Is there a problem?

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ABSTRACT

This is a narrative article, highlighting effective teaching strategies for teacher candidates at a four-year university in the South. The author examined preconceived negative notions teacher candidates expressed about being enrolled in a Math Block class and having to teach children about mathematics. After involving the teacher candidates in a hands-on series of classroom discussions and role playing related to problem-solving strategies, teacher candidates became excited about not only facilitating children's exploration of problem-solving strategies but how much they thoroughly enjoyed themselves, engaging in hands-on lessons compared to rote and memorization skills they had experienced as children.

Keywords: problem-solving, children's exploration, hands-on learning, role playing, facilitating learning

INTRODUCTION

A first year professor was simply overwhelmed the first day she encountered her first class of 44 students in Elementary and Middle School Level Mathematics, which is most commonly referred to as Math Block. The professor teaches at a four-year university in the South and recently accepted a job as an Assistant Professor in the Curriculum, Instruction, and Special Education Department. She is a former elementary school teacher and worked for eight years, providing intense interventions for children ages zero to five. She has taught several classes before as an Adjunct Professor; but walking into a classroom with 44 pairs of eyes staring was a most different and would prove difficult experience. What was even more alarming is that after discussing the course syllabus and all assignments, several students stayed after class and others e-mailed wanting to know the same information: Is solving math problems part of the class? Many of these students shared they hated mathematics and was hoping they would not have to do any mathematical computations. Their conversations were surprising because math is one of the most fun yet challenging classes that can be taught and a teacher can literally "watch the light bulbs come on". It was decided then that a much needed approach was vital for the semester to introduce and embrace mathematics in a different way, hoping to change the opinions of many and work with them on embracing and loving to teach the math they have learned to hate!

One of the first issues was to teach how fun and exciting mathematics can be and an even more important issue is to encourage all children to excel in math and be able to facilitate children's learning and link it to realistic experiences. Higher level thinking and learning were taught while simultaneously promoting and maintaining high expectations for all of students. Students, engaging in processes such as problem-solving, reasoning, and building connections between mathematics and other content areas outside of mathematics, ultimately, are able to understand the mathematics they use and have the ability to make sense of their world through mathematics (Griffin & Jitendra, 2008).

The first and only approach at this time was to teach problem-solving skills. It was critical for students to participate in their own mathematical learning and realize they could learn and understand mathematics despite the challenges they faced as students. Malloy (2008) further states:

> each student should receive a mathematics education that is inclusive and prepares for tomorrow; they should receive an education that enables them to learn powerful mathematics to help students [become] citizens in a society where their knowledge – especially their mathematical knowledge – can help determine their future and the future of their world (p. 24).

There was once a discussion whether current education reforms should now support an emphasis being placed on a conceptual understanding and reasoning over memorization and rote learning (Goldsmith & Mark, 1999; National Council of Teachers of Mathematics [NCTM], 2000). Consequently, according to Jitendra, Griffin, Deatline-Buchman, Dipipi-Hoy, Sczesniak, Sokol, & Xin (2005), they further explained that "a key aspect of the standards-based approach is its emphasis on the development of conceptual understanding and reasoning over memorization and rote learning" (p. 320). Current reform also advocates that teachers act as facilitators, helping students construct their own understandings of mathematical concepts and relationships such as problem-solving (Baxter, Woodard, Voorhies, & Wong, 2002). NCTM's (n.d.) process standards are also aligned from prekindergarten through grade 12 and highlight that teachers should help children build new mathematical knowledge and solve problems that occur in

mathematics. Teachers should also engage young children in using a plethora of appropriate strategies to solve problems and then actively participate in monitoring and reflecting on mathematical problem-solving.

Could the process of problem-solving be taught to young children in a developmentally, appropriate manner? Although it seems that planning a lesson on solving and posing problems for young children can be a daunting task, it really is not. The focus should be centered on the teacher's role as facilitator, expanding young children's understanding through the responsibility of planning, teaching, and evaluating a child's process. In general, a teacher must take time to know his/her students; understand the content of state standards and benchmarks; devise learning objective to meet these standards; and utilize available materials (Skinner, 1990). Solving problems is not only a goal of mastering specific mathematics objectives; instead, problem-solving should be viewed as an integral part of all mathematics learning (NCTM, 2004). The teacher can then and only then nurture a child's problem-solving acquisition skills by understanding the responsibilities that he/she takes for guiding the child's mathematical learning process (NCTM, 2004).

From the research standpoint, the Math Block students seemed to understand the importance of problem-solving and how to effectively use it with young children. It is important for future teachers to truly embrace the notion of talking and working with young children about numbers and boosting their success in mathematics. It is important for them to become knowledgeable and clearly be able to comprehend and articulate that a child's level of math knowledge when they begin school predicts future success (Levine, Suriyakham, Rowe, Huttenlocher, & Gunderson, 2010). This realization among the Math Block students enlightened them about the notion that math skills are important for children to succeed in school and in everyday life. Children learn easily when they can connect mathematical concepts and procedures to their own experiences, "seeing" the ideas that are being taught. It is abundantly clear that an important part of learning math is learning how to solve problems. Future teachers must learn to foster and encourage children to use trial and error to develop their abilities to reason and use effective problem-solving skills. They learn more than one way to solve a problem and even more than one answer! They are also able to express themselves clearly as they explain their solutions (NCTM, 2004).

LEARNING THE "ART" OF PROBLEM-SOLVING SKILLS

At this pivotal point in the semester, the Math Block students needed to literally engage in a problem-solving assignment. A PowerPoint was shared with the students, focusing on four-step problem-solving strategies (http://www.mathabout.com, n.d.), which include

- The first step, looking for clues.
    - Children read the problem carefully to get a general idea.
    - Children underline clue words.
        - Addition (sum, total, in all, perimeter)
        - Subtraction (difference, how much more, exceed)
        - Multiplication (product, total, area, times)
        - Division (share, distribute, quotient, average)
    - Children ask themselves if they have seen a problem similar to this one. If so, what is similar about it?
        - What needs to be done?

        - What facts are given?
        - What needs to be discovered?
- The second step, developing a game plan.
    - Children reflect on reading and rereading the problem to determine what the problem is asking for.
    - They then define a game plan.
    - Next, they decide and discuss in further details if they have seen a problem like this before.
        - They discuss what they did.
        - They also discuss why they did it a particular way.
    - Children then define their strategies to solve the problem.
    - Children test the strategies chosen.
    - Children take advantage of teachable moments. If at first some of the strategies don't work, it may lead them to having an "AHA" moment and to a strategy that does work.
- The third step, actually solving the problem.
    - Children read and revisit the problem again.
    - They then focus on the specific details of the problem.
    - Next, they decide which parts of the problem relate to each other.
    - They consider what form or how to write the answer.
    - Finally, they use their chosen strategies to solve the problem.
- The last step, reflecting on the problem-solving assignment.
    - The children review their solution.
    - They ensure they have the specific math operations the problem is asking for to perform and list them on paper in the order they are to be performed. It is critical for children to check their answers at each step of the operation. Then, they should check-off each step as they complete it.
        - Was the question answered?
        - Does the answer use the language in the question?
        - Was the answer reported in the same units used in the question?

IMPLEMENTING THE "ART" OF PROBLEM-SOLVING

The Math Block Students did not seem to have any major problems with understanding the information. They collectively decided they needed some practice problems and additional information about using problem-solving skills. Problems were created, using the students' names in the examples.

- Multiple step problems – Children may need to use more than one mathematical operation to solve the problem.
    - The blacksmith, Kimberly, could forge 6 swords in 2 days. How many swords could she forge in 9 days?
- Extra information – Children may need to extract extra information that is not needed to solve the problem.
    - At the basketball game, Jamie bought one hot dog for 50 cents, one bag of popcorn for 75 cents, one bag of cotton candy for 1 dollar, and baseball mitts for

his four children from Wal-Mart for 20 dollars. How much did Jamie spend on food?

- Logical reasoning – Children must use logical reasoning to solve problems.
    - The Lockhart Dance Festival presented dances from many different countries. 32 children joined in the dances. 19 danced the Waltz and 15 danced the Fox Trot. How many children participated in both dances?
- Choosing a calculation method – Children are expanding their problem-solving skills as they decide, which of these calculation methods is best to use…mental math, pencil and paper, or a calculator.
    - How many minutes did it take to reach the record for fencing?
    - How many inches is the archery record?

Spear Throw 100 Feet	Archery 600 Feet
Fencing 4 Hours	Shot Put 27 Hours

- Problems with more than one answer – Children may have problems that have more than one answer. When they find an answer to a problem, they need to continue asking themselves if there might be other answers.
    - The villagers were building a bridge. While working under the bridge, Elizabeth could only see only the legs of those walking by. She counted 10 legs in one group. What combination of sheep and children could have been counted in 2 groups?
- Deciding when to estimate – In some problems, children only need an answer that is close to being correct; they can then estimate. In some cases, they made need an exact answer. They must decide which method to use by what they are going to do with the answer.
    - Angel is on duty. It is 10:37 a.m. She wants to stop at Red Lobster to eat lunch with her friends. At what time should she tell her friends she will arrive?
    - Sam is practicing for a rowing competition. He wants to know how much greater his trial is than the course record time of 23 minutes, 9 seconds. Sam needs to know exactly how many seconds faster he must go to beat the record. What time should Sam's coach give him?
- Data from a chart – To solve some problems, children may need to sort through numbers in a chart to find the needed data.
    - How much taller is the tallest child than the shortest child?
    - How many ounces is Meghan?

Name	Height	Weight (ounces)
Amanda	4'11"	110
Kimberly	5'1"	103
Meghan	5'3"	107
Brandi	5'4"	118

- Work backwards – Children must also read and have in-depth comprehension skills to solve some problems; they many need to "undo" the key actions in the problem, which is a strategy known as working backwards.
    - The university students brought in 4 pies left over from the picnic. 12 pies were eaten at the picnic. Auburn took 2 pies home with her. How many pies did the students bring to the picnic at the beginning?
- Guess and check – Some problems cannot be solved directly; children would then need to consider using the guess and check method.
    - Daci divided her games into 2 piles: games she owns, and games her brother owns. She owns 3 more games than her brother. How many games does her brother own?
- Look for a pattern – Children may need to solve a problem by recognizing a pattern; a table may help them with this.
    - Jennifer arranged loaves of bread on 6 shelves in the basket. She put 1 loaf on the top shelf, 3 loaves on the second shelf, and 5 loaves on the third shelf. If she continues this pattern, how many loaves did Jennifer put on the 6th shelf?

Shelf	1	2	3	4	5	6
Loaves	1	3	5			

- Draw a picture – The children may need to draw a picture to help solve some problems.
    - Four children were in line. Shaletha was behind Lauren. Heather was between Shaletha and Lauren. Shaletha was in front of Lacey. A mud puddle was near the child, who was in the back of the line? Who was in the back of the line?

By now, the Math Block students clearly comprehend and can articulate why teaching young children effective skills and strategies for problem-solving is the key. Children learn math best through activities that encourage them to explore; think about what they are exploring; and solving problems, using information they have gathered themselves (NCTM, 2004). After working with the above problems and several practice problems, which they had to read and choose a method, they seem to understand the notions and concepts that Jitendra, Griffin, Deatline-Buchman, Dipipi-Hoy, Sczesniak, Sokol, & Xin (2005) believe is the pivotal point in learning effective problem-solving skills…"teachers must [have a] deep understanding of their content area to adequately prepare their students to engage in complex thinking and problem-solving, [encompassing] accommodating individual differences" (p. 333). Not only is it critical to guide future teachers in ensuring children make math a part of their day, they, too, must value

its importance. As they are trying to solve problems, the Math Block students were able to communicate their thoughts and even talk with others about what does not make sense to have a more developing understanding of helping young children learn to reason mathematically. My Math Block students (personal communication, October 27, 2010) also suggested that children role play problems to solve and to treat errors as opportunities to help children learn something new by not only literally practicing problems but role-playing them as well.

It was then pondered on how to provide Math Block students with hands-on opportunities to explore problem-solving and relate it to something that all of them could relate to. A resurgence of mathematics education is needed if children are to receive a mathematics education that prepares them for tomorrow and being productive citizens in society that can help determine the future. These future teachers participated in their own mathematical learning and realize for themselves that by engaging in active and meaningful mathematical experiences. They can then empower their future students and themselves in meeting and exceeding expectations as they develop and utilize their understanding of mathematics. It was critical for them to understand that mathematics must be used and taught to children, strengthening the notion that effective problem-solving skills have the ability to make sense of the world through mathematics.

MAKING THE "ART" OF PROBLEM-SOLVING A REALITY

After revisiting an idea from Crump (1997), the Math Block students were provided with the opportunity to complete a problem-solving birthday party for a little girl named Maci. Each group was given one of the following scenarios to complete for 100 points:

Food (Group One)

What kinds of foods should be provided for the party? Potato chips? Dips? Cupcakes? Doughnuts? Cookies? Pizzas? Whole cakes cut into slices? Hamburgers? Would it be more cost-effective to make some of the foods or buy food already prepared? Maci doesn't like tomato sauce, and TJ is allergic to chocolate. Maci's mother is not a good cook. There are 35 children attending the party. There is no budget for the food.

Food (Group Two)

What kinds of foods should be provided for the party? Potato chips? Dips? Cupcakes? Doughnuts? Cookies? Pizzas? Whole cakes cut into slices? Hamburgers? Would it be more cost-effective to make some of the foods or buy food already prepared? Maci's father does not eat sweets due to a medical condition. Maci's grandmother works at Kimmy's Bakery. She has been identified as one the best bakers in town. There are 22 children attending the party. There is a $135 budget for food.

Food (Group Three)

What kinds of foods should be provided for the party? Potato chips? Dips? Cupcakes? Doughnuts? Cookies? Pizzas? Whole cakes cut into slices? Hamburgers? Would it be more cost-effective to make some of the foods or buy food already prepared? Maci's mother does not eat

sweets due to a medical condition. Maci's grandmother and mother own Maci's Incredible Pizzas…Chicago Taste. There are 52 children attending the party. There is a $150 budget for food.

Drinks (Group Four)

What kinds of drinks should be purchased for each child? Soft drinks or some other types of drinks? How many ounces of drink should be provided for each child? How many ounces altogether? If soft drinks are bought, what is the most economical size to buy? Are cups necessary? Ice? Maci's mother has locally begun a program, targeting First Lady Michelle Obama's obesity initiative. There are 7 children attending the party. There is a $35 budget for drinks.

Drinks (Group Five)

What kinds of drinks should be purchased for each child? Soft drinks or some other types of drinks? How many ounces of drink should be provided for each child? How many ounces altogether? If soft drinks are bought, what is the most economical size to buy? Are cups necessary? Ice? The school district only allows birthday parties in the afternoon, 30 minutes before the dismissal bell. There are 25 children attending the party at school. There are 27 children attending the party at home. There is a $250 budget for drinks for both parties.

Decorations (Group Six)

What types of decorations would be best for the party? Party hats? Noisemakers? Balloons? Streamers? How about crepe paper to decorate the classroom? How much? What size rolls is it packaged in? Should each child be provided with a party favor? What kinds? How much does one cost? What would be the total cost for all of the children? Maci's father will be out of town for the birthday party. Maci's mother didn't want to cancel the party so she asked family members to assist with the party. There are 61 children attending the party. There is no budget for decorations.

Paper Products (Group Seven)

What kinds of paper products are needed for the party? Napkins? Plates? Cups? Is there a need any types of plasticware? Can the right number of each item be purchased so there are none leftover or wasted? What is the price of each item needed to purchase? What are the per-child cost for all paper products, and the total party cost? Maci's mother is having her social organization over to her home on Sunday to work on a volunteer project. There are 25 children attending the party. There is a $39 budget for paper goods.

Paper Products (Group Eight)

What kinds of paper products are needed for the party? Napkins? Plates? Cups? What types of plastic ware are needed? Can the right number of each item be purchased so there are none leftover or wasted? What is the price of each item needed to purchase? What are the per-

child cost for all paper products, and the total party cost? Maci's mother is involved in the kitchen ministry at her church. There are 18 children attending the party. There is a $50 budget for paper goods.

Games (Group Nine)

What kinds of games would be of interest to the children? How long should each game be played? How will teams be determined? How will scoring be done? Should prizes be given to members of winning teams? Who will be in charge if judges or referees are needed? Is any special equipment required? Create a tentative schedule for the games, including their beginning and ending times. Maci's uncle has a degree in exercise science; he is the physical education teacher at the local elementary school. There are 23 children attending the party. There is a $150 budget for games.

Games (Group Ten)

What kinds of games could the children play? How long should each game be played? How will teams be determined? How will scoring be done? Should prizes be given to members of winning teams? Who will be in charge if judges or referees are needed? Is any special equipment required? Create a tentative schedule for the games, including their beginning and ending times. Maci loves to play with her Memory Game, which was bought by her favorite aunt, Kimberly. There are 7 children attending the party at school. There is a $25 budget for games. There are 4 children attending the party at home. There is a $13 budget for games.

Decorations (Group Eleven)

What types of decorations would be best for the party? Party hats? Noisemakers? Balloons? Streamers? How about crepe paper to decorate the classroom? How much? What size rolls is it packaged in? Should each child be provided with a party favor? What kinds? How much does one cost? What would be the total cost for all of the children? Maci's father will be out of town for the birthday party. Maci's mother didn't want to cancel the party so she asked family members to assist with the party. There are 16 children attending the party. There is a $75.00 budget for decorations.

It was amazing at the different ways the class solved the parties. Most of the students are parents, and some of them even exchanged information with each other to use to plan their children's next birthday parties! They utilized the four-step problem-solving theory and created endless possibilities of solving the party. Below is an example of one assignment that was submitted for Group Nine:

Step One:

The group has to decide on the types and times of games. It needs to determine how teams will be formed so there is a need to talk with Maci's uncle in detail about equipment and setting up appropriate, physically active games. Then, it was decided to focus on using judges and scoring the games. It is important to remember a budget of $150.00 and 23 children at the

party. Then, add each of the costs for the games together and subtract from $150.00 and try to use as much of the budget as possible.

Step Two:

Maci is turning seven years old today, and her 22 guests are between the ages of 6 and 8. The birthday party is only going to last three hours; five games were chosen that will take a total of 90 minutes to complete all of them. Four adults will be responsible for judging and refereeing one game, and the last game will be played together, including Maci's uncle, who is a physical education teacher. Maci's uncle also asked us to make sure the games are physically-oriented because the children need to have an opportunity to exercise. The group will use the entire budget of $150.00. The party starts at 3:00 p.m.; the games will start at 4:30 p.m. and end at 6:00 p.m.

Step Three:

The first game will start at 4:30 p.m. and end at 4:45 p.m. Lindsey will be the first judge/referee. The games will take place at the park directly behind Maci's house.

Find the Birthday Girl Game

Lindsey will use 22 bandanas that cost $1.00 each to blindfold each student. Maci will hide and Lindsey will blindfold the other children and give them directions: two steps to the left and ten steps forward until the first or all the children find Maci. It should only take 15 minutes because Maci will only be about 25 feet away. All 23 children will receive a prize for following directions; Lindsey made them candy bags. The 23 bags cost $2.50, and the candy for the bags was $5.75. Find the Birthday Girl Game costs a total of $30.25

The second game will begin at 4:45 p.m. and end at 5:05 p.m. Hope will be the referee/judge of this game.

Hungry Crabs Game

Hope will use a box of 70 bean bags that cost $24.00, and 12 different color hula hoops that cost a total of $13.75. Hope will also use the park for her game. Hope will set-up the park by creating boundaries with cones (donated by the park ranger), scattering bean bags throughout the designated area. Each team's hula hoop is 25 feet of the boundaries. Hope will divide the children into 11 groups of two, and Maci will be partnered with Lindsey since there are an odd number of children. The children will crab walk to collect bean bags and place them in their team's hula hoop. Each team will try to collect the most bean bags before time runs out, or all the bean bags are gone. The team that collects the most bean bags will receive an "I'm a winner at Maci's party!" trophy. The two trophies cost $8.50. The Hungry Crabs Game costs a total of $46.25

Before the third game, Maci and her 22 guests will take a water break. The park has a water fountain, it was decided to have small bottles of water, and the bottles of water cost $3.95.

After the five minute break, the third game will begin at 5:10 p.m. and end at 5:20 p.m. Lauren will be the referee/judge of this game.

Crack the Whip Game

Lauren will not have to use any of the budget money for this game. The 23 children will hold hands, similar to the game Red Rover. Maci will be the leader of the line, and her classmate, James, will be the caboose. Maci will start running around frantically, and everyone else will follow, and they cannot let go of each others' hands. This game can be a lot of fun, but the children will get dirty from falling because Maci is a fast runner. Maci does not like to be dirty so Lauren will make sure that she does not fall. The Crack the Whip Game costs a total of $0.00.

The fourth game will be refereed/judged by Shaletha, and it will begin at 5:20 p.m. and end at 5:35 p.m.

Four Square Game

Shaletha will use a bucket of sidewalk chalk that cost $7.25, six standard red kick balls that cost $18.00, and a $2.00 yard stick to draw four squares on the ground. Each small square is roughly 8'x 8'. Each player will occupy one of the squares. Hope will also have to play with Maci and her 22 guests because there needs to be 4 people on each team. The squares each have a rank order. The square with the highest rank is called the King, but renamed the game, "Maci Square." Once the player hits the ball and it bounces out, the player is out, and the other three players will play until there is only one left. The winner of each four square will receive a $1.00 crown, and there will be six winners. After this 15 minute game, the children will take a two minute water break before the final fun game. The Four Square Game costs a total of $33.25.

The fifth and final game will begin at 5:37 p.m. and end at 6:00 p.m. Hope, Lindsey, Lauren, Shaletha, and Maci's uncle will play in this game along with the 23 children.

Bowling in the Park Game

The final game is Maci's favorite game. She loves to go bowling with her family and decided to have a bowling game in the park for her party. Since Maci's uncle and the four of us are playing along with the children, there are now going to be 4 groups of 7. Lindsey will have a team with six children. Hope will have a team with six children. Lauren and Shaletha will have a team of five children. Finally, Maci's uncle will have a team of five children and Maci. Four 10 feet carpet strips will be used for the lanes. The total cost of the carpet strips was $16.00. Forty 0 plastic bowling pins were bought with four rubber balls for a total of $18.00. Two party songs were played while they are bowling from a rummage sale, and they were $1.15 each. Maci brought her favorite pink CD player and allowed us to use it for this part of the party. In each group there will be a score keeper (who will write the score on the sidewalk with the sidewalk chalk from earlier in the afternoon), a ball returner, and two pin setters. Everyone will rotate so everyone will get a chance to do everything. By the time everyone has had a chance to bowl, take score, and set the pins up, it will be 6:00 p.m. and time for everyone to go home. The Bowling in the Park Game costs a total of $36.30.

The grand total for the games is $150.00.

$30.25 + $46.25 = $76.50 + $3.95 = $80.45 + $0.00 = $80.45 + $33.25 = $113.70 + $36.30 = $150.00

Step Four:

It was important to find the prices for the supplies and materials needed for the games. Estimates were provided by all party planners to ensure to stay within the confines of the budget. There were some games that could not be played because of the confines of the budget. There was some gaming equipment that took too much time and used too many resources. It is an awesome responsibility to plan for this party so one could only imagine how much times and resources it would take to plan the entire party.

CONCLUSION

This problem solving activity benefitted the Math Block students because they finally had the opportunity to be actively involved in generating mathematical knowledge. Many of the students had only been familiar with a drill-and-skill approach to mathematics. The creative learning and other student-centered activities throughout my course helped them to view mathematics as something more than numbers on a page. The students actually became excited and enthusiastic about mathematics; they looked forward to working together and having the opportunity to participate in the activities. What is even more valuable is the students used knowledge from outside the classroom to enhance their learning of mathematics in the classroom, which is the foundation to ensure children become the mathematical learners needed them to be in order to live in a more advanced, technological society.

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