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Evaluation Services Center

***K-5 Math Connects:***  
**Quasi-Experimental**  
**Field Study**

**Preliminary Results:**  
**Elementary School Teachers'**  
**Reports on Program**  
**Effectiveness**

**March 2009**

**Macmillan/McGraw-Hill and**  
**Glencoe**

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UNIVERSITY OF  
Cincinnati

# ***Math Connects: Preliminary Results: Elementary School Teachers' Reports on Program Effectiveness***

## **Evaluation Report**

### **University of Cincinnati Evaluation Services Center**

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# ***Math Connects: Preliminary Results: Elementary School Teachers' Reports on Program Effectiveness***

## **Purpose of the Evaluation**

The University of Cincinnati Evaluation Services Center, in collaboration with Saperstein Associates, is conducting a quasi-experimental field study of the effectiveness of the Macmillan/McGraw-Hill K-5 and Glencoe 6-8 mathematics program, *Math Connects*. The study involves a total of 141 teachers and approximately 4000 students nationwide. This research is designed to test the assumptions on which the *Math Connects* program is based and objectively assess the effectiveness of all components of the *Math Connects* program.

The design of this study incorporates valid quantitative assessment of student learning, student attitudes, teacher practices and teacher attitudes while also admitting the consideration of the teachers' professional wisdom through the solicitation of qualitative responses to open-ended questions about the materials they are using and their perceptions of their students' attitudes and knowledge gains. This preliminary report provides the basic analyses of the data collected from the initiation of the study at the beginning of the 2008-2009 school year up to the approximate midterm point of that school year (February 2009). A final, more comprehensive report of all study data is planned for October of 2009. This preliminary report examines only the major distinctions between teachers using the *Math Connects* program and teachers using other mathematics programs.

## **Research Design**

This study employs a quasi-experimental design (see Cook & Campbell, 1979; Shadish, Cook & Campbell, 2002). That is, functionally equivalent groups of teachers were created by the careful matching of teachers and schools on key variables (e.g. teacher experience, school locations and student social demographic characteristics) and comprehensive pretesting of students on the dependent variables of interest (knowledge and skill gain in mathematics and reading). The details of this matching process will be contained in the final report and are available from UCESC by request.

The quasi-experimental design was employed for several reasons. Shadish and Cook (2009) note that well designed quasi-experiments of this type can be as effective as randomized controlled experiments for making causal inferences. As Cook (2004) suggests, accepting the traditional research model of medical research and considering random control designs as the primary component of some "gold standard" of evaluation is misguided. Carpenter, Dossey and Koehler (2004) are very direct in their call for policy makers to recognize the limits of traditional, scientific experimental designs as they advocate for better

research employing different methods. Schoenfield (2006) implies a similar point in his critique of the often-cited but seldom understood standards outlined by the What Works Clearinghouse of the United States Department of Education.

The standards driving the design of this study were not the standards of clinical medical research but rather the standards accepted as ideal for the assessment of educational programs (see The Joint Committee on Standards for Educational Evaluation, 1994). To enhance the external validity of this research, a nationwide study was created that included as many geographical locations as possible. This design allowed the involvement of a total of 106 schools in 11 states. The choice was also made *not* to mix experimental conditions *within* schools. Often randomized control studies assign classrooms within the same school to different experimental conditions. Thus, for example, one second grade mathematics teacher may be given a new program to use while the second grade teacher in the next room continues to use the older program. That is a procedure which, in the abstract, provides an effective control against confounding “school effects” or “teacher effects.” However, such designs result in a situation where *students and teachers within the same grade within one school are actually using different programs*. Such designs make treatment reliability highly questionable because they assume that teachers do not share practices across conditions and that students do not interact with each other. Thus they create learning environments that rarely, if ever, actually occur in schools. The quasi-experimental design was used to maximize ecological validity.

**Sampling and Assignment to Condition.** Initially, participants were recruited via a mass emailing. The initial pool of respondents was screened for geographical location, teachers’ characteristics and school characteristics. A final sample consisted of 141 teachers within 106 schools in 11 states nationwide.

The full study employs a 2 x 2 design producing four basic conditions to which teachers were assigned (see figure below). The two main variables of interest were the mathematics curriculum used by the teachers (*Math Connects* vs. other basal materials) and teachers’ use of supplemental “reform-based” alternate materials (teachers using supplemental materials vs. teachers using materials drawn strictly from their basal curriculum). The general study is designed to provide a direct comparison between teachers using the *Math Connects* materials and teachers using other basal mathematics materials (cells 1 & 2 compared with cells 3 & 4). The study also allows a direct comparison between teachers who use alternate reform-based materials along with their basal materials and teachers using basal materials only (cells 1 & 3 compared with cells 2 & 4). Analyses among individual cells will provide insight into how the use of the *IMPACT Mathematics* alternate materials might contribute to outcomes beyond the use of the basal *Math Connects* materials (cell 1 vs. cell 2); they also allow comparison of how the use of the *IMPACT Mathematics* materials may differ from other available reform-based materials (cell 2 vs. cell 4). However, the data reported in this preliminary report focused solely on the major comparison of mathematics curricula used.

## Study Design: Materials Used in Classrooms

|   |  |
|---|--|
| <p style="text-align: center;"><b><u>Cell 1:</u></b></p> <p style="text-align: center;"><b>Teachers using <i>Math Connects</i><br/>Basal Curricular Materials</b></p> | <p style="text-align: center;"><b><u>Cell 2:</u></b></p> <p style="text-align: center;"><b>Teachers using <i>Math Connects</i><br/>Basal Curricular Materials with<br/>Supplemental Reform-Based<br/>Materials (<i>IMPACT Mathematics</i>)</b></p> |
| <p style="text-align: center;"><b><u>Cell 3:</u></b></p> <p style="text-align: center;"><b>Teachers using other Basal<br/>Curricular Materials</b></p>                | <p style="text-align: center;"><b><u>Cell 4:</u></b></p> <p style="text-align: center;"><b>Teachers using other Basal<br/>materials with Other Reform-<br/>Based Supplemental Materials</b></p>  |

## Measures

Student learning is being assessed in a pretest-posttest fashion. Student engagement in mathematics will be assessed via a year-end survey of student attitudes and through regular assessments of the teachers' perceptions of student activity and involvement. Teachers' attitudes will be assessed at the end of the school year to discern their perceptions of the materials they used and their attitudes about teaching mathematics.

**Student Learning.** All students within the study will be tested both on mathematical abilities and reading in a pretest-posttest fashion. All students will take the grade-level-appropriate version of the TerraNova Survey of reading and mathematics (CTB/McGraw-Hill; [www.ctb.com](http://www.ctb.com)).

Reading level is being assessed for at least two reasons. First, especially at primary levels, reading ability is known to affect academic performance in mathematics in fairly robust ways (see, for example, Walker, Zhang and Surber, 2008). Thus reading is being assessed as a potential moderating variable in discerning the effects of the different materials being used by teachers. However, it should also be noted that one of the primary features of the *Math Connects* program is the inclusion of a reform-based set of alternate materials (*IMPACT Mathematics*) purportedly designed to be efficiently blended with the basal *Math Connects* materials. The primary dimension of this horizontal alignment (*IMPACT Mathematics* with *Math Connects*) is that the vocabulary of the *Math Connects* basal material is closely matched with the vocabulary used in the *IMPACT Mathematics* materials. Students are being tested in reading to assess whether this integrated vocabulary may enhance students' overall reading abilities.

**Student Engagement.** One important consideration in the full study will be the extent to which students' attitudes about studying mathematics are affected by the materials they use. All students at the fourth and seventh grade levels will be surveyed to assess several things. First, the students' attitudes about the materials they used in their mathematics classes will be assessed via a survey constructed by UCESC personnel. This survey will be specific to the materials used and will assess the extent to which the students used each component and how helpful the students found each component.

Students' attitudes about studying mathematics will be assessed in several ways depending on the grade level of the student. Most generally, student engagement will be assessed using the brief instrument employed effectively by Marks (2000). Additionally, math anxiety will be assessed via the revised Math Anxiety Scale created by Pajares and Urdan (1996). Finally, a more comprehensive assessment of student motivation will be obtained by using the Motivated Strategies for Learning Questionnaire (Pintrich & DeGroot, 1990). The final report will thus include an assessment of a range of student variables that will be valid indicators of students' orientations toward studying mathematics.

**Teachers' Practices and Perceptions.** One of the major data collection activities of this research is teacher completion of semimonthly online activity logs. That is, twice each month teachers are required to log in to a specified web site and respond to a brief set of questions about their activities in their mathematics classrooms. This log primarily consists of a teaching practices scale designed to assess the extent to which the teacher has been engaging in reform-based or traditional teaching practices (McCaffrey, Hamilton, Stecher, Klein, Bugliari & Robyn, 2001). Additional items assess teachers' perceptions of students' engagement in the class. At the end of the school year teachers will be surveyed in a comprehensive manner to discern their opinions of each component of the materials they used during the previous year.

## Midterm Data Collection

In early January of 2009, the teachers' semimonthly log questions were altered to provide a formative assessment of the effectiveness of the curriculum materials being used. This brief questionnaire asked teachers to directly assess the key components of their curriculum materials.

Teachers were asked directly about specific dimensions of the materials they are using. They were presented with a series of 14 statements and asked to indicate the degree to which they agreed with each statement (1=strongly disagree, 2=disagree, 3=agree and 4=strongly disagree). These closed-ended items served as general, but direct reports of the teachers' perceptions of the materials and how they are functioning. The results of each of these closed-ended items are presented within this report in graphic form by topic area.

Additionally, teachers were prompted to provide open-ended comments. The initial items in the questionnaire invited the teachers to describe both the best things and the worst things that were happening in their classrooms this year. Immediately following many of the closed-ended items, teachers were also invited to provide additional comments on specific topics. These comments are voluminous. Where relevant, exemplars of teachers' comments are provided in this report *in representative proportions*. That is, the displays of teachers' comments included in this report contain both negative and positive comments in the same proportion that they occurred within the complete sample. More extensive analyses of these comments will be contained in the final report of this research.

## Results of Midterm Data Analyses for the Quasi-Experimental Field Study of the *Math Connects* Program

Midterm assessment data was received from 128 teachers in 106 schools in 11 states. Overall, 62 teachers are using *Math Connects* in their classrooms and 66 are using some other program. The table below displays the distribution of teachers by grade and by program used.

### Grade and Condition of Teachers in Midterm Assessment

| Grade   | Condition                  |                      |       |
|---------|----------------------------|----------------------|-------|
|         | Using <i>Math Connects</i> | Using Other Programs | Total |
| Second  | 22                         | 29                   | 51    |
| Fourth  | 27                         | 27                   | 54    |
| Seventh | 13                         | 10                   | 23    |
| Total   | 66                         | 62                   | 128   |

The midterm assessment was designed to get teachers' direct perceptions of major characteristics of any mathematics curriculum. But most primarily, teachers were asked to report on *student learning* and *how well prepared students seem to be for their state tests*. Beyond that, this assessment focused on seven fundamental characteristics of academic programs thought to be essential to their effectiveness:

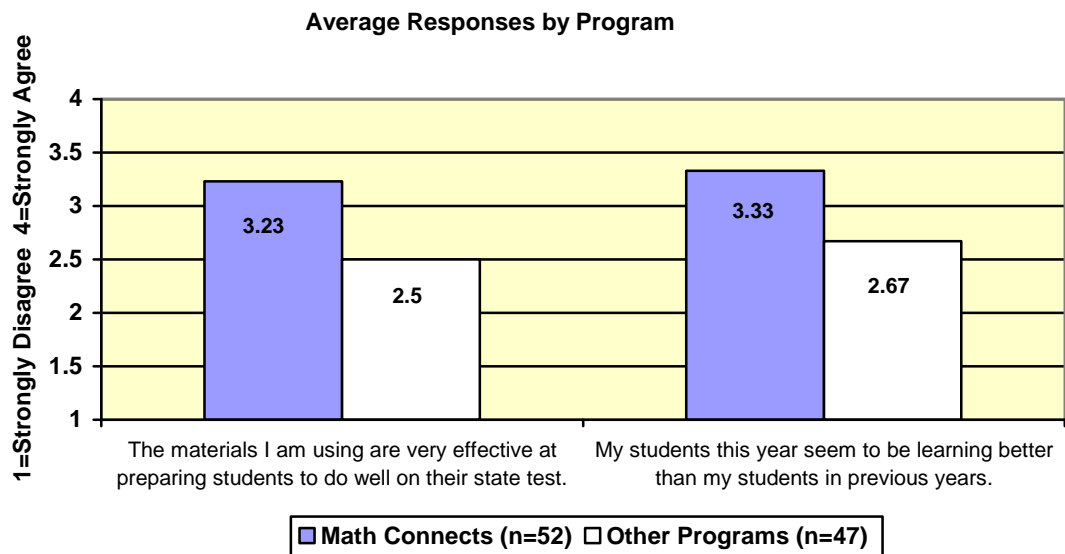
- 1) The *vertical alignment* of the curriculum materials.
- 2) The extent to which the materials facilitate *balanced instruction*.
- 3) The effectiveness of the materials at promoting *mathematical literacy*.
- 4) The effectiveness of the materials in facilitating *differentiated instruction*.
- 5) The effectiveness of the materials in facilitating *diagnostic intervention*.
- 6) The effectiveness of the *assessment materials*, both formative and summative, within the program.
- 7) The effectiveness of the *technology resources* for both teachers and students.

## Results for Elementary Grade Teachers

**Teachers' Perceptions of Student Learning.** The longitudinal testing of student knowledge gains will not be complete of course, until the end of the school year when all students once again complete both the reading and mathematics survey version of the TerraNova. However, it seems reasonable to expect teachers to have valid perceptions of their students' learning. For this midterm assessment, teachers were asked two direct questions about their perceptions of student learning. First, they were asked to report on how well prepared they think their students will be for their state tests. Also, they were asked to compare the learning that they see happening this year in their classrooms to the learning they have seen in previous years.

The teachers using the *Math Connects* feel strongly that their students will do well on their state tests. Additionally, they indicated that their students tend to be learning better this year than in years past. The *Math Connects* teachers were significantly more positive than teachers using other programs. Regarding preparation for a state test, the mean response for teachers using *Math Connects* was 3.23 while the mean for teachers using other programs was 2.5 ( $t = 5.11$ ;  $p = .00$ ). In comparing this year's learning to learning in previous years, the mean response for teachers using *Math Connects* was 3.33 while the mean for teachers using other programs was 2.67 ( $t = 4.54$ ;  $p = .00$ ).

### Elementary School Teachers' Perceptions of Student Learning



- *According to the elementary school teachers using the program, Math Connects is very effective at preparing students to do well on their state test. The Math Connects teachers were significantly more positive about their students doing well on the state test than teachers using other programs. These teachers also indicated that their current students seemed to be learning better than students in previous years and they were significantly more positive about this than teachers using other programs.*

## Elementary School Teachers' Comments on Student Learning with *Math Connects*

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"Students are understanding some of the concepts that they've had trouble with in the past. I believe this is due to the vast amount of practice material."

"I see computation and problem-solving skills developing at a deeper level than I have in years past. Students are excited about the materials, such as the textbook, workbooks, and manipulatives."

"I think math class is going much better than last year. The students are engaged in the activities. The book lays things out in an organized, spiraled manner that is easy to follow. The best thing that happened this year is my students actually got the concepts I was trying to get across to them..."

"The best things that are happening this year is that I feel the students are retaining the information that I am teaching them. They seem to enjoy math and the book is easy to follow. I like that all the resources are there to use if I choose to do so."

"The students are learning and understanding way more content than any other program I have taught."

"I am very pleased with how well the students are able to comprehend the real-world problems."

"...my students are getting a real grasp for the different concepts. Even my low students have been able to master specific skills, that in previous years they have been unable to."

"The students recently took our district's benchmark assessments. The class scored an 86 percent average..."

"I think the materials I am currently using are going at a faster pace; however, so far the students are able to keep up and are learning the skills. They are ahead of the other second grade classes in our district."

"It has been great to have a math curriculum that aligns with the state standards... Many of the students were enthusiastically completing all of the graphs and charts in the workbook. They did not want to skip any of the charts or graphs..."

"I teach the higher-end students in the three second grade classes. This program is well set up to go fast or slow and has lots of resources to help learning."

"The drawbacks are mostly due to students' abilities when they entered fourth grade. Reading comprehension difficulties make story problems a chore. I like the fact though, that there are a lot of story problems to practice. Some students don't know their multiplication facts so that has to be added to the curriculum. Worse, some can't add or subtract. This too must be taught, but I've been assigning homework to address that problem..."

"I think my students are on par with my students from the past year in their learning."

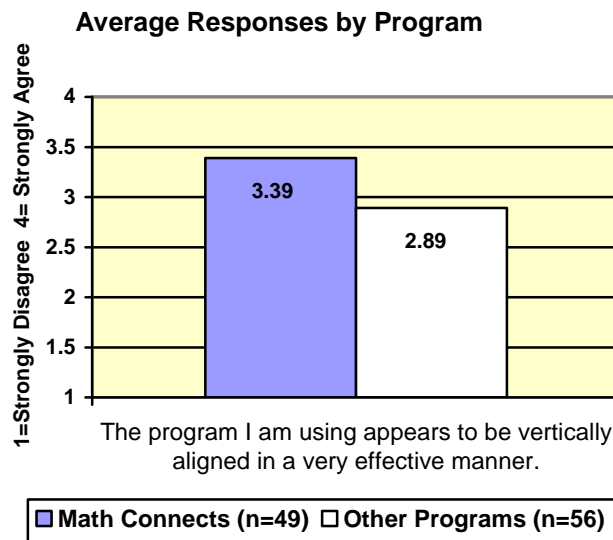
"I have mentioned several times that my students are on- or below-grade level. I see a lack of basic skills with a lot of them. I believe they all have the ability to learn this material, but some of them are allowing themselves to give up or become frustrated."

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**Vertical Alignment.** In their articulation of principles for effective mathematics education, The National Council of Teachers of Mathematics (NCTM) asserts that “(a) curriculum is more than a collection of activities; it must be coherent, focused on important mathematics, and well articulated across grades.” (NCTM Principles and Standards; see [www.nctm.org](http://www.nctm.org)). They go on to assert that “(i)n a coherent curriculum, mathematical ideas are linked to build upon one another so that students’ understanding and knowledge deepen and their ability to apply mathematics expands.” The *Teacher Handbook* of the *Math Connects* program states that *Math Connects* is vertically aligned into an articulated, coherent sequence of content. This study tested that assertion directly by asking all teachers in the study about the vertical alignment of the mathematics curriculum they are using.

Results indicate that teachers using the *Math Connects* program were more likely to agree that their program was vertically aligned in an effective manner than teachers using other programs (see figure below). The mean response for the *Math Connects* teachers was significantly higher than the average response for teachers using other programs ( $t = 3.4$ ,  $p = .00$ ).

### Elementary Teachers: Perceptions of Program Vertical Alignment

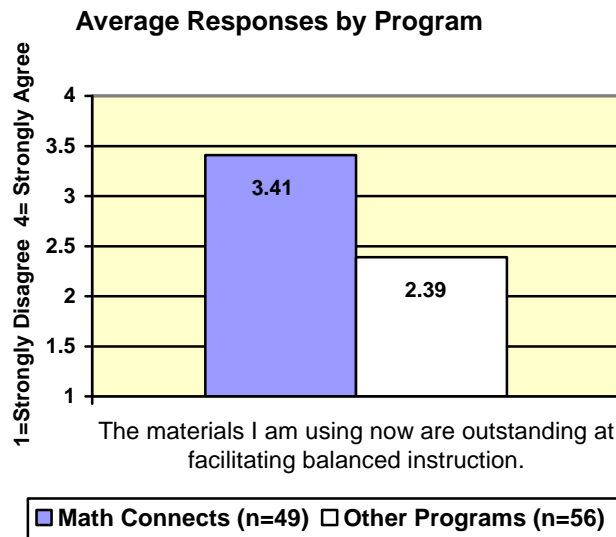


- *Elementary school teachers using Math Connects were very positive about the vertical alignment of the Math Connects program. Results suggest that, according to elementary school teachers, the vertical alignment of Math Connects is superior to the vertical alignment of other programs.*

**Balanced Instruction.** Effective curricular materials enable teachers to provide *balanced instruction*. That is, to speak very generally, effective instruction requires that teachers provide a coherent blend of holistic learning activities along with direct instruction and other applications (see, for example Stanulis & Floden, 2009). The pre-development research that provided the foundation for *Math Connects* indicates that the program was intended to help teachers in their efforts to provide such balance (Edwards, 2009). The *Teacher Handbook* of the *Math Connects* asserts that the program facilitates balanced instruction by providing resources for teaching conceptual understanding, computational and procedural skills and real-world problem solving within every unit. Thus the midterm assessment asked all teachers for their direct perceptions of the effectiveness of *Math Connects* in facilitating balanced instruction.

The elementary teachers using the *Math Connects* materials were very positive about the resources for balanced instruction within the program. The figure below displays the results regarding balanced instruction. The teachers using *Math Connects* were significantly more likely to agree with the statement indicating that their materials were outstanding at helping them provide balanced instruction. The mean for *Math Connects* teachers was 3.41 (on a 1-4 scale) while the mean for the teachers using other programs was 2.39 ( $t = 7.5; p = .00$ ).

## Elementary Teachers: Perceptions Regarding Balanced Instruction



- Elementary school teachers using Math Connects overwhelmingly agreed that the Math Connects materials were outstanding in helping them to provide balanced instruction to their students. These teachers were significantly more positive about their materials than teachers using other programs.

Teachers provided comments relevant to balanced instruction in several places. Some comments occurred in response to the initial questions which asked teachers to describe the best and worst things that had been occurring in their classes this year. Some comments also occurred in response to a final question asking teachers to provide additional comments about student learning. Below are representative comments from the teachers using *Math Connects*. The full text of all comments will be included in an appendix in the final report of this research.

## Elementary School Teachers' Comments on Balanced Instruction in *Math Connects*

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"*Math Connects* is a very complete and appropriate math program for my second graders. They love math time and the workbook. The math concepts are so well developed. There are very good practice pages that lead to appropriate tests. I am enjoying teaching it and it is very easy to follow."

"I am thoroughly enjoying the *Math Connects* program and love teaching math every day...They absolutely love the *Real World Problem Solving* and much of the science related information. The materials are amazing and really assist in my teaching. I've never seen a math book so full of wonder for kids!"

"I really think the color workbooks and the CDs help to provide and promote different formats for math success. It gives students a variety of learning for each of the activities. This helps stop boredom and helps different learning styles. I would recommend this curriculum to anyone teaching second grade."

"There is such a wide range of materials and ideas that I can use to help me teach lessons. Also, there are many different activities for practice that leads to knowledge and understanding for my students."

"I love the variety of materials that I received with this book... I love the variety of activities for each lesson and my students are really benefiting from the hands-on activities. My favorite part of the materials is the manipulatives kit."

"I really enjoy the *Math Connects* materials. The supplemental materials are strong and my students love using the Web site to reinforce skills and concepts in a fun manner. My students are all showing much improvement...and I even see my students with lower math skills being able to connect to previous skills to help them learn new ones. My two favorite parts of this program is the emphasis on problem solving. Here is the application of skills, understanding of processes and math language most evident; and I LOVE the homework connections."

"The best thing that is happening this year is that the materials have been perfect for assisting my students in both their new learning and extending their prior knowledge. My students have really enjoyed the real-world problem solvers and the books that are provided. The workbooks are fun and colorful and the students have shown an interest in learning the new vocabulary words (we add them to a mathematics word wall)..."

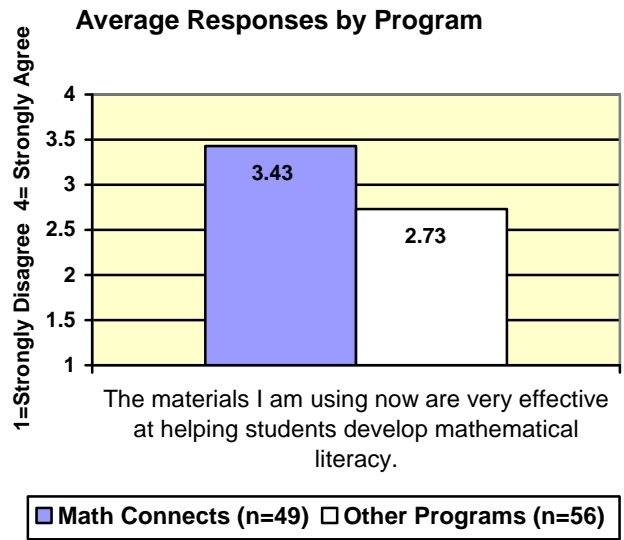
"The worst is not having enough time to utilize everything that could enhance my students' learning. I have used the problem solving booklets and love them, as well as the practice sheets and reteach sheets. I have used the textbook only sometimes, but it has great definitions and examples. I have also used the manipulative packages. I want to be able to effectively use more of what this program has to offer."

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**Mathematical Literacy.** One significant issue often raised along with issues of balanced instruction is the notion of mathematical literacy (see Jablonka, 2003). Put simply, mathematical literacy occurs as students develop a sound understanding of the vocabulary of mathematics. Thompson and Chappell (2007) explain how the NCTM standards emphasize that learning effective communication and representation of mathematical concepts is absolutely fundamental to learning mathematics. In the midterm data collection, teachers reported on the effectiveness of the materials they were using in helping students to develop mathematical literacy.

The elementary school teachers using the *Math Connects* program felt strongly that their materials were very effective at helping their students develop mathematical literacy (see figure below). The mean response for teachers using *Math Connects* was 3.43 on a 4-point scale. Thus teachers using *Math Connects* tended to either strongly agree or agree that the *Math Connects* materials are very effective in the domain of mathematical literacy. Once again, the mean response score for the teachers using *Math Connects* was significantly higher than the mean score for teachers using other programs ( $t = 6.11; p = .00$ ).

### Elementary Teachers: Program Effectiveness at Developing Mathematical Literacy



- Elementary school teachers using *Math Connects* reported that their materials are very effective at helping their students develop mathematical literacy. Their average response was significantly higher than those of teachers using other materials. This preliminary data suggests that the *Math Connects* program is effective at addressing the NCTM standard of communication and representation.

While there was not a specific question asking for open-ended comments on mathematical literacy or vocabulary, a few teachers provided comments about these aspects of the materials. Some comments occurred in response to the initial questions which asked teachers to describe the best and worst things that had been occurring in their classes this year and others occurred in response to a final question asking teachers to provide additional comments about student learning. Representative comments from the teachers using *Math Connects* are displayed below. The full text of all comments will be included in an appendix in the final report of this research.

## Elementary School Teachers' Comments Relevant to the Mathematical Literacy Components in *Math Connects*

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"The vocabulary development is great. Highlighting the important vocabulary and using it in the text helps the students learn the correct terms used for each math concept."

"The focus on vocabulary is helpful by enabling the students to do well on the state test. If the students do not know the vocabulary, then they will not know what the test question is asking them to do on the state test."

"The workbooks are fun and colorful and the students have shown an interest in learning the new vocabulary words (we add them to a mathematics word wall). The Impact books have been a perfect complement for my students who need just a little extra practice."

"The students who struggle the most are the students who have very little home support and limited basic skills. The vocabulary development is great. Highlighting the important vocabulary and using it in the text helps the students learn the correct terms used for each math concept."

"I also have many below-level readers who have a very difficult time with the vocabulary -- which is why we spend a lot of time with the vocabulary."

"I am using the workbooks for the classroom to follow-up on lectures, then *Homework Practice* and *Reteach* worksheets as homework. I am also using the glossaries on a regular basis, and I think they are helping the kids to understand concepts better."

"Students are really thinking about and demonstrating their understanding of mathematical concepts using different representations. The materials provided by *Math Connects* really aid this process."

"We have really been enjoying the manipulatives and the supplemental reading books. I also appreciate the new approaches to teaching math."

"My entire class is English Language Learners. They struggle with academic language."

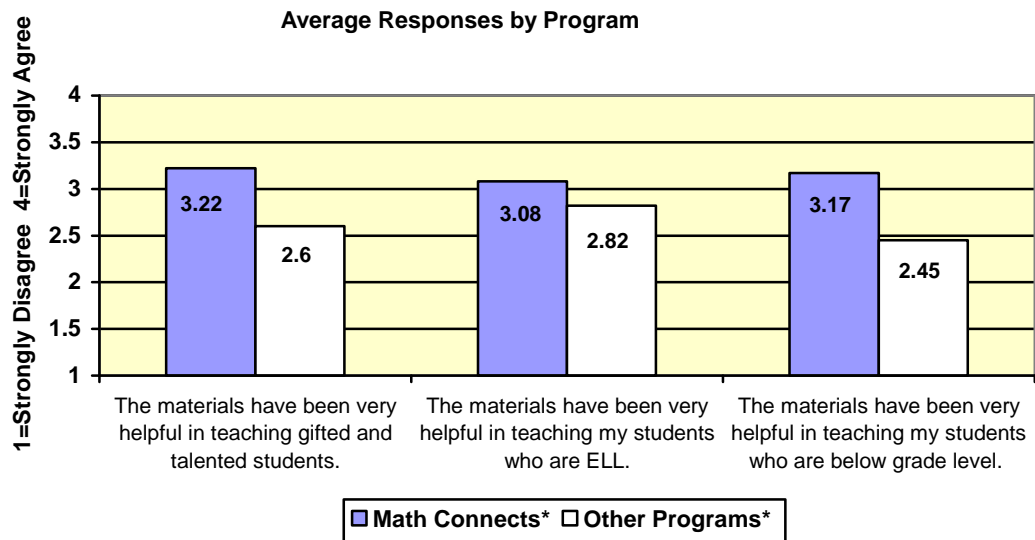
"The math text is laid out in a way such that it is difficult for students to access -- in terms of both vocabulary and math. The reading levels are far higher than my students' ability (largely)..."

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**Differentiated Instruction.** In the extensive background review of research for *Math Connects*, Papa and Brown ([www.glencoe.com/glencoe\\_research/research\\_maths.html](http://www.glencoe.com/glencoe_research/research_maths.html)) summarize the voluminous research on differentiated instruction. It is widely recognized that effective instruction requires adapting both instructional content and instructional practices to meet the students at their individual level of readiness. This is, understandably, a major challenge for most teachers as they encounter classrooms that have, at the same time, students who are above grade level in ability and ready for enrichment activities, students who are below grade level for any of a variety of reasons, and even students for whom English is not their first language. Teachers are faced with finding ways to teach these diverse groups effectively and, according to the *Teacher Handbook* of *Math Connects*, one major component of the *Math Connects* program is the provision of multiple options for providing differentiated instruction. The individual components that constitute these resources will be assessed separately in the final report at the end of the school year. This midterm assessment asked teachers specifically about the three major challenges mentioned above: teaching gifted and talented students, helping students who are below grade level, and teaching students who are English language learners. Teachers were asked about these three student groups after being prompted to consider the topic of differentiated instruction. Thus they were being asked to consider these three groups at the same time.

Results clearly suggest that the *Math Connects* program is effective at providing differentiated instruction. The teachers using *Math Connects* responded in a very positive manner regarding all three of the student groups for which teachers typically need to differentiate instruction (see figure below). For all three groups, the teachers using *Math Connects* responded in a significantly more positive manner than teachers using other programs. (Test for the gifted and talented item:  $t = 3.99$ ;  $p = .00$ ; for the item on ELL students  $t = 2.79$ ;  $p = .01$ ; for the item on students below grade level  $t = 4.74$ ;  $p = .00$ ).

### Elementary Teachers: Program Effectiveness in Providing Differentiated Instruction



\*Due to the nature of the questions, teachers were given a “not applicable” option and n sizes varied from 36 to 56 on these items.

Immediately after the close-ended items on differentiated instruction, teachers were asked, “Any other comments about how your materials have affected your ability to provide differentiated instruction?” Below are representative comments from the teachers using *Math Connects*.

## Elementary School Teachers’ Comments on *Math Connects*’ Resources for Differentiating Instruction

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“They are great. I probably wouldn't differentiate as much if I didn't have them.”

“The best things are the differentiated options and materials. I have around three to four different levels going at any one time and having teaching suggestions plus materials is awesome!”

“I love the *Daily Reteach*, *Additional Skills*, and *Problem-Solving Practice*. This is the most practical and balanced math program for teaching to various levels.”

“I teach the struggling students of the second grade...I have used the manipulatives a lot. I have also used many of the reinforcement sheets in the classroom and to send home. They are making slow progress, but they are learning. I really like the way the chapters are laid out. I introduce with the *Math Connects* CD. I often use it to reinforce and practice during the chapter.

“The flow of the program and the reinforcements for reteaching and the extra practice for each objective is one of my favorite parts of the program. The students do seem to be learning the material taught. It is helpful having various levels of materials available for the various levels of students.”

“My talented and gifted students are able to complete the math workbook accurately, work on math computer games that track their progress, and work on some more advanced worksheets... They enjoy the challenge...My English Language Learners benefit from the colorful workbooks and engaging hands-on lessons. They are doing well with the program...”

“There are so many options to cater to all learners in daily work and in testing. It's wonderful. It has made a difference in being able to provide differentiated instruction.”

“The materials lend themselves to differentiated instruction, but it takes time to continuously change out the groupings as the students master concepts.”

“There are many great alternative lessons, extensions, and reteaching times, but my class's pace is not as fast as I would like...we have to pick and choose what to teach or have the kids do according to what their needs are. It's nice to have these tools at my fingertips, I just feel like I'm not doing as much as I want. I have a few very high-level students and the work is too easy for them. The enrichment pages are great, but still a bit easy for some. I've had to bring in materials from other programs (third grade), but this is not truly a complaint, just an observation.”

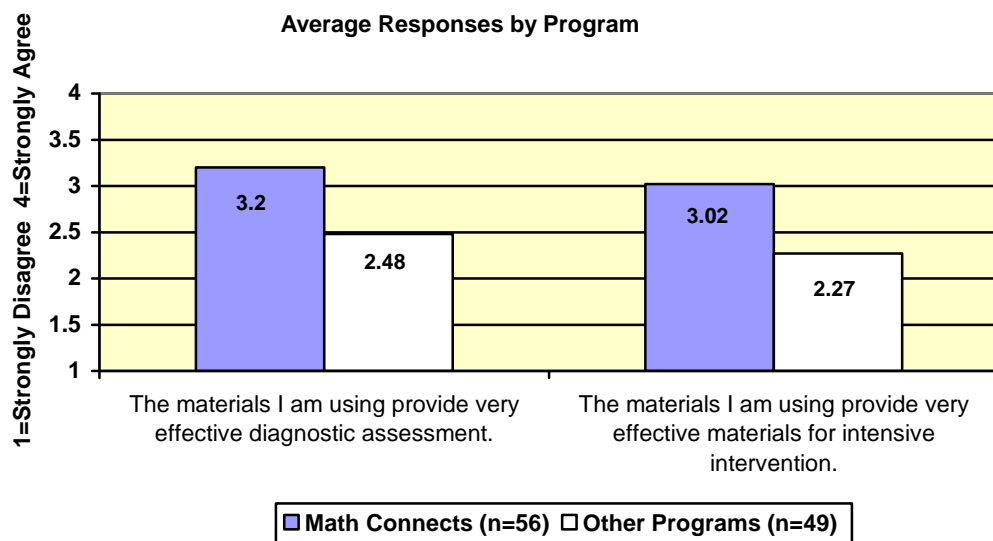
“My very lowest students are having a hard time with math. The manipulatives are helpful, but it is so hard to differentiate for the bottom percent of the class who have difficulty adding single digits.”

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**Diagnostic Assessment and Intervention.** As Papa and Brown (www.glencoe.com/glencoe\_research/research\_maths.html) note, volumes of research in mathematics education advocate the assessment of mathematical proficiency as a strategy to *inform* instruction. The NCTM standards clearly state that assessment procedures should function to support students' learning and not just serve as a means to make judgments about progress after the fact. Edwards (2009; the pre-development research for *Math Connects*) makes explicit how the design of the *Math Connects* program is intended to facilitate the smooth coordination of diagnostic assessment materials with intensive intervention activities. We tested this claim directly by asking teachers to judge how effective their programs were at providing both diagnostic assessment and intensive intervention. The data in response to these questions is displayed below.

The data indicate clearly that teachers using *Math Connects* find their materials to be very effective at providing diagnostic assessment and intensive intervention. The teachers using *Math Connects* responded in a significantly more positive manner than the teachers using other programs. For the question regarding diagnostic assessment the mean response for the *Math Connects* teachers was 3.2 (on a 1-4 scale) and the mean response for the teachers using other programs was 2.48 ( $t = 4.92; p. = .00$ ). For the question about intensive intervention the mean response for the *Math Connects* teachers was 3.02 and the mean response for the teachers using other programs was 2.27 ( $t = 5.47; p. = .00$ ).

## Elementary Teachers: Program Effectiveness for Diagnostic Assessment and Intensive Intervention

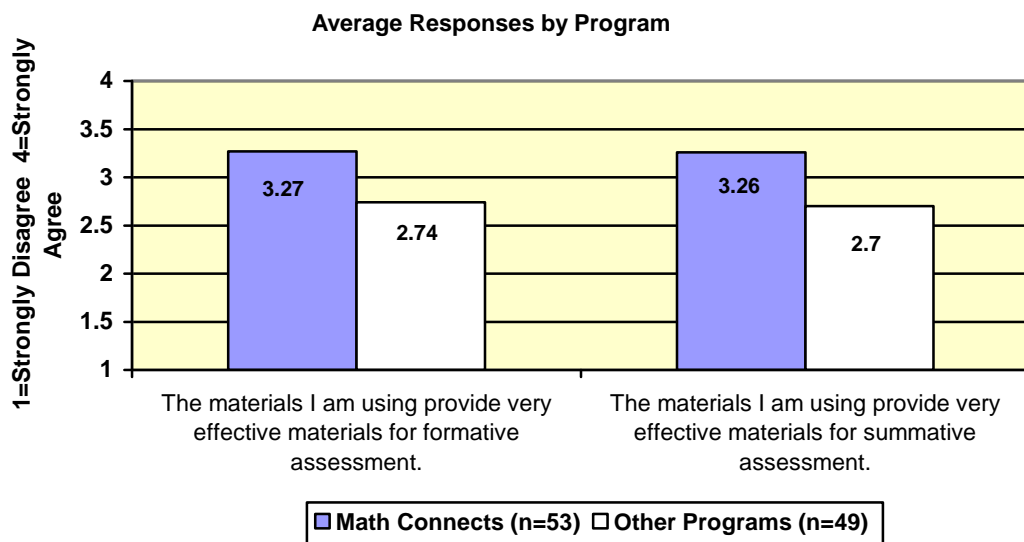


- According to the elementary school teachers using Math Connects, their materials are very effective for use in diagnostic assessment and intervention instruction. These teachers were significantly more positive about their materials in these areas than teachers using other programs.

**Formative and Summative Assessment.** Because of the continuous emphasis on accountability and assessment in mathematics instruction, one central focus of this evaluation was on the teachers' perceptions of the assessment materials provided within the programs they were using. As Wilson and Kenny (2003) state directly, valid assessment is essential to effective mathematics instruction. The *Teacher Handbook of Math Connects* asserts that every effort has been made with that program to integrate assessment activities into instruction. This notion seems to be directly consonant with the framework suggested by Lesh and Lamon (1992) when they advocate for the seamless integration of instruction and assessment.

The teachers using the *Math Connects* program clearly perceive the assessment materials within *Math Connects* as very effective. They responded in a very positive manner to both the formative and summative assessment materials. And, their responses were significantly more positive than those provided by teachers using other programs. The mean for the *Math Connects* teachers regarding formative assessment was 3.27 (on a 1-4 scale) and the mean for the teachers using other materials was 2.74 ( $t = 4.23$ ;  $p = .00$ ). The mean for the *Math Connects* teachers regarding the summative assessment materials was 3.26 and the mean for the teachers using other materials was 2.7 ( $t = 4.35$ ;  $p = .00$ ).

## Elementary Teachers: Effectiveness of Formative and Summative Assessment



- According to the elementary school teachers using Math Connects, the assessment materials provided by Math Connects are very effective. They evaluated both the formative and summative assessment materials in a very strongly positive manner. The Math Connects teachers were significantly more positive about their assessment materials than teachers using other programs.

All teachers were asked to comment directly on their assessment materials. Specifically they were asked, “Any comments about the assessment materials you have available to you?” Representative comments from the teachers using *Math Connects* are displayed below.

## Elementary School Teachers’ Comments on *Math Connects*’ Assessment Resources

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“I love the assessment opportunities throughout *Math Connects*.”

“I really like all the assessment options that are available for me to use. I am looking forward to being able to do even more with them, particularly with the assessment software and the alternative assessment ideas.”

“I love all the options, especially the online tests!”

“I like the student workbook assessment pieces and the extra chapter tests in the chapter resource books. I also like the notes in the *Teacher Edition* about what to do if ... for certain kids. They are very, very helpful.

“I find that it is useful having several assessments to choose from because I have to create my own assessment from the resources. I haven’t found an assessment that I would not change.”

“I find the mid-chapter reviews / assessments to be quite helpful in targeting those learners who need additional instruction. I would like to see more scaffolding of concepts in the major assessments.”

“I like the fact that we have two tests at the end; one in ITBS format giving the needed practice as second grade is the first year we test. I also really like the mid-chapter tests. It really helps guide my lessons.”

“Often the tests that are already designed or created by the company have much more material included than I have covered in instruction. I prefer to make up my own tests, but because of time restraints, I have not been able to adequately do that this year. I will need my summer break to create assessments that suit the concepts I have covered.”

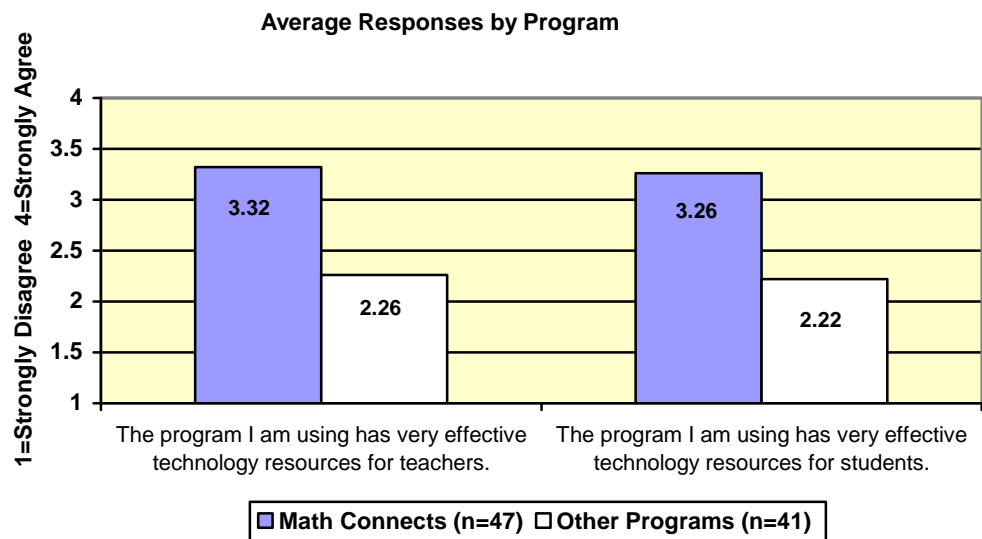
“I enjoy the assessments, but the pre-tests seem to be too easy. Almost all of my students score well on the pre-test, but have a much harder time with the chapter concepts. If the pre-tests were a little harder, I think I would get a better snapshot of how they are really performing.”

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**Technology Resources.** The NCTM *Principles for Teaching Mathematics* state directly that technology is essential in the teaching and learning of mathematics. Advances in technologies of many types have had a great impact on the teaching and learning of mathematics (see Wong, 2003). Given the rate with which technologies tend to develop, it is reasonable to expect that teachers may struggle to use technology in an effective manner (Kysilka, Geary & Schepise, 2002). “Technology” is a broad term which may refer to many very different kinds of resources. The *Math Connects* program contains many individual technological components for students and teachers (see [www.macmillanmh.com/math/](http://www.macmillanmh.com/math/)). Each individual component will be assessed in the final data collection at the end of the school year. For this midterm assessment, teachers were asked to report on their general perceptions of the technological components of the programs they are using.

The teachers using the *Math Connects* program were extremely positive about the technology resources within the program. Also, the teachers using the *Math Connects* program were significantly more positive about both the technology resources for teachers and the technology resources for students than teachers using other programs. Regarding resources for teachers, the mean response for teachers using *Math Connects* was 3.32 (on a 1-4 scale) while the mean for teachers using other programs was 2.26 ( $t = 6.67; p = .00$ ). In reference to the effectiveness of the technology for students, the mean response for teachers using *Math Connects* was 3.26 while the mean for teachers using other programs was 2.22 ( $t = 6.00; p = .00$ ).

## Elementary Teachers: Effectiveness of Technology Resources



- The elementary school teachers using Math Connects were very positive about the technology resources available for both students and teachers. The vast majority agreed that the technology resources were “very effective.” They were significantly more positive about their programs’ technology than teachers using other programs.*

While teachers were not asked directly to provide comments about technology, several teachers did provide relevant comments within other sections of the midterm log. Specifically, these comments occurred at the point they were asked to comment on the best and worst things happening in their classes and also at the end of the questionnaire when they were asked to provide any additional comments. Below are the comments provided by elementary school teachers using the *Math Connects* program.

## Elementary School Teachers' Comments on *Math Connects*' Technology Resources

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"I think this program is very effective and I am lucky that I can differentiate the program because of the other teachers I work with. I also love the technology component."

"Students enjoy the problem-solving problems and the integrated technology activities."

"My general impression of how my math classes are going this year is well. The students are more academically focused than classes in the past and typically want to do well. The best thing that is happening this year is that a number of students have shown significant growth with their basic computation skills. We are using a variety of materials, skills books, textbooks, supplementals, real-life materials, and journaling. Regarding technology, we are using a white board which, in my opinion, has increased student involvement."

"The students that I have this year are much lower than I have had in the past so this could affect how much progress I see in my students compared to previous years. The technology piece has been a struggle for my students. They have trouble using the CD because they do not have someone to sit beside them to step them through the process daily."

"My students love the *Math Connects* series. It is very hands-on and interactive online. It will be hard next year to go back to the district basal math series..."

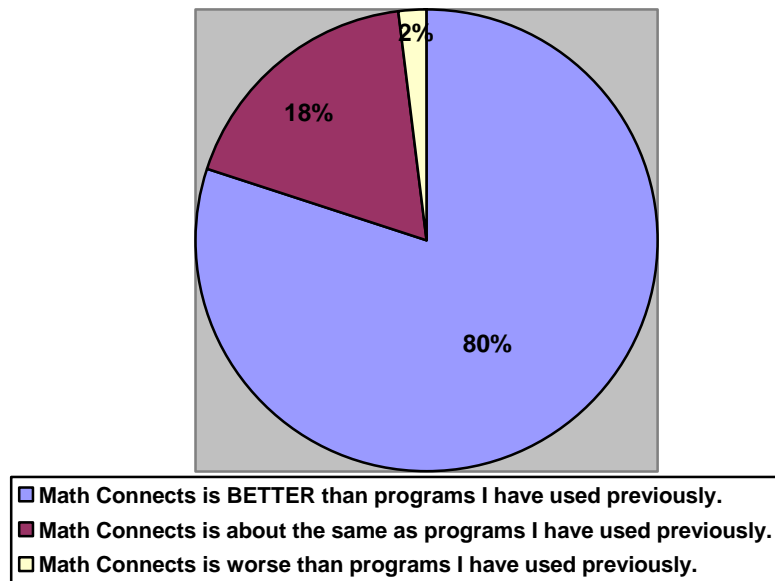
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**Teachers' Comparisons with Other Programs.** The final component of the midterm teachers' assessment asked teachers to make some very general comparisons of their current program with other programs they have used to teach mathematics. First, one major claim of the *Math Connects* program is that it was designed to actively engage students through a variety of strategies (e.g. colorful graphics, involving technology and differentiated instructional strategies). We tested this claim directly by asking teachers the degree to which their students were actively engaged by the program being used in their classrooms. Teachers were prompted to respond in a manner that compared the program they are using now to programs they have used previously.

The figure below displays the response data from the teachers using *Math Connects*. Overall, 80% (39 of 49) of those teachers said that *Math Connects* engages their students better than the programs they have used previously.

## Elementary Teachers' Perceptions of Student Engagement in Mathematics

**"To what degree does the program engage your students in mathematics?" (N=49)**



- *Teachers using Math Connects indicate that the program is effective at engaging their students in the study of mathematics. Eighty percent of the teachers using Math Connects reported that the program engaged their students in mathematics better than programs that they have used previously.*

There were no open-ended questions asking teachers directly about student engagement in mathematics. However, many teachers commented on student engagement and motivation in response to the initial questions about identifying the best and worst things happening in their classes so far this year. Representative comments from teachers using the *Math Connects* program are displayed below.

## Elementary School Teachers' Comments on Student Engagement

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"My students LIKE math. They have success during math time, they enjoy the manipulatives, and we work on a skill over a period of days so that the children have a chance to really understand it before moving on."

"Students are more engaged. Having materials and other supplemental materials has increased student learning. I also like that this program is more sequential in the teaching of skills than the one our district uses."

"Students seem to be much more engrossed in their mathematical learning. The materials are wonderful. I wish we could continue to use them next year."

"My students continue to be enthusiastic about mathematics. They have become much more comfortable working with a textbook and workbook."

"I am quite satisfied with this program. The children are engaged and interested, although somewhat challenged by the new material."

"Students are always actively engaged and learning. The manipulative bags are really great. Students get hands-on lessons every day."

"They are more motivated."

"I am very happy with the progress so far. The kids started out very low and unmotivated - homework was usually not completed. They were not interested in math, in general. I have seen increases in motivation which has led to an increase in their success. They are engaged and are learning to like math."

"The program has been challenging for my students. The materials (manipulatives) that I have been using have been wonderful and engaging for the students. The supplemental material (homework book / reteach pages / challenge material) has been excellent."

"I love the math materials and so do my students."

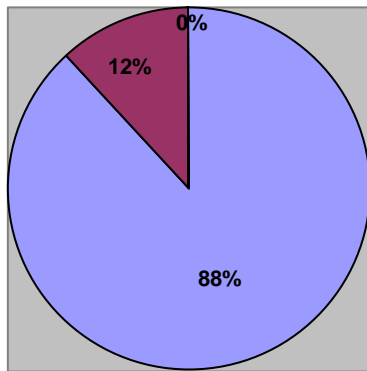
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It was also expected that using a new program, such as *Math Connects*, might put an unwelcome burden on the teachers in the test condition as they worked to learn to use the innovations in the program. Therefore, teachers were asked directly about how easy their program was to use and also to simply make a global judgment about the overall quality and effectiveness of the program they are using.

The response data for these comparisons is displayed below. Overall, 88% of the teachers using *Math Connects* reported that the program is easier to use than programs they have used previously. Overall, 84% of the teachers using *Math Connects* reported that “(a)ll things considered, (*Math Connects*) is better than programs they have used previously.”

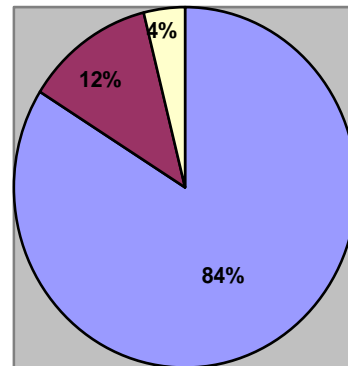
### Elementary School Teachers’ General Comparisons of *Math Connects* with Other Programs

**"How easy to use is your current program?" (N=49)**



- Math Connects is BETTER than programs I have used previously.
- Math Connects is about the same as programs I have used previously.
- Math Connects is worse than programs I have used previously.

**"All things considered, my current program is:" (N=49)**



- Math Connects is BETTER than programs I have used previously.
- Math Connects is about the same as programs I have used previously.
- Math Connects is worse than programs I have used previously.

- *The vast majority of teachers using Math Connects reported that Math Connects is easier to use than programs they have used previously. They also reported that, overall, considering all aspects of the program, Math Connects is a better program than the programs they have used before.*

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