

***Exploring Math: A Pilot Study of its
Effectiveness for Helping Students with High
Incidence Disabilities***

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Introduction

Exploring Math is an intervention program developed based upon research principles that targets students' specific mathematics deficits. All participating students are given a preliminary assessment that sets the stage for the intervention procedures. This tool allows the teacher to specifically target the deficit(s) most common for her student(s). *Exploring Math* presents a well-rounded approach to remediating these specific standard-aligned deficits by integrating whole group, small group, and individualized instruction. The program also integrates real-life challenges in math as well as hands on manipulatives and games to reinforce skills.

Exploring Math was designed to target academic skills typically covered in Grades 1 to 5, but because the program was designed to be a flexible resource for tutoring, summer school, or as a supplemental curriculum it is ideal for working with students with special academic needs. The program allows the teacher to evaluate individual students as well as her classroom as a whole and design a flexible program based on her students' needs using the toolbox of materials in *Exploring Math*.

This report presents the results of implementing *Exploring Math* in the special education math program of a San Francisco area high school during the spring academic semester of 2006. The high school is a large high school that serves the entire district in the San Francisco Bay Area. The primary purpose of this study was to examine the effects of the program on a group of high school students who were receiving special education services in the area of math. The secondary purpose of this study was to examine its effects on student self-efficacy.

Methods

Participants and Setting

Exploring Math was implemented during the two periods of resource math for students who should be taking algebra. The vast majority of these students presented with basic mathematics deficiencies, which kept them from transitioning to a regular algebra class. Three classrooms of special education algebra participated in the study, resulting in a sample of 22 students. This included all students placed in the special education algebra classes at an urban high school in northern California and were students ranging from ninth grade to twelfth grade.

These students all presented with labels of either Learning Disabled (LD) or Emotional/Behavioral Disorder (EBD). This is one of the most underserved and difficult to serve populations in the country. A control group was not used in this preliminary work in order to deliver intervention to as many students as possible. It is important to

note that these students presented with academic deficits as well as behavioral deficits. Most of these students have repeatedly faced failure in school and year after year tend to regress rather than make progress.

Research Study Procedures

The teacher conducted the placement tests in mid-January of the spring 2006 semester and determined the Unit 4 Fractions and Decimals of Level D would be the unit most beneficial for all students. The average pretest score on this placement test was six out of fifteen possible points. The teacher began using the program during the first week of the spring semester, the first week of February. Prior to assessing students or beginning the program, the participating teacher completed a half-day training workshop provided by Teacher Created Materials.

Between February 2, 2006, and June 5, 2006, the teacher focused on remediating the students' fractions and decimals skills using Unit 4 of the *Exploring Math* program. Two random integrity checks were conducted by the principal investigator to ensure that the participating teacher was adhering to the *Exploring Math* curriculum. Both integrity checks resulted in the participating teacher adhering to 100% of the components outlined during the initial teacher training workshop.

The teacher reported that she typically used the program four times a week for 15 to 30 minutes each session. Each lesson took two to three days to complete, and the classes completed Unit 4 on June 5, 2006. The post-tests were completed on June 12, 2006. Additionally, students completed the *Math Self Efficacy Growth Scale* (Lunsford, 2006) upon completing the program.

Measures

To measure academic growth, the researcher analyzed the data gleaned from pre and post-test data taken using the placement tests used in *Exploring Math*. This placement test conveys an accurate measure of the students' specific knowledge of fractions and decimals. An example of this measure can be found in Appendix A.

The *Math Self Efficacy Growth Scale (MSES)* is a measure developed to reflect how much students feel about their math skills and how much they have grown in the past year. This measure reflects student perception of his/her progress over the year (Progress subtest); to what they attribute their success (luck; hard work) (Attribute subtest); how they compare to other students (Comparison subtest); and the amount of social feedback they receive regarding their math skills (Feedback subtest). This scale was created by adapting the *Reading Motivation and Self Efficacy Scale (RMES)* which was created by the author of this report. The RMES was created by pulling from several norm-referenced tests that measured student motivation and self-efficacy, including the Reader Self Perception Scale (RSPS; Henk & Melnick, 1995), the Motivation to Read Questionnaire (Wigfield & Guthrie, 1997), and the Estes Reading Attitudes Survey

(Estes, 1997). This scale is currently being field tested and norm-referenced on a large scale basis. An example of this scale can be found in Appendix B.

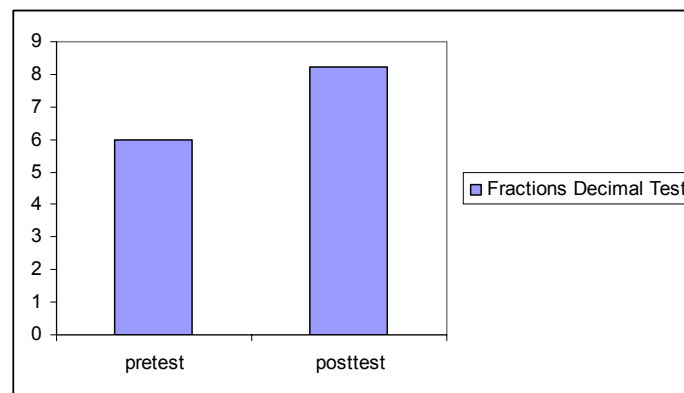
All academic data was collected and scored by the participating teacher. To maintain the highest level of reliability the primary investigator also scored each of the placement tests and reported 100% agreement in scoring the data. All self-efficacy data was collected by the participating teacher but scored by the primary investigator. An assistant to the investigator conducted reliability checks on 50% of the measures and reported a 100% agreement on all surveys checked.

Results

Improvement in Fractions and Decimals Skills

A paired samples t-test (two-tailed) was used to compare students' scores on the placement test before and after receiving the *Exploring Math* intervention package. The students' scores revealed a significant increase in the number of items correct after participating in the *Exploring Math* program, $t(21) = 3.859$, $p = .001$. Students scored an average of 6.00 on the pretest and scored an average of 8.23 on the post-test. Figure 1 demonstrates the change in pre and post tests for the group.

Figure 1. Comparison of Treatment Group Pre and Post-test Measure



Given that the students participating in the study were at the high school level and many had received years of instruction without increasing their math scores, these results are very, very encouraging. It is evident that when a teacher chooses to target a specific skill that those skills can be successfully remediated. It is also important to note that several students showed very, very large gains between the pre and post test.

Because a number of these students present severe behavioral deficits, one has to recognize the level of efficacy and engagement that *Exploring Math* created for this classroom of students. Most high school students at this level with such deficits begin to drop out and refuse to complete their work. Impressively, the participating teacher reported that each student in the treatment group completed 100% of the Unit 4 lessons. The level of task completion for these students in this program is in itself to be lauded.

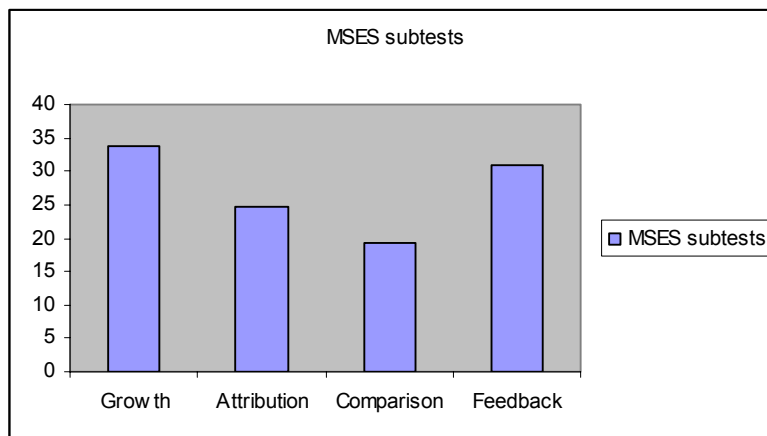
Given the positive reports from students and increased participation levels, the primary investigator completed a follow-up survey of the students' feelings of self-efficacy in their math skills.

Student Math Self Efficacy Growth

The MSES was administered to all students at the end of the treatment period. The MSES is scored on a 45 point scale, and the students scored an average of 33.86 on the Growth subtest, an average of 24.62 on the Attribution subtest, an average of 19.29 on the Comparison subtest, and an average of 31.05 on the Social Feedback subtest. The Growth subtest showed the highest score, followed by the Feedback score. See Figure 2 for an illustration of these scores.

The MSES detected that students felt that they had grown in their math skills over the past year and that they were receiving more positive social feedback about their math skills. Although students still reported that they felt that they performed far below their peers and that they attributed their success to variables other than intellect or hard work, their self-concepts regarding their math skills appear to be on the rise. This is very, very encouraging, especially considering that this study targeted a population that has faced years of frustration and struggle in academics.

Figure 2. Student performance on measures of math self-efficacy.



Conclusions

This pilot data illustrates the potential for *Exploring Math* to remediate the math deficits of students who are significantly lagging. This intervention was effective in significantly increasing the specific math skills of a group of students with math deficits. Additionally students who participated in the program reported that they felt like they had improved in their math skills and received stronger feedback on their math skills.

This study presents a clear argument for implementing *Exploring Math* in a larger scale manner with students with special needs. Future research with larger groups with a more structured and valid research design would extend these preliminary findings. For example, a study with a larger group, a control group, and for an extended period of time would answer even more questions regarding our ability to help these students who are so far behind their peers. Additionally, implementing standardized measures of mathematic ability to measure pre and post-test growth would also contribute to the generalizability of the new skills learned. Overall, *Exploring Math* has shown to be an effective means to improve the deficits of high school students with a label of special education, and future research should replicate and validate these findings.