Effects of Preservice Teachers' Math Literacy in a Tutorial Field Experience.

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Abstract

Schools emphasize reading readiness, reading comprehension, and math because of end of grade testing and accountability. Math literacy is an important factor in math readiness and application. Children may have large vocabularies and sight word recognition needed for learning to read and comprehend, but may lack the necessary vocabulary or definitions of the same site words to learn mathematics. This often leads preservice teachers and children to have a fear of math. This research looked at preservice teachers and their preconceived ideas of their math abilities and perceptions of them teaching math to children who may have the same perceptions and fears of math. The researchers gathered the preservice teachers/tutor's field notes (reflections from tutoring), self-awareness math surveys, math vocabulary assessment survey, and post self-awareness math surveys. By examining and observing what preservice teachers do and say regarding their tutorial practice, educators can improve upon the connections between theory and practice. This research found preservice teachers were unfamiliar with using conversation, writing, and games to tutor and teach math. After being exposed to teaching strategies used for reading literacy, preservice teachers started to see a change in the students they tutored along with their perceptions of math.

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Schools emphasize reading readiness, reading comprehension, and math because of end of grade testing and accountability. Vocabulary and sight word recognition plays a major role in how well children learn to read and comprehend. Math literacy is an important factor in math readiness and application. Children may have large vocabularies and sight word recognition needed for learning to read and comprehend, but may lack the necessary vocabulary or definitions of the same site words to learn mathematics. This often leads preservice teachers and children to have a fear of math. Preservice teachers and children sometimes do not have the math vocabulary to help comprehend textbooks and word problems. This research examines preservice teachers math literacy for learning and teaching math.

History of Teaching Math

Math in schools required the use of numbers and symbols (Lampert, 1985). Children were first taught numbers, addition, and subtraction. Mathematical sentences were drawn (4+2=8) without context to written vocabulary or meaning. Very little time was dealt with math vocabulary. Symbols were used in place of words such as +, -, =, etc. Teachers explained the concept in words but demonstrated in symbols. There was also no relationship between math and real life experiences. Children were expected to learn and memorize the concepts by completing mathematical sentences in the form of worksheets. Children learned by rote memory exercises (worksheets). Lampert (1988) wrote;

> Commonly, mathematics is associated with certainty; knowing it, with being able to get the right answer, quickly. These cultural assumptions are shaped by school experience, in which doing mathematics means following the rules laid down by the teacher; knowing mathematics means remembering and applying the correct rule when the teacher asks a question; and mathematical truth is determined when the answer is ratified by the teacher (p. 4).

To help with the rote learning, manipulatives were added to the teaching of early math. Children used blocks, chips, pictorials, and other objects to help visual the concept or to prove the mathematical rule. These manipulatives did not necessarily have a relationship with real life situations. However, the use of manipulatives was rather short lived. According to Lampert (1985);

> For practical, conceptual, and developmental reasons teachers usually stop using objects to represent mathematical processes in second or third grade. That is when the numbers get bigger, making the objects more unwieldy; it is also when the connection between objects and symbols becomes more complex (p. 2).

Manipulatives helped younger children visualize numbers, yet did not help in comprehension of math concepts. Often teachers shared their meaning by giving the students the mathematical rules and problems followed by the students completing the work to find the right answer. Teachers then reviewed the work and explained the solution without inviting students to participate in the meaning of mathematics. Children did not always have an understanding of mathematical terms, concepts, or meaning.

Later the introduction of word problems were included in the teaching of math. Students were to make the mathematical formula connection to the word problem. First,

students were expected to understand the vocabulary and meaning of the written problem which did not always occur. According to Lampert (1985);

> After they have learned to use the conventional procedures to do these multiplications, students might be asked to solve word problems like: "If baseball shirts cost $8.95 each, what would be the total cost of 73 shirts?" But doing such problems does not necessarily indicate an understanding of the algorithm. Children can learn to recognize problems like this as members of a set of "word problems" to which multiplication should be applied, (usually because they come at the end of the chapter on multiplication), but they probably could not tell you why multiplying gets you the correct answer (p. 4).

As math levels increased, verbal problems become more complex and without context meaning and vocabulary, students misunderstood the problems and the mathematical processes.

New Thinking in Mathematics

More emphasis has been placed in schools with math, literacy, and language arts because of testing. The National Council of Teachers of Mathematics (NCTM) in 1989 suggested a shift in the way math is presented in schools. According to Perry (2001);

> Suggesting a broader definition and use of communication in the mathematics classroom, NCTM (1989) called for an increase in students' reading, writing, discussing, representing, and modeling mathematics, because, "as students communicate their ideas, they learn to clarify, refine, and consolidate their thinking." Teachers who embraced the standards sought ways to shift the emphasis in their classrooms from talking and writing as answer-giving to talking and writing as sense-making (p. 71).

There are many ways teachers are providing different approaches to teaching mathematics so students can negotiate meaning with math concepts. Some ways are written communications such as journal writing and dialogue writing, oral communications, and peer-group discussions and activities. According to Lynch (2003);

> writing in mathematics can be a vehicle for students to construct their own mathematical meaning. Using writing to make sense of mathematics allows students to see mathematics as more than just a manipulation of symbols and a collection or right answers (p. 12).

Writing about math allows the written word to be edited and revisited, to help retain meaning, to help organize new ideas, and to establish an active process (Lynch, 2003). Writing about mathematics helps students make sense about what they are doing and why. Writing can create a relationship between the math process to the real world.

Peer group work allows students to negotiate meaning by asking each other questions about solving, about their thinking, clarifying and explaining thoughts, and different ways to solve the problems followed by whole class debriefing (Perry, 2001). Group work also allows students who are social beings that may not listen to directions or may not understand math to participate with others through questioning and becoming active (Perry, 2002).

Oral communications allowed students to question, defend, make hypotheses, trial and error with guessing, argue, develop strategies, and negotiate meaning (Lambert, 1988). Lambert (1988) writes:

> Mathematical discourse is about figuring out what is true, once the members of the discourse community agree on their definitions and assumptions. These definitions and assumptions are not given, but are negotiated in the process of determining what is true. Students learn about how the truth of a mathematical assertion gets established in mathematical discourse as they zig-zag between their own observations and generalizations –their own proofs and refutations — revealing and testing their own definitions and assumptions as they go along (p. 15).

To master math and math literacy is frequent practice. However, repetitive worksheets and memorization are tiresome to both students and teachers (Clark, 1997). Whereas, games provide the opportunity to practice what is being learned along with applying critical thinking skills (Clark, 1997; May, 1998). Games can be as simple or complicated as teachers or students prefer (Clark, 1997). After playing games, students take what they learn from the games and transfer the skills to other applications in math and literacy. Games also allows teachers to evaluation what children are learning.

One problem faced in teacher education programs is changing the perceptions of preservice teachers who were taught to use the math rule to find the correct answer and who now hate, fear, and misunderstand mathematical concepts.

Purpose

Some preservice teachers in elementary education at this university have a fear of teaching math prior to any field experiences such as tutoring, interning or student teaching. Math educators have the problem of lowering the fears to help elementary teachers feel confident in tutoring/teaching children math skills, concepts, and applications. This research looked at preservice teachers and their preconceived ideas of their math abilities and perceptions of them teaching math to children who may have the same perceptions and fears of math.

Methods

Preservice elementary teachers in their first tutoring field experience participated in an after-school tutoring program. Before preservice teachers were assigned to a specific school and grade level, they were required to attend workshops to help prepare them for tutoring. During the workshops, math and reading strategies, alternative assessments, literature, and learning games are presented, discussed, and practiced. A selected group of preservice teachers were asked to incorporate math vocabulary and comprehension skills in reading math textbooks and word problems with the tutees. Literature and games were provided to help tutors accomplish this goal. Each preservice teacher was required to enter weekly field notes regarding tutoring. Both preservice teachers and children were given a vocabulary packet to assess their math literacy and

comprehension ability. Both the preservice teachers and tutees completed a self-awareness survey examining their attitudes towards math.

Data Source

The researchers gathered the preservice teachers/tutor's field notes (reflections from tutoring), self-awareness math surveys, math vocabulary assessment survey, and post self-awareness math surveys. The preservice teachers efforts and reactions to incorporating math vocabulary and comprehension skills were recorded explored. All the surveys were collected and examined for common themes and to evaluate the strengths and weaknesses of the perceptions of math. Throughout the semester, preservice teachers were given strategies, opportunities, and responses to what they were doing in tutoring. Some of the strategies were taken from reading literacy instruction such as echo reading and choral reading. Journal writing for math was also suggested as a way to learn math (this was beyond field notes and researchers did not examine). Supervision by the researchers were present to help when a problem would arise.

Validity and Reliability

Obligation is placed on the researcher to be methodical in presenting sufficient details regarding the method of data collection and the process used to analyze so others can judge the quality of the research product (Patton, 1990). The validity of the data was enhanced through triangulation of multiple methodologies and data sources (Lincoln & Guba, 1985; Patton, 1990). Triangulation was used to present a holistic picture and check accuracy of findings in one source against those in another to make sure findings were consistent and valid. The multiple data sources consisted of reflective journals, and surveys from the participants. The multiple methods included content analysis and tabulation of survey results, inductive analysis of the field notes/reflections.

Survey Analysis

The two survey results and fieldnote/reflections were compiled and coded for emerging themes and categories (Bogden & Biklin, 1998). Percentages were determined by dividing the number of replies given by the total number of respondents. Since students often made more than one response within a question, some of the totals equaled more than 100 percent. Not all the data collected are discussed in the analysis because some responses were idiosyncratic and others did not correspond directly to the questions of this study.

Results

Pre Survey

This survey was given to 75 preservice teachers at the beginning of coursework and/or tutoring. Looking at the first question regarding their feeling about math, 18% said they did not like math. One preservice teacher wrote, "I do not like math. I have never

liked math. When the word math comes up in a conversation, the first thing I think is 'Ugh." However, 33% of the preservice teachers claimed to have anxiety and fearfulness regarding math along with 6% saying math was difficult. Thirty-seven percent felt comfortable with math. One preservice teacher wrote, "I enjoy math and realize that it is crucial to problem solving strategies that are essential in everyday life. Mathematical awareness enhances the thinking process for children and adults alike." When asked about their competency with math, 44% were competent while 40% said they were not competent at all. Twelve percent felt competent with basic math only. One preservice teacher responded, "I don't feel very confident about my math ability on the college level. There are certain areas that I have more confidence in than others-such as problem solving." Sixty-four percent claimed to have completed advance college math courses. The preservice teachers responded to why they like math or dislike math. Eleven percent that liked math said it was because math had practical application and 13% disliked math because they didn't understand math concepts. As one student replied, "I am afraid of not understanding it and getting behind. I did not pass the praxis math. I am very afraid of the retest."

Field notes

Once the tutoring began, tutors submitted weekly pre-established field notes/reflections. The field notes/reflections varied from one preservice teacher to another. Some field notes were short and descriptive, while others showed depth and perception. Nevertheless, the field notes/reflections revealed students' perceptions about what they were doing and why. One preservice teacher mentioned early in the tutoring;

> My tutee is in the 9th grade, but is on a 4th or 5th grade math level. I am working with him on his multiplication as well as negative numbers. The multiplication will come with time, but he is having problems understanding the negative numbers concept.

Other preservice teachers had similar traditional views of math. Another wrote, "We worked on her math. She had several worksheets for homework. We got most of it finished. I tried to help again this week on getting her to use other items other than her fingers to count." A third preservice teacher wrote;

> We worked on her math. She had a lot of homework this week and we worked a long time to get it finished. She is learning how to find the perimeter and area and volume of rectangles, squares, and triangles. I have to admit that I had to refresh myself on the formulas so that I could be of any help. She seemed to remember a lot of the formulas without looking, but it was hard for her to plug the numbers into the formula. It seems that would be the easy part.

Preservice teachers during class or in field notes would ask what more could be done to help. Preservice teachers were starting to see that children being taught only one math definition or method then left alone to work didn't get it. After a couple of weeks into tutoring, one preservice teacher explained, "It helped me to show him several ways to do the problem. I think this helped him to find a way to understand courtesy of me. Otherwise, with only one option to choose from, I am doing him a discourtesy because of

miscommunication." Preservice teachers started expanding their strategies for tutoring math. A preservice teacher described her method in tutoring;

> My tutee is having lots of trouble in math. He said he made a 68 on his test and the teacher wanted him to go back and correct all the ones that he missed. I tried to help him to understand why he missed those problems. Once again, most were find the area, perimeter, etc. for various shapes. A lot of the ones he missed were word problems. Some were problems of angles and chords. I noticed that when we took the time to draw out a square, triangle, rectangle, etc. and label the sides with the appropriate measurements, He could see it and work the problem. Evidently, he can't see the shape in his mind.

Preservice teachers and their tutees often misunderstand word problems due to the lack of math vocabulary and reading comprehension. Students read word problems as if they were reading dry text without fluency, fluctuation, and word emphasis. Another preservice teacher discovered conversation helped with tutoring. She wrote;

> We go over it step-by-step together. We talk about the first step, work that part of the problem out, and then move on. If they are not comprehending anything we start taking the problems apart and talk about each step. I tell my tutees that I am like a 2 year old because I'll ask them 'Why?' a thousand times. I want them to tell me exactly why they did each step in the problem.

Others found games to be helpful with teaching math and math concepts. One preservice teacher created her version of Bingo for math using multiplication as the objective to learn. Another created a yarn and marble games to help teach the multiplication of 3's.

Preservice teachers that had computers available for tutoring used them to download games for math. All these preservice teachers agreed that the games helped and children enjoyed them. Preservice teachers did mention that it was difficult for their tutees to write about math. The tutees preferred to talk about what they were doing and why instead of writing about it. Preservice teachers were comfortable letting the children talk instead of write. However, the preservice teachers found writing about math helped them see what they were doing to help students and reflect upon their strategies.

Post-survey

The post-survey asked the same questions as the first. However, only 55 preservice teachers responded to the post-survey. Examining the results showed a positive attitude change in the preservice teachers regarding their perceptions of math and the teaching of math. Forty-five percent of preservice teachers responded that they were starting to enjoy mathematics because they were getting a better understanding of problem solving. One preservice teacher wrote, "Generally, math scares me, but I have a better feeling about is since taking this class." Only 14% of 55 respondents replied they still didn't like math. In their responses to their feelings of math competency, 51% felt competent with 34% feeling better after the semester. One preservice teacher replied, "I feel more competent now than when I started – the math started making sense."

Only 9% were still leery of their competence. When asked about the feelings of readiness to teach math, 96% of the preservice teachers felt ready and looking forward to the challenge. Preservice teachers made comments that they had more examples and different methods to take into the classroom. The preservice teachers biggest concern with math fears is misunderstanding. Twenty-two percent of the preservice teachers felt they may not completely understand the problem. Examining the response to why they like math, 78% out of the 43 responses, found math to be now fun and exciting. One preservice teacher wrote, "I think it is interesting and can be fun to see the different ways it can be used." When asked about why they didn' t like math, only 21 preservice teachers responded. Nineteen percent still found math to be frustrating. One preservice teacher wrote, "Well, I' ve never been good at it. I like what comes easily. However, I am better now, thanks to my daily affirmations."

Conclusions

This research informs teacher educators how preservice teachers' core beliefs can change through experimenting with different learning/teaching strategies and giving students time to reflect. By examining and observing what preservice teachers do and say regarding their tutorial practice, educators can improve upon the connections between theory and practice. This research found preservice teachers were unfamiliar with using conversation, writing, and games to tutor and teach math. They entered the program with the idea that math is explained by the teacher and problems are given to the students to solve individually. After being exposed to teaching strategies used for reading literacy, preservice teachers started to see a change in the students they tutored along with their perceptions of math. Preservice teachers started to realize that literacy in has a large impact on how children learn and put into practice what they learn.

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