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Teaching and Learning Middle Grades Mathematics with Understanding

Gerald Kulm, Robert M. Capraro, Mary Margaret Capraro

Texas A&M University
Abstract

This paper addresses the nexus of two critical challenges for today’s mathematics teacher. On the one hand, teaching for understanding for all students is clearly the goal of most mathematics teachers. However, many teachers also must acknowledge and address the requirement that students do well on high stakes tests. This study analyzed data on sixth grade students’ performance and achievement after a yearlong classroom implementation of *Connected Mathematics*. Texas Assessment of Academic Skills (TAAS) data were analyzed, comparing students’ achievement on the 6th grade TAAS with their achievement on the previous year’s 5th grade TAAS. The variables of at-risk, gender, socio-economic status, and ethnicity were analyzed to determine the nature, practical importance, and significance in accounting for variance in TAAS scores.

The results indicated that the overall gain over the previous year’s mathematics achievement as measured by Texas Assessment of Academic Skills (TAAS) was 4 points. The at-risk students demonstrated a mean 10-point gain while the non at risk students demonstrated a mean 2 point gain. Only two of 105 students failed the TAAS, compared to 9 failures the previous year. No differential effects were found for gender, ethnicity, or socio-economic status.
Introduction

*Teaching and Learning with Understanding*

Teaching and learning mathematics with understanding involves some fundamental forms of mental activity: (1) constructing relationships, (2) extending and applying knowledge, (3) reflecting about experiences, (4) articulating what one knows, and (5) making knowledge one’s own (Carpenter & Lehrer, 1999). Furthermore, the specific classroom activities and teaching strategies that support these mental activities, include appropriate tasks, representational tools, and normative practices that engage students in structuring and applying their knowledge and in reflection and encourage articulation about tasks and about their own mental activities. Fairness and equity is an especially important issue in making learning and understanding available for all students. There may be differential effects of this type of instruction for some students (Secada & Berman, 1999). Classrooms that promote learning mathematics with understanding for all students involve a necessarily complex set of interactions and engagement of teacher and students with richly-situated mathematical content (McClain & Cobb, 2001).

There are specific instructional and learning factors that produce cognitive change and understanding of mathematics concepts and procedures in middle grades students. In particular, activities that (1) build on students’ prior ideas about mathematics and (2) promote student thinking and reasoning about mathematics concepts are important factors in building understanding (Kulm, Capraro, Capraro, Burghardt, Ford, 2001). Research on these variables has provided evidence of their importance in mathematics teaching and learning that is designed to lead to conceptual change.
Building on Student Ideas about Mathematics

Fostering conceptual understanding requires taking time to attend to the ideas students already have, both ideas that are incorrect and ideas that can serve as a foundation for subsequent learning (Ball, 1993). The importance of taking account of students’ ideas has long been recognized. Ausubel (1968) noted that "the most important single factor influencing learning is what the learner already knows." There are many implications of this finding in mathematics teaching and learning. Difficulties in mathematical problem solving are often caused by students’ ineffective use of what they already know (Schoenfeld, 1992). If students have narrow conceptions and representations of ideas or procedures that do not extend to other situations, their subsequent work can result in misconceptions (Fischbein, Deri, Nello, & Marino, 1985; Bell, Greer, Grimison, & Mangan, 1989). For example, students’ intuitions about number operations need to be revised when they move to expanded number systems (Graeber & Campbell, 1993). Students may decide, for instance, that when multiplying, the result is always larger than either of the two original numbers – a generalization that can lead to trouble when they move to working with numbers less than one. Hart (1988) and Matz (1980) also found that prior knowledge from arithmetic leads to misconceptions when generalized to more advanced topics.

Teachers who understand students’ knowledge and thinking are able to use this information to improve the quality of their instruction (Carpenter, Franke, Jacobs, Fennema, & Empson, 1998; Cobb et al., 1991). Several strategies have been found that are effective in identifying and addressing prior knowledge. For example, a discussion of how students perceive the difference between two solutions to an exercise or problem can provide insights into student understanding (Cobb, 1988). Also, an assessment of how students extend
procedures to other contexts and situations can reveal misconceptions or lack of understanding (Hiebert & Wearne, 1986). Both of these strategies apply to a wide range of mathematical ideas and procedures.

Instruction should also provide opportunities for students to make connections between and among mathematical ideas and skills. Resnick (1987) concluded that without explicit assistance in connecting ideas, people do not usually learn concepts simply by building up pieces of knowledge. Unless instruction attends to students’ prior knowledge and teachers are alerted to it, the sequence of activities might be inappropriate (Mack, 1990). Moreover, further misconceptions may develop or achievement will be diminished for many students who are unable to develop more sophisticated ideas, partially due to persistent errors (Brown & VanLehn, 1982; Matz, 1980).

Promoting Student Thinking About Mathematics:

Classroom discourse can exploit the use of language as a powerful tool for orienting and focusing attention and is crucial for constructing relationships (Greeno, 1988; Resnick & Omanson, 1987). Specifically, students who are expected to engage in communication about mathematics will have improved conceptions of the nature of mathematics (Lampert, 1989). Work in pairs and small groups can be an effective tool for promoting student communication. Both Slavin (1989) and Webb (1989) found that work in small groups can enhance achievement through student interaction if the work is focused carefully on learning mathematical ideas.

Guidance of student interpretation and reasoning through classroom discourse and work in small groups can help students construct and formalize their ideas so they are more accessible. Students need the opportunity for self-discovery through activities that are
unstructured enough to allow them to derive generalizations and invent their own procedures (Doyle, 1983). Questions in the lesson summary can also help students reflect on the mathematical concepts and help them establish linkages between mathematical topics (Madsen-Nason, 1988).

**Aligning Curriculum Materials and Instruction**

Since textbooks are such an important tool for mathematics teachers, it makes sense to select textbooks that incorporate the results of research on mathematics learning. The variables ‘building on student ideas’ and ‘promoting student thinking’ have been identified as distinctive characteristics of the *Connected Mathematics* (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1998) textbooks (AAAS, 2000). Research is beginning to emerge on the teaching and learning of middle grades with the *Connected Mathematics* (CMP) materials. Students who had three years in the CMP curriculum demonstrated deep understanding of a significant piece of algebra (Krebs, 1999). In addition to developing conceptual understanding, students using the CMP algebra units reported that they learned alternate methods for solving algebra problems (Kersaint, 1998).

There have been mixed results when inexperienced teachers use *Connected Mathematics*. For example, two of four preservice teachers using the materials developed new understandings of ratio and standards-based reform, while the other two preservice teachers reverted to traditional methods for solving ratio and proportion problems when challenged with a new experience (Hutchinson, 1996). Similar difficulties may occur with experienced teachers who try to make major changes in their teaching that *Connected Mathematics* requires. Further research is needed on this issue, including the professional development and other support that are needed for effective implementation.
Research Questions

The present study considered questions about middle school mathematics teaching and learning with understanding. These questions were of practical interest to the teachers and administrator who were involved and represented concerns that the authors and the teachers worked together to address. This article reports initial progress toward data-based answers to the questions: Is teaching and learning with understanding compatible with achievement on high stakes multiple-choice tests? Can teaching with understanding address the needs of all students, including those who are at risk and those who are high achievers with more traditional approaches?

Methodology

Setting

The intermediate school teachers in a suburban community decided after piloting a few units, that the curriculum Connected Mathematics (Lappan, et al., 1998) would address their desire to provide better instruction, especially for students who were not achieving well with traditional texts and those who were high achievers. The teacher leader approached the senior author who agreed to help purchase textbooks. They agreed that a careful study of implementation would provide important data to support the teachers’ implementation efforts. Three of the four sixth grade teachers agreed to participate in the data collection part of the project. The purpose was to study mathematics teaching and learning, not to compare individual teachers. It should also be noted that the purpose was and is not to promote or extol the virtues of Connected Mathematics, except to note that these materials do reflect current research on teaching mathematics with understanding. Several other middle grades
textbooks have similar characteristics (AAAS, 2000). The teachers in this school happened to prefer *Connected Mathematics*.

**Participants**

Two of the three teachers taught three blocks of sixth grade CMP mathematics while the other teacher had a self-contained class. The study included 140 sixth-grade students; however, due to attrition data was available for 105 student participants. Mobility accounted for 35 students lost to this study. Demographics within the sample are typical of those of the school district and are displayed in Table 1.

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Table 1: Demographics of Participants

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic status</td>
<td></td>
</tr>
<tr>
<td>At risk</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
</tbody>
</table>

Demographics were determined by each student’s parents. Economically disadvantaged was determined by qualifying for free or reduced meal programs. At risk was determined by state criteria.

**Data Analysis**

Our objective in this study was to analyze data on students’ (n=105) performance and achievement after a yearlong classroom implementation of *Connected Mathematics*. The results of the Spring 2000 and 2001 Texas Assessment of Academic Skills (TAAS) were analyzed, comparing students’ achievement on the 6th grade TAAS with their achievement on their previous year’s 5th grade TAAS. The variables of at-risk, gender, socio-economic status, and ethnicity were analyzed to determine the nature, practical importance, and significance in
accounting for variance in TAAS scores. In addition to the overall score, components of the TAAS that report performance on specific mathematics topic areas were used in the analyses.

The Texas Learning Index (TLI) is a standardized score that characterizes a student’s performance on the TAAS in relation to the passing standard. The TLI was developed to allow students, parents, and schools to relate student performance to a passing standard and to compare student performance from year to year. A TLI of 70 represents a passing standard. The top end of the score range may differ from subject to subject and from year to year. For example, the 6th grade mathematics top TLI in 2000 was 93; the top score in 2001 was 92. If a student receives a TLI score that is the same as last year’s, the student has demonstrated one year’s typical progress and his/her performance is in about the same position as in the previous grade (Texas Education Agency, www.tea.state.tx.us; 9/16/01).

The variable “at risk” was used to compare students who had been identified by the state as being in a category that characterizes them as in danger academically or as a potential dropout. According to the state’s definition, “at risk” includes but is not limited to students who: did not advance from one grade level to the next for one or more years, is of limited English proficiency, had been placed in alternative education or was expelled during the current or preceding school year, or resided in an emergency shelter, halfway house, or foster group home (Texas Education Agency, www.tea.state.tx.us, 9/16/01).

In addition to obtaining quantitative data, researchers observed the teacher participants and their students a total of 18 times. Field notes, observation checklists, and video and audio recordings were used to collect observational data. This data helped to determine the level of implementation and fidelity to the curriculum materials.
Results

Observation Data:

Teachers in the study were each observed six times using field notes, observation checklists, and video and audio recordings. This data helped to judge the extent to which the Connected Mathematics materials were implemented as they were intended. The three teachers varied in their approaches to implementation, depending mostly on how closely the instructional approach used in Connected Mathematics matched their own teaching style. The following excerpts from observation notes and transcripts of videos provide examples of this variation. The statements and questions denoted by ‘T’ are exact quotations from the teachers. The responses denoted by ‘S’ represent either exact quotes from individual students, or a summary statement that represents several students’ responses. The response denoted by ‘C’ represents a choral class response. Any names that appear within the transcript have been changed to protect the anonymity of the participant.

**Teacher A** – Introductory Investigation in the unit Data About Us.

T: What is data?
S: Information, anything you research.
T: In Bits and Pieces did we use data?
S: Yes, in the cats table.
T: What information did the database contain about cats?
S: It had their name, weight, and age.
T: How do you think they collected the data about cats?
S: They asked questions.
T: Could they find data like the weight by asking? How much does your cat weigh?

How do you know?

S: I would guess.

T: Unless you have recently been to the vet, you would have to actually weigh the cat.

This is another way to gather data. Think of other ways you can gather data.

Teacher A used a question and answer approach, following the suggestions provided by the *Connected Mathematics* teaching guide to find out what students know about data representation. She helped the students to connect their knowledge about data from a previous unit, and began to introduce them to different approaches to collecting and representing data.

**Teacher B** – A lesson from *Ruins of Montarek*. Students are handling and describing 3-dimensional shapes.

T: If we could go on then maybe we could learn the names of the rest of these. Okay, in your *Connections* they say how many faces, edges, and vertices are there in the Great Pyramid of Kufu? It says the Great Pyramid of Kufu is a square pyramid.

So it has one square face and four triangular faces. So there are five faces in all.

Count your faces on your … square pyramid.

S: Five

T: Okay, you’ve counted all of them and the bottom. So there are five faces in all.

There are four edges where the side faces meet the base. Four more edges are where the side faces meet each other. So there are eight edges in the pyramid in all. There are four vertices of the square’s base and a vertex where each of the
Teacher C – An investigation with pentominoes from the unit *Ruins of Montarek*.

T: So, all of you remember perimeter, right? What do you do to count the perimeter?

*(Pause)* How do you know what the perimeter is?

S: If it’s like a square, it’s the length times the width times two. It’s the length around the.....
T: Okay. If it’s a square, if it’s a square or rectangle, it’s length plus width times two.

Okay. It’s just the outside edge. The outside of your object and in this case it happens to be pentominoes. Anybody want to give a little guess on the perimeter of your pentominoes? (Pause) Are they all different?

C: Yes.

T: Is the area all the same?

C: Yes.

T: What is it?

C: Five.

T: How about the perimeter? Damon quit counting.

S: They’re all the same, I know.

T: You know.

S: Uh-huh.

T: Anybody else have an opinion on that? What do you think Martin?

S: I don’t think the perimeters are the same because “I” has four sides and “W” has six sides or something.

T: Okay. Good observations.

S: Well the “P” doesn’t have as many sides open as the “W.”

T: What do you guys think of that? Did you hear what she said? (Pause) Sean?

S: Kind of like what Sharon said. Like different things, the “X”, and the “P”, and the “W.” They have more open sides. Like the “P” is closed.

T: Uh-huh. Uh-huh. Janie?

S: The more zigzags and open spaces you have, the more perimeter.
T: Okay. Right. The more open spaces. Tell you what, I’m going to give you a paper. You’re going to be able to record the perimeter of each pentominoe. Then you’re going to go on to pentominoe pairs, pentominoes together. Kind of like your homework except this time you are going to be finding perimeters on pentominoe pairs. Okay? Why don’t you get started on it just as soon as you get your paper. If you have any questions, I can answer them. *(Walks around classroom)*

Teacher C used students’ answers, including incorrect ones, to encourage the students to explore on their own. The teacher asks the students to think about the shapes, rather than counting, in order to develop a conceptual understanding of the relationships. The students’ observations begin to develop toward a generalization about the relationship between the shapes of the pentominoes and their perimeters.

These excerpts are representative of the lessons that were observed. Overall, we found that the *Connected Mathematics* materials were implemented reasonably well, neither perfectly nor poorly. As might be expected, as the year progressed, each of the teachers appeared to become more comfortable with the material. They expressed this perceived change to us in post-observation conversations. However, we have developed no specific measures to determine the extent to which their implementation improved. In summary, the observation and video data support the conclusion that *Connected Mathematics* was implemented with reasonable fidelity throughout the year, with the intention of providing students the opportunity to learn mathematics with attention to understanding concepts as well as learning skills.
In examining the TAAS data, the Texas Learning Index (TLI) and the Mathematics Differential (the difference between the 2000 and 2001 TLI scores), components of the TAAS student report, were used as dependent variables and an “at risk” indicator was used as the independent variable.

Table 2 contains the participants’ fifth grade mean TLI of 82.43, \(SD\) 11.96 on the Spring 2000 mathematics portion of the TAAS as compared to their sixth grade mean TLI of 86.63, \(SD\) 5.71, a net mean gain of 4.20 on the mathematics portion of the TAAS. Table 2 also contains the two-tailed \(t\)-test on 2000 (5th grade) and 2001 (6th grade) TLI scores, means and standard deviations. These differences were statistically significant, \(t\) \((105) = p<.01\). Three students in the study received a perfect TLI score of 92 answering all 56 questions correctly. Thirty-nine (37%) of the students missed only two to four questions resulting in a score of 90 or 91. All but two students passed with a score of 70 or better. The standard deviation decreased from 11.96 to 5.71 a difference of 6.25.

| INSERT TABLE 2 ABOUT HERE |

The variable ‘at risk’ was used to compare students who had been identified by the state as being in a category which characterizes them as in danger academically or as a potential dropout. In this study, sixth grade \((n=105)\) participants’ TLI scores were compared to their fifth grade TLI scores on the basis of being at risk or not at risk. Table 3 lists the means, standard deviations, and sample size for the at-risk \((n=25)\) and not at-risk groups \((n=80)\). In comparing the means, the at-risk group gained a mean of 10.16 \((SD= 17.37)\) TLI
points from fifth to sixth grade as compared to the not at risk group which gained a mean of 1.74 (SD=4.32) TLI points.

In a further analysis of the data, a two-way analysis of variance (ANOVA) on Mathematics Differential was conducted with gender (male vs. female) and at risk (at risk vs. not at risk) as the independent variables. The results of the ANOVA are shown in Table 4. The main effect for gender was not significant at the .05 level. The main effect for at risk was significant at the .01 level, with the students not at risk out-performing those at risk ($F(1,89) = 11.731, p<.01, \eta^2=.141$). The interaction of gender by at risk was not significant at the .05 level. The 14% effect size is practically important in this study and can be considered large by comparison to similar studies reporting an effect size statistic.

In order to examine possible differential effects of *Connected Mathematics* instruction across mathematics content areas, four of the thirteen Texas Essential Knowledge and Skills (TEKS) Mathematics Grade Six objectives were the focus of teacher observations and student interviews during the study. TEKS objectives focused on number, algebra, geometry, and probability and statistics respectively. These TEKS objectives were reflected by four corresponding TAAS performance objectives. Each set of TAAS performance
objectives was assessed by four test items, with a sub-score provided for each set. Table 5 lists the TAAS performance objectives and a sample test item for each of them.

Most educational research settings demand an analysis that accounts for reality so a multivariate analysis should be used to match the research design as closely as possible (Baggaley, 1981). Using a multivariate approach in real-life research situations increases the reliability of the results by limiting the inflation of Type I "experimentwise" error rates by reducing the number of analyses in a given study (Capraro & Capraro, 2001; Shavelson, 1988; Thompson, 1991). Further, Thompson (1991) stated multivariate approaches limit "experimentwise" error, reducing the probability of making a Type I error anywhere within the investigation. A MANOVA was performed to determine whether a statistically significant difference was present among the four TAAS objectives as a function of ethnicity, at risk, and economically disadvantaged. Table 6 provides the results of the MANOVA and was found to yield statistically significant results, \( p < .05 \). As the results show, the difference between the at risk groups were significant only for the algebra and statistics items. There was a significant effect for ethnic groups the mean of the white students being greater that of all other ethnic groups for algebra. There was also an interaction for at risk and economically disadvantaged for the statistics items. The \( R^2 \) for Objectives 1, 2, 3, and 4 are 6.9%, 10.1%, 4.8%, and 13.1% respectively. Objective 5 contributes the most to the variance accounted for the model overall followed by Objective 2 each effect size is of practical importance and could be considered high by comparison to similar studies.
The use of effect size is becoming more common and the work of Jacob Cohen (1988) is often cited in determining the relative magnitude. Cohen termed .20, .50, and .80 to be small, medium, and large effects respectively. However, there is no such guideline when using multivariate statistics. Instead, one should interpret the differences in the means accounting for magnitude and scale, and then effect size based on comparable studies with similar samples. (CITATION) In this study on Objective 2 (Algebra) White students have a mean of .93 (SD = .37) and non-White students a mean of .65 (SD = .49). The results are both statistically significant and practically significant. This objective consisted of four questions and was scaled as 1 mastered or 0 not mastered. In comparing the means, the non-White student mean is approximately 31% lower. While non-White students approached 1/3 not achieving mastery on the algebra objective nearly all the White students achieved mastery. The differences in the means for Objective 2 and At Risk were also practically significant. The mean for at risk .68 (SD = .48) and not at risk .94 (SD = .35) indicated that not at risk students achieved mastery nearly 28% more often. Therefore, the effect size of 10% is relatively large in comparison with other similar studies and the differences in the mean important enough to warrant attention.

The means for Objective 4 (Statistics) for at risk was .88 (SD = .33) and not at risk .99 (SD = .11) indicates that nearly all not at risk students mastered this objective. The mean for economically disadvantaged on Objective 4 was .95 (SD = .20) and .97 (SD = .20) for not economically disadvantaged. In this case the sample size may have resulted in producing the statistically significant result. Even though the test of statistical significance indicates that the
difference between economically disadvantaged and not economically disadvantaged is important when considering the means it obviously indicates the difference is too small to be practically important. The relatively large effect size of 13.1% for the statistics objective indicates a practically significant result which could be accounted for in the at risk comparison or in the statistically significant interaction effect for at risk and economically disadvantaged students.

Discussion

The importance of achievement on high-stakes tests cannot be under-estimated in states that use them for school and teacher accountability. In these contexts, the implementation of new teacher materials and strategies must first provide evidence that they “do no harm.” Further, if these new approaches are to be embraced and more widely adopted, they must improve the achievement of students who have not succeeded well with more traditional approaches. Finally, it makes practical sense for school districts to proceed with caution, pilot testing new approaches with volunteer teachers before moving forward on a wider scale. This article is a report on such a study. It is necessarily small scale and focused on a somewhat narrow question: how well do students achieve on high-stakes state mathematics assessment? On the other hand, the study also represents a fairly typical setting with “average” students and teachers and without a rich set of resources to support implementation.

The primary issue related to implementation was not the level or quality of implementation or a comparison of the degrees of implementation. Our observations were mainly aimed at determining first, whether the materials were actually used consistently. The teachers had their traditional district-adopted textbook, as well as their own favorite
materials, available throughout the year. They did use these textbooks and materials from time to time but remained committed to using *Connected Mathematics* as the primary text. The second aim of the observations was to assure that the “spirit” of the materials was reflected; that is, the appropriate balance of teaching for understanding and of developing procedural skill. Although this objective was more difficult to judge, our observations consistently noted that teachers used the introductory investigations, the hands-on activities, and the student reflections questions that *Connected Mathematics* employs to build student understanding. We have reported elsewhere further details that provide evidence to support our conclusion that the materials were reasonably well implemented (Kulm, et. al, 2001).

The first result that the teachers and administrators noticed was that only 2 students failed to pass the 6th grade TAAS mathematics test. Although the school’s average on the test had always been good, only 60 to 75% of minority, disadvantaged, and at-risk students had usually passed the test. Our formal analysis of the data provided further insight into this result.

The mean scores on the TLI reflect not only the significant difference between the previous and current year, and also the rate of growth. The 4 point mean gain on the TLI represents an acceleration in mathematics achievement. The standard deviations show that the spread of TLI scores was compressed 52%, illustrating that the TAAS has limited usefulness in measuring students scoring near the upper limit the previous year. An additional important factor in this compression is the 10-point gain in TLI by at-risk students. This gain represents at least one additional grade level equivalent in achievement growth, without sacrificing achievement for students in the not at risk group.
It is especially important to note that the main source of gain in TAAS achievement scores was improvement by at-risk students. These students, especially those classified as Limited English Proficient and who represent a growing population, present a challenge to many teachers in improving mathematics achievement. The usual approach is to implement intensive test practice programs. Many schools require time be set-aside in each mathematics class to do practice TAAS items. The teachers in this study paid close attention to aligning the *Connected Mathematics* units and lessons with the TAAS objectives to assure content coverage. They also constructed a mid-year “benchmark” test to determine areas that needed additional work. Finally, the students completed a TAAS practice test a few weeks before the “real thing.” None of these practical and sensible measures were inconsistent with the intended implementation of the *Connected Mathematics* materials.

The achievement gains varied somewhat across mathematics topic areas. Although only a few items of the TAAS measure each of these, there appeared to be differential effects on at-risk, minority, and disadvantaged groups for Algebra and Statistics objectives. Since the *Connected Mathematics* materials develop algebra ideas primarily in 7th and 8th grades, these students may not have had an opportunity to fully develop their understanding in this topic. A full 6th grade unit in *Connected Mathematics* addresses statistics. However, in our preliminary analysis of student interviews on selected statistics-related tasks, we found that it takes some time for students to develop and revise their ideas. Statistics may be a relatively new topic for at-risk students. The emphasis in earlier grades, especially for these students, is likely to have been on number operations. It may take more time for these students to make significant gains in their understanding and achievement of statistics ideas and skills.
Summary

This study addressed practical questions that were of interest to a few teachers in one school, but which represent concerns of many mathematics educators and teachers. We found that teaching and learning with understanding is compatible with achievement on high stakes multiple-choice tests. We also found that the needs of all students can be addressed with high quality high curriculum materials. Students who had been classified as being at risk for failure gained more than two grade levels in mathematics achievement. The results of the study have had practical impact. The sixth grade students have moved to a middle school this year. The teachers and principal in that school have been convinced to adopt the Connected Mathematics materials so that these students can continue to develop their mathematical understandings.
References


Kulm, G., Capraro, R.M., Capraro, M. M., Burghardt, R., & Ford, K. (April, 2001). Teaching and learning mathematics with understanding in an era of accountability and high-stakes testing. Paper presented at the research pre-session of the 79th annual meeting of the National Council of Teachers of Mathematics. Orlando, FL.


**Author Note**

Inquires concerning this paper should be addressed to the authors at College of Education, Texas A&M University, 4232 TAMU, College Station, TX, 77843-4232, (979) 845-8007. E-mail gkulm@coe.tamu.edu; rcapraro@coe.tamu.edu; mmcapraro@coe.tamu.edu;

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Table 1

Demographic Characteristics of the Sample

<table>
<thead>
<tr>
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<th>Economically Disadvantaged</th>
<th>At Risk</th>
<th>Not At Risk</th>
<th>Total*</th>
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<tbody>
<tr>
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<tr>
<td>Female</td>
<td>10</td>
<td>9</td>
<td>46</td>
<td>55</td>
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</table>

n = 105* Numbers in the first three columns are not independent; that is, a student may be counted in two or more categories.
Table 2
Analyses of Previous (5th Grade) and Current (6th Grade) Texas Learning Index Scores

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
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<tr>
<td>5th Grade TLI</td>
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<td>11.504</td>
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<td>6th Grade TLI</td>
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<td>-3.899</td>
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<td>.000</td>
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</table>

Note. Texas Learning Index is a measure designed to compare student progress from year to year.
Table 3.

Texas Learning Index Means and Standard Deviations for At Risk and Not At Risk Students

<table>
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<th>SD</th>
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<td>At Risk</td>
<td>10.16</td>
<td>17.4</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>3.74</td>
<td>9.8</td>
<td>105</td>
</tr>
</tbody>
</table>
Table 4.

ANOVA of Mathematics Differential by Gender and At Risk

<table>
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<th>Source</th>
<th>df</th>
<th>F</th>
<th>Eta Squared</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td>.349</td>
<td>.003</td>
<td>.556</td>
</tr>
<tr>
<td>At Risk</td>
<td>1</td>
<td>13.418</td>
<td>.117</td>
<td>.000</td>
</tr>
<tr>
<td>Gender X At Risk</td>
<td>1</td>
<td>.503</td>
<td>.005</td>
<td>.480</td>
</tr>
<tr>
<td>Error</td>
<td>101</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $R^2 = .139$ (Adjusted $R^2 = .113$)