MEAP test over the last three years, and summary data obtained from students from the TIMSS test taken last May? I will not be using any individual student data that could be traced to a student (such as copies of writing or test scores).

I plan to use student test scores in summary form only. If you have any questions about the study, please contact me at 652-6368. If you have any questions about the human subjects rights in the study, you may contact the Chair of Grand Valley’s Human Research Review Committee, Paul Huizenga at 616-895-2472.

Thank you for your time, and your attention to this matter.

Sincerely,

Mark R. Brown, Mathematics Teacher
Grant Public Schools

Approved by: Dee Korson
Position: M.S. Principal Date: 5-10-01
May 10, 2001

Ms. Carolyn Hummel
Principal, Fremont Middle School

Dear Ms. Hummel

May I receive permission to conduct my master’s thesis study using Newaygo County ISD curriculum materials, summary data obtained from students in Fremont using results from the MEAP test over the last three years, and summary data obtained from students in Fremont from the TIMSS test taken last May? I will not be using any individual student data that could be traced to a student (such as copies of writing or test scores).

I plan to use student test scores in summary form only. If you have any questions about the study, please contact me at 652-6368. If you have any questions about the human subjects rights in the study, you may contact the Chair of Grand Valley’s Human Research Review Committee, Paul Huizenga at 616-895-2472.

Thank you for your time, and your attention to this matter.

Sincerely,

Mark R. Brown, Mathematics Teacher
Grant Public Schools

Approved by: ____________________________

Position: Principal  Date: 5/11/01
ABSTRACT:

This thesis studies the impact of the use of a reformed mathematics curriculum on student achievement. The study compares the results of two West Michigan school districts on the Michigan Educational Assessment Program mathematics assessment over a three year period. One district used a reformed mathematics curriculum and the other used a traditional curriculum. The results of the study were inconclusive.