Increasing Problem Solving Skills in Fifth Grade Advanced Mathematics Students

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Abstract

Because No Child Left Behind (NCLB) calls for every student to make gains during every school year, even advanced students who are already performing at the top must make these gains. Teachers need to find areas to target with advanced students. One area that could be targeted to strengthen is problem solving skills. Research shows that daily practice and strategy instruction in problem solving skills will increase students' problem solving abilities. I dedicated 5-10 minutes per day to problem solving practice and strategy instruction for a five week period. Pre- and post-assessment data were collected using confidence surveys constructed by the teacher and problem solving tests to show growth from the beginning to the end of the study. Results indicate that although confidence in problem solving did not show notable increases, there was evidence indicating an increase in problem solving skills both in correct answers and strategy knowledge.

Introduction

When mathematicians, scientists, engineers, and many other people in mathematical occupations sit down to work, do they ever sit down to a mathematical problem laid out in front of them? Or, do they look at information, analyze the data, and look for a solution? Elementary mathematics does not often enrich students with the life skills needed to achieve in a mathematically driven world. Research has shown that spending a great deal of mathematics instructional time teaching arithmetic skills does not prepare students to solve problems (Burns, 2000). According to researchers Traiton and Midgett (2001), "problem solving is a vehicle by which students make sense of mathematics and learn content, skills, and strategies" (p. 532). Yet, while looking at curriculum guidelines, a push for problem solving is not a top priority. Rather, in a world of high-stakes testing, there appears to be a push for a teaching-to-the-test mentality. Literature and research shout the praises of teaching through problem solving and teaching problem solving skills; however, with the pressure to increase test scores, many teachers hesitate to veer from the textbook to the uncharted, yet very beneficial, world of life and math skills through mathematical problem solving.

According to Burns (2000), "teaching children to be problem solvers does not minimize the importance of arithmetic. Arithmetic is necessary for solving many problems in life" (p. 15). Rather, teaching through problem solving requires students to focus on the meaning of arithmetic operations. To solve a word problem, the student needs to analyze the data and translate it into an arithmetic problem that can be solved. Likewise, according to the National Council of Teachers of Mathematics (2000), "good problems can inspire the exploration of important mathematical ideas, nurture persistence, and reinforce the need to understand and use various strategies, mathematical properties and relationships" (p. 182). Unfortunately, good problems are not being brought into many schools. Results from tests such as the National

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Assessment of Education Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS) clearly reveal that while students can perform basic skills in mathematics, they cannot perform at high levels. When it comes to using knowledge and skills to solve problems, they perform poorly (Traiton & Midgett, 2001).

Not only does teaching through problem solving and teaching problem solving skills prepare students for a life full of able-mindedness, it also has many other benefits. Problem solving helps students develop confidence as problem solvers and become mathematical risk-takers (Traiton & Midgett, 2001). Students in problem solving classrooms that stress communication learn to listen to and respect the thinking of one another. In addition, they become more confident in themselves as mathematical students (Traiton & Midgett). Lastly, Ollerton (2007) claims that not only does teaching problem solving prepare students for the future and build confidence, it also fosters independent learning. He says, “Problem solving is an important aspect of independent learning and helps create a shift away from didactic teaching. The more pupils are working independently, the more effective learners they become” (p. 5).

Many studies that support teaching problem solving in order to prepare students to be active, productive members of society also suggest that teaching problem solving strategies is a good way to teach students to solve problems. Burns (2000), in *About Teaching Mathematics,* says, “Students benefit from learning about problem solving procedures that are useful for analyzing and solving problems” (p. 19), and refers to these problem solving procedures as strategies. According to Schoenfeld (1980), a strategy is only a “general suggestion or technique which helps problem-solvers to understand or to solve a problem” (p. 795). Classroom textbooks often approach teaching strategies by attaching strategies to particular areas of the mathematics curriculum; this does not make strategy usage relevant to the student. Rather, strategies should be used alone or in combination to solve a large variety of problems. The majority of students do not use problem solving strategies instinctively and when they gain familiarity with a variety of strategies by seeing and practicing them, they begin to try to apply them to their own problem solving tasks. These strategies provide them with a set of tools for tackling problems and broadens their problem solving abilities.

Traiton and Midgett (2001) state that, “When they [the students] solve problems, a variety of approaches emerge from them without formal instruction” (p. 535). However, it is through formal instruction that students learn more mature strategies and become more empowered at problem solving tasks. Researchers say that these mature strategies actually cause students to perform arithmetic more effectively (Traiton & Midgett). In fact, a study done by Wood and Sellers (1996) which looked at two different classroom types over a two year period showed that students with problem solving instruction as a focus understood arithmetic concepts significantly better than those in textbook-instructed classes.

Practice in Problem Solving

Schoenfeld (1980) claims that it is not the teaching of strategies that makes a difference in a problem solving classroom; rather, it is the practice of problem solving that makes a difference. In an attempt to show that strategies do make a difference, Schoenfeld set up a study where two groups of students were put into problem solving classrooms where only one group was taught strategies. Every student in the strategy group outscored the students in the regular problem solving group; so, even though practicing the skills of problem solving made a difference in a student's application of problem solving skills, greater gains were made when students were taught strategies with which to solve problems. Thus, it seems, teaching strategies does make a difference. It is through learning and being able to apply these learned strategies to problems that students can attack problems and develop understanding (Zemelman, Daniels, & Hyde, 2005). Through this instruction, students will begin to develop metacognition with their problem solving. Eventually, students have a "powerful tool for thinking, helping them create models—mental maps used to organize their world, solve problems, and explore relationships" (Zemelman et al., p. 117).

Problems with Textbook Teaching of Problem Solving

Problems arise while looking at the presentation of problem solving and problem solving skills in many of the traditional mathematics textbooks in the United States. Zemelman et al. (2005) claim that while problem solving is an "excellent vehicle for developing understanding," traditionally, problem solving has been viewed as an "application of skills after mastery" (p. 117). To put this in simpler terms, after a student learns how to solve 2+3, he or she may be given a word problem that requires the use of this knowledge. In addition, many traditional textbooks are organized so that the same procedure, such as addition, is used to solve all the problems on the same page (Jitendra et al., 2007). For example, students begin to realize that the word problems at the end of the lesson are testing what they learned during that lesson. Therefore, they know that to solve the problem in the lesson titled "Addition with Single-Digit Numbers" they are going to add the numbers given to them in the word problem; this is not problem solving. With this method, "students do not have the opportunity to discriminate among problems that require different solution strategies" (Jitendra et al., p. 115).

In addition, traditional textbooks encourage students to look for keywords such as *in all*, *left*, *altogether, total, how many more, times,* and *each*. This kind of teaching is misleading (Jitendra et al., 2007). Many word problems do not have key words, and learning to do problem solving through these keywords sends a wrong message about doing math. As Jitendra et al. explain, "These approaches ignore the meaning and structure of the problem and fail to develop reasoning and making sense of problem situations" (p. 116).

Finally, Fan and Zhu (2007) found that there were large gaps among the national syllabi, curriculum standards, and the textbooks being used in classrooms for the problem solving curriculum. Therefore, Fan and Zhu suggest that it is important for policy makers, curriculum developers, textbook authors, and teachers to realize these gaps and to take steps to remedy the problem.

Where and Who I Taught

This research was conducted in a school set in a growing, rural community with high community involvement. Originally mainly farmland, the area experienced tremendous growth with the development of new subdivisions in the last few years. The school building was entirely new and in its first full year of operation.

The school contained approximately 720 students and was growing almost daily. The race of the students was predominantly white with minority students comprising less than 1% of the student population. There was a range of socioeconomic status represented within the school; however, only 32% of the student population was considered economically disadvantaged.

This research involved 26 fifth grade students from an advanced placement math class. There were 14 boys and 12 girls working with sixth grade mathematics materials. Parental permission was obtained for 25 of the students, the subjects of the study. Each student was placed in the advanced class based upon reading and mathematics Tennessee Comprehensive Assessment Program (TCAP) test scores as well as teacher recommendations. These students were chosen for this particular study because of their advanced placement status.

Purpose and Research Questions

The purpose of this study stemmed from a need for students who scored in the top quintile on standardized tests to make gains in accordance with NCLB. Looking at past years' data, I could see that the advanced students did not lack basic arithmetic skills; rather, they lacked techniques to apply mathematical concepts. Based on these factors, I sought to push the advanced mathematics students beyond basic arithmetic into the uncharted waters of problem solving.

As I began this study, my focus was on increasing the advanced placement math students' problem solving skills. As I looked at the research, I realized that strategy instruction and daily immersion were essential to good problem solving instruction. Thus, I decided to find out if strategy instruction and daily immersion in problem solving would increase the problem solving confidence and skills in 5th grade advanced placement mathematics students.

Methods and Procedures

The following data sources were utilized in the study: practice work scores, observations of the students, pre- and post-test data, survey, and the *t*-test data. Because this research has two purposes, looking at both student confidence levels and problem solving ability, I knew I would need to have at least two different instruments.

Based on the review of the literature, I created a survey to address the issues related to student confidence and then compared results of pre- and post-tests of problem solving to assess student growth in that area.

Survey

For this study, I created a survey to analyze students' problem solving abilities (Appendix A). The survey posed questions related to how students solved problems and how confident they were in their problem solving abilities. The questions were designed to rate confidence levels and to provide a better understanding of students' problem solving skills. The survey data was obtained immediately following the pre- and post-test in order to obtain feelings toward problem solving ability directly following a problem solving task.

Pre- and Post-Tests

I first compiled a pre- and post-test (included in Appendix B) with questions from *The Problem Solver 6* (1987), a problem solving book with problems arranged by strategy on a 6^{th} grade level. I selected a pair of problems for each of the five strategies from *The Problem Solver 6* that would be taught during the implementation. Then, I numbered the problems for each strategy with a "1" or "2" and randomly assigned the problems to either the pre- or post-test. Although the problems were very similar and on the same level, I wanted to minimize the bias in which problems would appear on the pre-test and which would appear on the post-test.

Procedures

I began data collection in late October 2007 with the timed pre-test and problem solving survey. On the first day of the study, the students were allotted 25 minutes for completion of the pre-test after which they filled out the survey. During the five week data collection period, I introduced a different problem solving strategy each week. Instruction and practice with each strategy followed a consistent schedule. I designated Friday as a "challenge day," requiring students to attempt a problem for which the appropriate strategy had not yet been taught. Then, on Monday, I introduced and taught the focus strategy and guided students in solving the problem from the previous Friday. The weekly schedule allowed for practice of the strategy of the week on Monday, Tuesday, and Wednesday, while Thursday was reserved for the review of a previously learned strategy problem. Problems used throughout the implementation were also compiled from *The Problem Solver 6*, and were given at the end of class each day. The students then had the night (or weekend) to work on the problems before they were solved as a whole group exercise at the beginning of each class the following school day. To solve the problems in the whole group setting, a student read the problem aloud and I recorded possible answers to the questions on the board. Then, with prompting from me, we solved the problems as a whole class on the board. Only 5-10 minutes were devoted to the problem solving tasks in each class period. After five weeks, a post-test and survey were given, and the study was concluded. The post-test was conducted exactly as the pre-test: a 25 minute timed test was immediately followed by the problem solving survey. Table 1 contains the study timeline.

Table 1
Action Research Timeline

Intervention strategy/activity	Dates
Pre-test and survey	October 26, 2007
Strategy: Organized list	October 29, 2007—November 2, 2007
Strategy: Draw a picture/diagram	November 5, 2007—November 9, 2007
Strategy: Draw a table	November 12, 2007—November 15, 2007
Strategy: Make it simpler	November 19, 2007—November 21, 2007
Strategy: Logical reasoning	November 26, 2007—November 30, 2007
Post-test and survey	December 6, 2007

Data Analysis

Pre- and post-test data were analyzed beyond the designation of "correct" or "incorrect." For each of the five problems, students could earn up to 20 points. If the correct answer was obtained, they earned 20 points. However, if the correct answer was not obtained, they received 10 points for attempting to use a problem solving strategy that was appropriate for the problem or five points for attempting some other strategy that showed understanding of the problem and might have led to a correct answer. I wanted to see if the students had grown in their problem solving abilities after the short intervention time period, even if they were not able to produce correct answers.

Students were not required to do the word problems before the beginning of class; rather, they were offered extra credit for attempting and succeeding at them. This extra credit was compiled on a chart that allowed me to see which students were participating in the research and their rate of growth. Each student received one extra credit point for attempting the daily problem while a correct answer elicited two points of extra credit.

The surveys were used for multiple purposes. One was to provide insight about students' perceptions in terms of their problem solving skills. A second purpose was to provide insight about the ways students typically solved problems. However, for my research, this survey was used to look at their confidence in problem solving skills. Question 3 in the top half of the survey and question 4 in the bottom half of the survey were utilized for this purpose (see Figure 1). I analyzed students' answers before and after the study to find out if they felt more or less skilled after the implementation. I applied a number rating to each multiple choice response to see if the total confidence rating increased, decreased, or if there was no change after the research. Figure 1 presents the scale I used for analysis.

Figure 1. Questions from survey used to calculate confidence level in problem solving.

3. How do you feel about word problems?

I am great at them, and I usually get the right answer. (3 points)
I am okay with them, but usually I need some help. (2 points)
I am not good with word problems. (1 point)

4. I believe that I do a good job with problem solving:

Always (5 points)	Usually (4 points)	Sometimes (3 points)	Rarely (2 points)	Never (1 point)

Results

Of the 25 students in the advanced placement mathematics course in which the intervention was conducted, none reported previous problem solving instruction outside of the basal textbook instruction in problem solving. The basal textbook contained minimal exercises in problem solving. Scores on the pre-test and post-test were compared for each student individually. The change in scores is shown in Table 2.

Table 2
Comparison of Pre-test and Post-test Scores and Growth

Student	Pre-test Score	Post-test Score	Raw Score Change
1	10	45	+35
2	15	40	+25
3	20	70	+50
4	25	30	+5
5	15	50	+35
6	5	10	+5
7	0	70	+70
8	5	40	+35
9	5	30	+25
10	15	40	+25
11	20	30	+10
12	5	25	+20
13	25	50	+25

Student	Pre-test Score	Post-test Score	Raw Score Change
14	50	50	+0
15	5	60	+55
16	15	50	+35
17	15	35	+20
18	25	60	+35
19	10	25	+15
20	15	55	+40
21	25	40	+15
22	0	40	+40
23	20	50	+30
24	0	75	+75
25	10	40	+30

Table 2 shows the growth of each student and the points each gained from the pre-test to the post-test. Based on percentage growth, the growth from the pre-test to the post-test for these students ranges from 0% growth to +1400% growth. The average growth was a gain of 30 points from the pre-test to the post-test or a 200% change. The pre-test and post-test data is show below in Table 3.

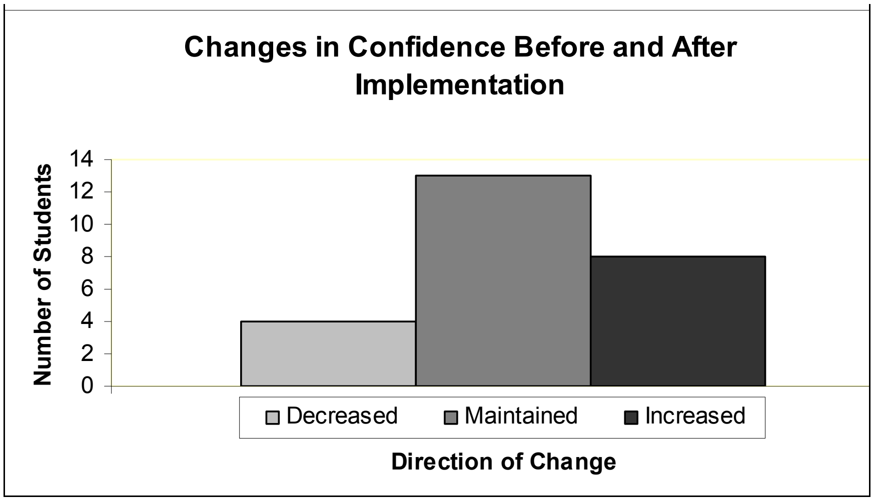
Table 3
Pre-test and Post-test Data Review

Group	Pre-test	Post-test
n	25	25
Mean	14.20	14.00
SD	11.06	15.50
SEM	2.21	3.10

To analyze statistical significance of the students' growth, a paired *t*-test was performed to compare the means of the pre-test and the post-test. The *t*-test yielded t = 8.1325, df = 24, and p-value = 0.0001. The results of this *t*-test showed the students' growth to be statistically significant. The average difference between the pre-test score and the post-test score was 30.20.

Two items on the confidence survey were self-rated: (a) How do you feel about word problems? and (b) I believe I do a good job with problem solving. Each student's confidence was rated using a scale and the change in confidence results are noted within Figure 2.

Figure 2. Comparison of the number of students that decreased, maintained, or increased confidence during the intervention.



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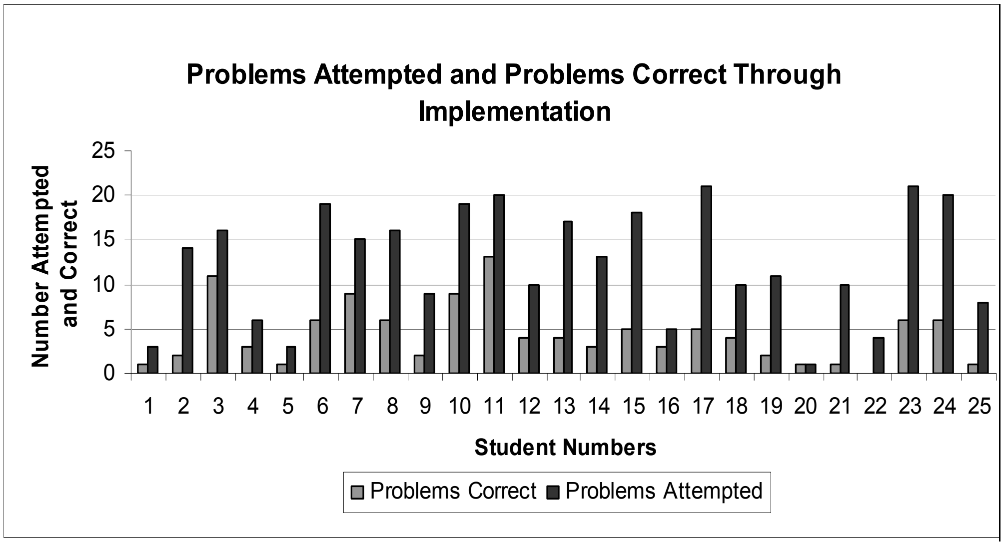
Looking at the results of the confidence ratings, there are no notable changes. Eight of the 25 students increased in their confidence, but only students 10 and 24 showed confidence growth greater than one point on the confidence scale. Much more noteworthy is that 13 of the 25 students maintained their initial confidence levels.

Daily word problems were done as a class. Records were kept of each student's progress related to attempts and successes each day. No students were required to do the word problems before the beginning of class; rather, students were offered extra credit for attempting and or succeeding at them. However, all students were required to listen to and participate in the solving of the word problems during the daily activities in the classroom. The record for these practice problems is displayed in Figure 3.

Figure 3. The record of student attempts and correct answers during the intervention.



During the course of implementation, 24 of the 25 students showed growth on the problem solving post-test. The student who did not show growth had the highest score on the pre-test. The class experienced an average growth of 200% over the course of the intervention. There were no significant patterns of growth in confidence levels. Many students maintained their initial confidence levels.

Selected Students for Discussion

Although every student except one experienced growth in problem solving during the study, five students were selected to be examined more closely to look at trends. Two of these students, numbers 7 and 24, are noteworthy because of the large growth between their pre-test and post-test scores. In addition, three other students are also noteworthy and will be discussed in the following paragraphs (Students 1, 20, and 22).

Student 7. Student 7 scored 0 points on the pre-test and 70 points on the post-test. He solved 9 of the 15 practice problems (60%), placing him third in the class in terms of the percentage of correct attempted problems. Since this student was in my homeroom, I was able to watch him spend time trying to work the problems. He spent a lot of time on the problems and worked on them until he was sure they were correct. Although he was wrong occasionally, he appeared to learn from his mistakes and always tried to understand where he went wrong. He seemed to place value on understanding the problems.

Student 24. Another highly-motivated student, number 24, showed over a 1400% growth, moving her score from 0 to 75. She appeared willing to spend time with the problems and to try hard to understand them. Of the 20 practice problems attempted, she got six correct; however, five of these six were on review days or the third day of strategy instruction. Therefore, since there is a strong correlation between these days and her correct answers on the practice problems, I am led to believe that because of strategy instruction and her hard work, her ability to do the problems increased.

Students 1, 20, and 22. As previously mentioned, three other students are also noteworthy, but for reasons different from those of Students 7 and 24. All three students had limited success on individual practice problems. The first of these students, student number 1, achieved a pre-test score of 10 and a post-test score of 45. However, Student 1 only attempted three practice problems during the intervention. Student number 20, like Student 1, showed an increase between pre- and post-test scores from 15 to 55. Also, like Student 1, Student 20 attempted only one problem during individual practice. Following the same pattern as Students 1 and 20, Student 22 increased the pre-test score from 0 to a post-test score of 40 while only attempting four individual problems and getting none of those correct.

Analysis of Results

Students 1, 20, and 22, demonstrate important implications of this research. As a reminder, during the intervention, students were not required to do the daily problems before class; however, they were required to work them with the class during discussion time. With very limited individual practice, all three of these students were able to increase their scores 35-40 points on the post-test indicating that the daily practice in class and the strategy instruction had a large impact on their scores. Only 5-10 minutes of practice per day for five weeks was enough to result in notable pre- and post-test score increases for these three students. Likewise, when the 5-10 minutes that the entire class received was supplemented with meaningful additional practice, as in the case of students 7 and 24, growth was even more notable.

While confidence levels in 8 of the 26 students did increase, the increase was not a notable difference, and with the majority maintaining the same confidence level, the increase is not noteworthy. However, after five weeks of problem solving strategy instruction and daily practice, 25 of the 26 students in the class were able to improve their pre-test score on the post-test. Therefore, findings indicate that daily practice on problem solving skills combined with strategy instruction is effective in increasing problem solving skills in fifth grade advanced placement mathematics students.

Lingering Questions and Limitations

At the end of this action research process, I noted some limitations of this study and was left with some lingering questions. Since the study granted extra credit for attempts at daily problems, the reward might have given the more grade-conscious students an advantage. Upon reflection of this limitation, I wonder what the impact would have been on the students had this been part of their grade. Also, if the problems were required, how would this have impacted the number of problems that they attempted during class?

I also wonder if my results were impacted by the timing of the study. In the middle of my intervention, the students began Math Olympiad, which is a problem solving contest given across schools where the schools compete against each other. The Math Olympiad experience with a problem solving competition could have contributed to the increases between the pre- and post-test scores.

Finally, I looked at the lack of increased student confidence levels. The literature produced by Traiton & Midgett (2001) shows that teaching problem solving strategies and daily practice leads to an increase in skills and confidence which was not confirmed in my results. I wonder if my results had anything to do with the group of students selected for this study. The participants in this study were advanced students who were selected for the class because of their outstanding scores in math and reading; perhaps being selected for this elite class resulted in initial high confidence levels. Likewise, a condition that I recognized during the study may have caused limitations with the increase in confidence levels. As stated, I used practice and test problems that were drawn from *The Problem Solver 6*, a collection of problem solving problems arranged by strategy on the 6^{th} grade level. Although these students were doing mathematics problems that targeted a 6^{th} grade level and were working from a 6^{th} grade textbook, they were actually in 5^{th} grade. Would the students' confidence levels have increased if I had used fifth grade level materials for the test and practice problems?

Reflecting on the results, I recall what Traiton and Midgett (2001) said: "Problem solving is a vehicle by which students make sense of mathematics and learn content, skills, and strategies" (p. 532). I realize that even with the questions and limitations of this study, these students demonstrated growth in their problem solving skills. Through problem solving, students have potential to grow in their understanding of the use of mathematics in daily living.

Implications and Next Steps

Reaching today's generation of students requires teachers to teach in new ways. Students need to see that what they are learning in the classroom will be relevant and useful once they leave the classroom. High-performing students need to be challenged in terms of math instruction and students who are struggling need to have math made relevant to their lives. The teaching of problem solving strategies should be implemented to address the challenges of both of these student populations. Teachers should take steps toward making problem solving a routine in their daily mathematics instruction. This five week study showed that 5-10 minutes of daily instruction in problem solving made a difference in problem solving abilities. Imagine what a year's worth of problem solving immersion could do for a student.

In addition, mathematics educators should consider alignment of problem solving skills and strategies with mathematics lessons to provide relevant experiences for students. Many problem solving books such as *The Problem Solver,* which was utilized in this study, break problems down into areas of mathematics instruction to make alignment with the mathematics curriculum easily accessible for teachers trying to make problem solving success a reality for their students.

Within higher education, mathematics teacher educators should make problem solving a high priority. I have personally seen many teachers that shy away from teaching problem solving because they are uncomfortable with their own problem solving skills. Therefore, mathematics teacher educators should consider the inadequacies of many pre-service and current teachers regarding problem solving and adapt their curriculum accordingly. Likewise, educators should realize their own inadequacies and seek professional development opportunities that would foster growth in these areas. Participating in such opportunities will allow pre-service and current teachers to become comfortable in their own problem solving skills, enabling them to bring problem solving and strategy instruction into the classroom. When relevant mathematics experiences are integrated into daily instruction, students' problem solving skills are more likely to translate to real world applications.

References

Burns, M. (2000). *About teaching mathematics* (2nd ed.). Sausalito: Math Solutions Publications.

Fan, L., & Zhu, Y. (2007). Representation of problem-solving procedures: A comparative look at China, Singapore, and US mathematics textbooks. *Educational Studies in Mathematics*, *66*(1), 61-75.

Jitendra, A., Griffin, C., Haria, P., Leh, J., Adams, A., & Kaduvettoor, A. (2007). A comparison of single and multiple strategy instruction on third-grade students' mathematical problem solving. *Journal of Educational Psychology*, *99*(1), 115-127.

Moretti, G., Stephens, M., Goodnow, J., & Hoogeboom, S. (1987). *The problem solver 6: Activities for learning problem-solving strategies*. Columbus, Ohio: Creative Publications.

National Council of Teachers of Mathematics (2000). *Principles and standards for school mathematics.* Reston, VA: NCTM.

Ollerton, M. (2007). Teaching and learning through problem solving. *MT: Mathematics Teaching,* 201, 3-5.

Schoenfeld, A. (1980). Teaching problem-solving skills. *The American Mathematical Monthly*, 87(10). 794-804.

Traiton, P., & Midgett, C. (2001). Learning through problems: A powerful approach to teaching mathematics. *Teaching Children Mathematics 7*(9), 532- 536.

Wood, T., & Sellers, P. (1996). Assessment of a problem-centered mathematics program: Third grade. *Journal for Research in Mathematics Education*, *27*(3). 337-53.

Zemelman, S., Daniels, H., & Hyde, A. (2005). *Best practice: Today's standards for teaching & learning in America's schools* (3rd ed.). Portsmouth: Heinenmann.

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Appendix A

Student Survey

Name: ____________________________ Date: _____________________________

Circle the answer that best describes you.

1. How do you feel about mathematics?

I dislike math.	Math is okay.	I like math.

2. I am able to do math problems on my own:

Mostly on my own	Some of the time	Very rarely

3. How do you feel about word problems?

I am great at them, and I usually get the right answer.

I am okay with them, but usually I need some help.

I am not good with word problems.

4. Why are word problems harder than other problems?

It is hard to figure out what the problem is asking.

It is hard to figure out what methods to use in solving it.

It is hard to think through the problems.

Other: ____.

Answer these questions about how you problem solve and how you feel about problem solving. Circle the word that best describes you.

1. I draw pictures to help me solve a problem.

Always	Usually	Sometimes	Rarely	Never

2. I read a word problem more than once.

Always	Usually	Sometimes	Rarely	Never

3. I check my answers to make sure they make sense by looking back at the problem.

Always	Usually	Sometimes	Rarely	Never

4. I believe that I do a good job with problem solving:

Always	Usually	Sometimes	Rarely	Never

Appendix B

Problem Solving Pre-Test Questions

1. It is Louis' first day at summer camp, and he is selecting snacks to bring on the hike. The camp store has a limited inventory: first aid supplies, beverages, and some snacks. The snacks are in 1-ounce plastic packages: trail mix for 12 cents, nuts for 10 cents, dried pineapple for 8 cents, and dried apricots for 4 cents. Louis has 46 cents to spend on snacks. How many different ways can he combine snacks to total 46 cents?

2. Peter studied the partner assignment list on the gym wall. It was a rainy day, and rainy days meant square dancing in P.E. His square included the names T.J., Carl, Christopher, Jenny, Becky, Blanca, and Marisol. When they got started, T.J. and his partner were to the left of Blanca. Across from T.J. was Peter, who was to the right of Christopher. T.J.'s brother's partner, Jenny, was across the square from Blanca. Becky was not on Blanca's right. Can you name the four pairs of partners?

3. All the workers at the Cookie Castle, Marty, Jim, and Dan are trying to increase their production of almond puffs, triple-chocolate squares, and lemon mounds. In the first hour Marty makes 12 puffs, Jim makes 11 squares, and Dan makes 7 mounds. In the second hour they make 13 puffs, 22 squares, and 8 mounds. During the third hour they turn out 15 puffs, 12 squares, and 11 mounds. The fourth hour they make 18 puffs, 24 squares, and 16 mounds. The fifth hour they make 22 puffs, 14 squares, and 23 mounds. If they continue at these rates, how many hours would it take before they could make a combined total of more than 15 dozen cookies in one hour?

4. Jason has borrowed a friend's sailboat and has stayed out too late. The fog has settled in, and he is lost and hungry. He radios for help and the harbormaster's voice comes across the wire, giving him directions to the harbor. He asks Jason if he remembers seeing a lighthouse and Jason remembers seeing one several miles back. The harbormaster tells him to return to the lighthouse and go directly north for six miles, then turn east for two miles because of a sandbar. Next he should go north for three more miles, then go west for one mile. The harbor entrance is one mile due west of that. How many miles is the harbor entrance from the lighthouse?

5. Madalyn inherited her grandmother's quilt, and she proudly keeps it on her bed. She always thought there were 81 squares in the quilt, because there were squares in 9 columns across and in 9 rows down. One day she realized that there were actually more squares than 81 on the quilt. How many squares were there altogether?

Problem Solving Post-Test Questions

1. Directly across from the Big Beast Booth at the county fair is the Bowl-A-Ball Booth. Mary Louise is ready to bowl her ball down the miniature alley and into one of the five circles labeled 0, 2, 4, 6, and 8. Mary Louise has three attempts to score 8 points. How many different ways can she score 8 points in three attempts?

2. Program cards are being handed out in 5th period P.E. As he passes out the cards to the members of his class, Arthur notices that 8 students are on the basketball team as well as on the leadership council; 7 students are on the track team as well as on the leadership council; and 5 students are on the track team as well as the basketball team. How many more students are in the leadership class than are on the track team?

3. The Gadfly Gazette is published every day, rain or shine. Marion helps her sister Janet to get the paper delivered. Marion is on a schedule that includes folding, delivering, and collecting. Every 6th day she goes collecting, every 3rd day she delivers the paper, and every 4th day she folds the papers. If she helped Janet for 12 weeks, how many times did Marion do all three jobs in the same day?

4. Joe and Jim have tickets to see Harvey Pond and the Frogs in concert. The stadium where the concert is being held has six entrances from the street, four stairways to the first balcony and three stairways to the second balcony. Joe and Jim have tickets for the second balcony. How many different paths can they take to get to their seats in the second balcony?

5. It is the year 2029, and the Cosmos communication Network is unveiling its newly completed multi-million dollar video communication system, linking all 23 earth satellites to each other and to earth. If each connection costs $1,000,000.00, what will be the total cost of the network?