



A STUDY ON THE PERSPECTIVES OF MATHEMATICS: ENDING THE NEGATIVE CYCLE

BY: KELLI JOHNSON AND PAT GRAY

WEST CHESTER UNIVERSITY OF PENNSYLVANIA DEPARTMENT OF MATHEMATICS



BACKGROUND INFORMATION

The goal of this project is to gain insight on the underlying factors that contribute to the beliefs and anxieties about mathematics, which are experienced by pre-service elementary school teachers (PSTs). A teachers' beliefs regarding mathematics can have a profound impact on the practice of teaching (Charalambos, Philippou & Kyriakides, 2002; Ernest, 2000). The students of teachers who exhibit positive beliefs towards mathematics tend to benefit from successful learning experiences, which often result in them seeing mathematics as both useful and necessary (Karp, 1991). Therefore, it can be argued that a teachers' beliefs can play a major role in their students' achievement, and the formation of their beliefs and attitudes toward mathematics.

Identifying and addressing the causes of negative beliefs about mathematics held by pre-service elementary teacher education students is crucial for both improving their mathematical teaching skills and the learning of their future students. Ultimately, these causes for math anxiety must be addressed by teacher educators so that pre-service teachers can transform their own attitudes and beliefs. How can we ask teachers, who have completed a degree program with a minimal understanding of the nature of mathematics, who have extreme animosity about learning mathematics to alter the attitudes of their students? It is a classic case of "I cannot give what I do not have." Without research into the causes of these negative attitudes towards teaching and learning mathematics, these future teachers will ultimately perpetuate these beliefs, passing them onto their future students.

If we are going to have any chance of addressing the problem of math attitudes and understanding in the general population, we must start with the people who are charged with teaching math in the lower grades. This research was designed to ascertain some of the underlying characteristics of the educational experiences of math phobic students, specifically examine some of the factors that contributed to the anxiety in the first place.

METHODOLOGY

316 pre-service teachers (PSTs) from 4 different universities, who enrolled in an initial mathematics course for their teacher certification in elementary education, were recruited to complete a survey with regards to their beliefs about mathematics. The survey utilized both quantitative and qualitative items concerning their beliefs and attitudes about mathematics and their prior experiences with learning mathematics. The instrument was designed to invite students to talk about their beliefs on the nature of mathematics, as well as the potential influences on the formation of these attitudes.

Data analysis used a mixed method approach to look for correlations between the PSTs beliefs about mathematics and their experiences throughout their mathematics education. Cross-tabulation analysis of multiple categorical variables was used to determine whether differences between sample subgroups are statistically significant. Descriptive statistics were used to analyze qualitative responses and will serve as the basis for conclusions drawn about the nature and etiology of attitudes toward mathematics. Descriptive statistics were used as a basis for the analysis, comparing means of their current beliefs on mathematics and the past learning experiences.

SURVEY QUESTIONS

Questions regarding their current beliefs on mathematics (participants could respond with strongly agree, agree, disagree, strongly disagree)

1. Mathematical ability is something people are born with
2. People who are good at math do not need to work hard to do well
3. I am embarrassed when I make a mistake in mathematics
4. Mathematics is about quickly getting correct answers
5. How would you describe your skill level in mathematics - high, above average, proficient, below average, or low
6. How much fear or anxiety do you associate with learning mathematics - high, some, none
7. How would you define mathematics
8. In general, how much satisfaction do you get from solving mathematics problems
9. How confident are you that you can successfully teach mathematics in today's schools

Questions regarding their past learning experiences in mathematics (participants could respond with seldom, sometimes, or frequently)

When you think about your experiences while learning math in school, would you say your teachers emphasized:

1. Procedures for arriving at the correct answers
2. Understanding the math concepts underlying the problem
3. Memorizing the sequence of steps needed to solve the problem
4. Finding correct answers quickly
5. Have your teachers been influential in shaping your attitudes towards mathematics learning

OUR FINDINGS

We found that **88% of the PSTs** claim that their beliefs about mathematics were directly influenced by their previous education experience. Additionally, 78% of PSTs claim to have anxiety when doing mathematics. It is important to note that PSTs lack of confidence in teaching mathematics is highly correlated **with them having previous experiences where mathematics was taught** with an emphasis on memorization of procedures and finding correct answers quickly. This is problematic since these students want to be future elementary teachers who will be required to teach mathematics. These findings are the first step in understanding where these beliefs come from and how they can be addressed in mathematics education courses.

Specifically, that 71.9% of PSTs that indicated a high level of anxiety were seldom taught with an emphasis on understanding. In fact, 76.5% of PSTs where were NOT confident in their ability to successfully teach mathematics claim they were frequently taught with an emphasis on procedures and an emphasis on memorizing sequences of steps to solve problems. Additionally, 82.3% of PSTs who were NOT confident to teach mathematics were taught with an emphasis on finding answers quickly.

Conversely, 62.5% of PSTs who WERE confident in their ability to teach mathematics were taught with an emphasis on understanding. These same PSTs claim they are NOT embarrassed to make mistakes when doing mathematics and 62.7% believe that you need to work hard to do well in mathematics.

CONCLUSION

Negative beliefs about learning mathematics begins in elementary school and is continued through high school mathematics, we need to end this cycle as we train future teachers. Mathematics education courses in college must take the initiative to STOP the negative cycle. The data from this study provides evidence of how this cycle began and what learning experiences correlate with anxiety and lack of confidence. PSTs anxiety begins with their experiences in math classrooms where the emphasis is on memorizing procedures without understanding.

The question now becomes, how can we give PSTs experiences where learning math is about understanding concepts, solving challenging tasks and exploring the numerical patterns that exist in the world around us? How can we create excitement and curiosity about the world of mathematics around us that can transform the PSTs beliefs? How can we give PSTs positive experiences while learning mathematics so that they can take that enthusiasm with them into their future classrooms and end this negative cycle?

REFERENCES

- Charalambos, C., Philippou, G., and Kyriakides, L. (2002). Towards understanding teachers' philosophical beliefs about mathematics. Paper presented at the International Group for the Psychology of Mathematics Education (PME), Norwich UK.
- Ernest, P. (2000). Teaching and learning mathematics. In V. Koshy, P. Ernest, & R. Caskey (Ed.), *Mathematics for primary teachers*. London, UK: Routledge.
- Karp, K. S. (1991). Elementary school teachers' attitudes toward mathematics: The impact on students' autonomous learning skills. *School Science and Mathematics*, 91(6), 265-270.

Figure 1. Shows the counts associated with students confidence level

PST's reported higher confidence levels towards teaching mathematics in the future when they were previously educated with an emphasis on understanding the underlying concept.

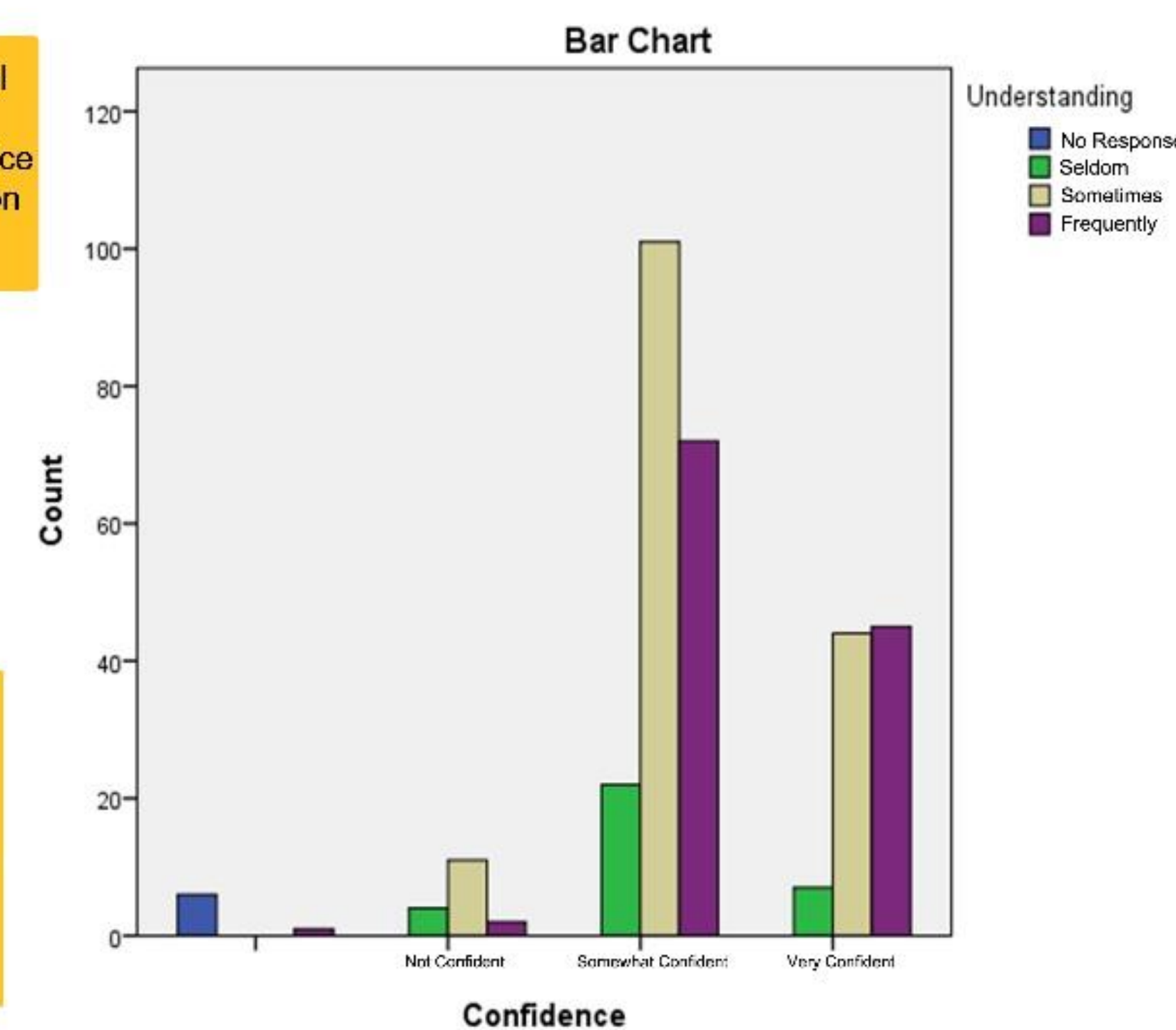
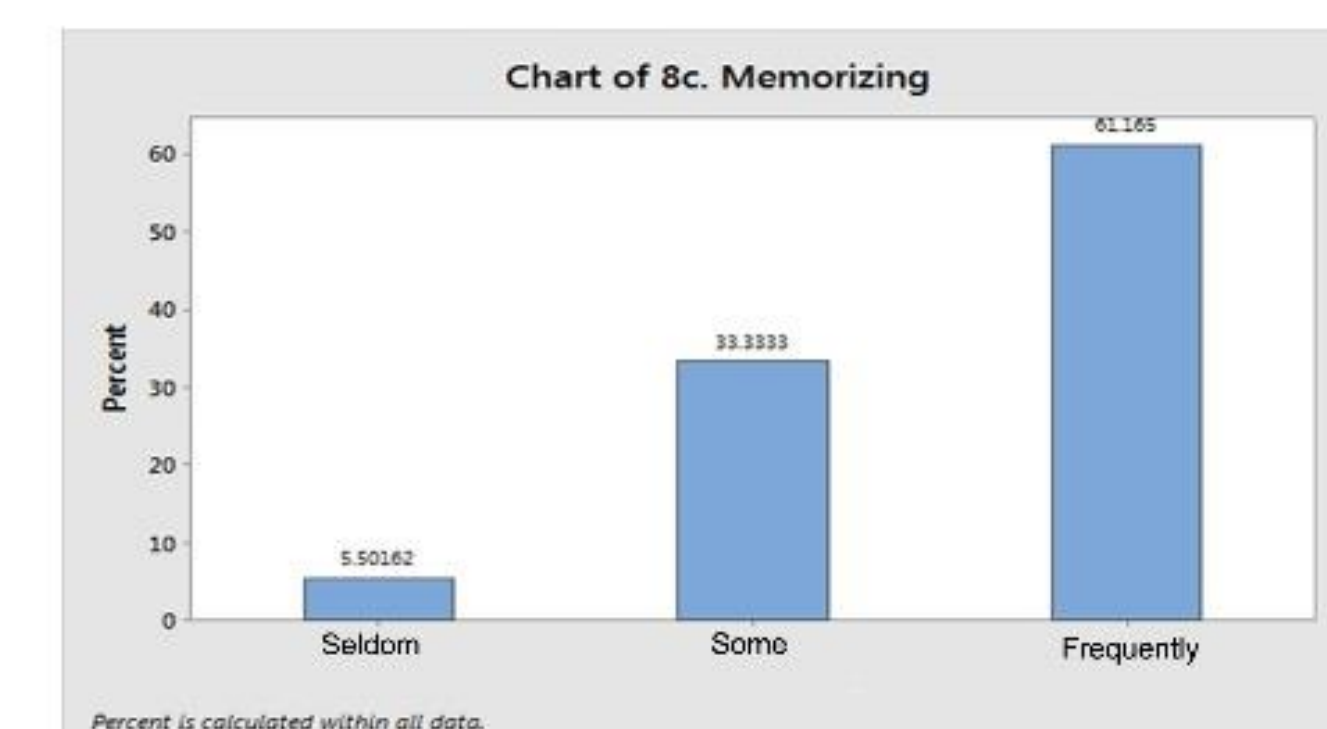
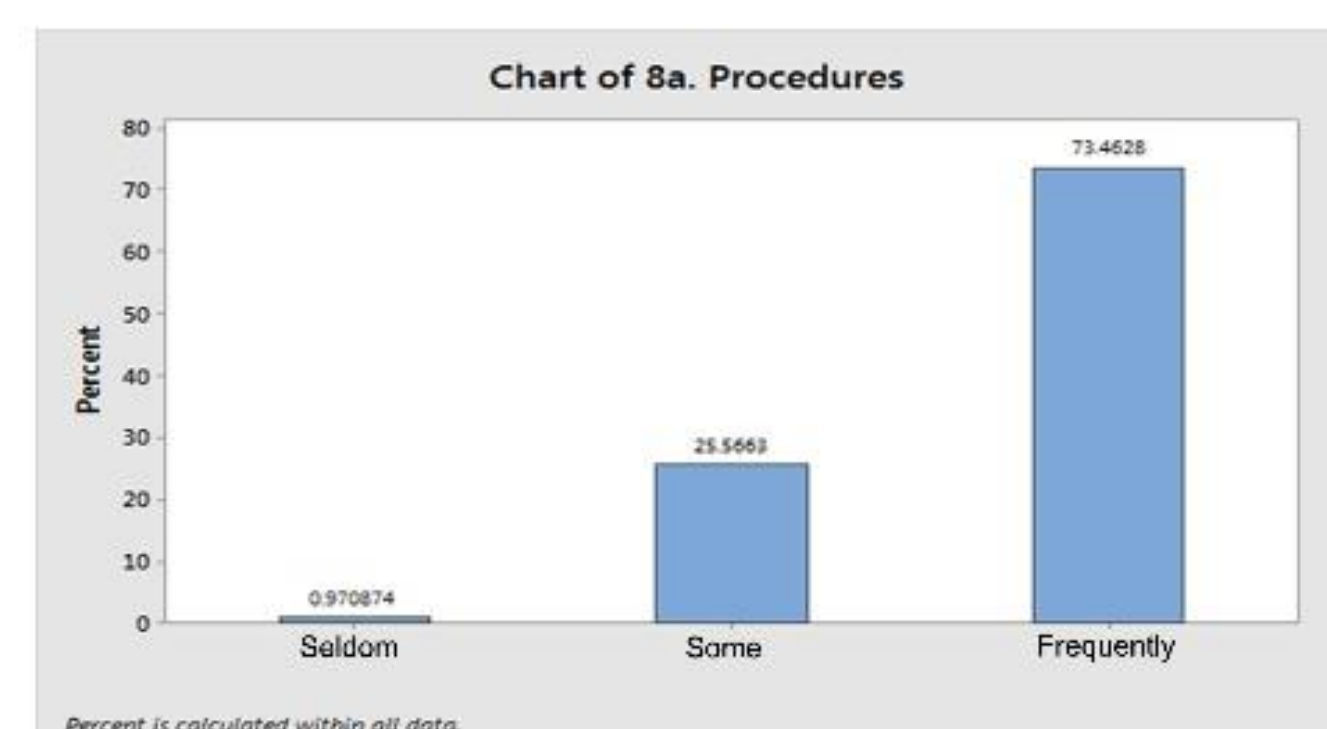


Figure 2 & 3: Shows the percentages for students who were taught with an emphasis on procedures and an emphasis on memorizing steps.

A majority of the PST's reported that they were either sometimes or frequently taught with an emphasis on using procedures and memorizing a sequence of steps to find correct answers.



CORRELATIONS BETWEEN VARIABLES

ANXIETY & UNDERSTANDING

Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	18.729 ^a	9	.029	
Likelihood Ratio	20.955 ^a	9	.013	
N of Valid Cases	315			

We can conclude that there is a relationship between those who report that they have anxiety towards mathematics and if they were taught with an emphasis on understanding the underlying concepts.

QUICKLY & TAUGHT WITH AN EMPHASIS ON QUICKLY

Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	28.117 ^a	9	.001	
Likelihood Ratio	31.346 ^a	9	.000	
N of Valid Cases	315			

We can conclude that there is a relationship between those who think that mathematics is defined by finding answers quickly and those who were previously taught with an emphasis on finding the correct answer quickly. This goes to show the direct implications of the impact of ones past educational experiences and how they perceive mathematics.

EMBARRASSED & ANXIETY

Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	53.656 ^a	12	.000	
Likelihood Ratio	52.355 ^a	12	.000	
N of Valid Cases	315			

We can conclude that there is a relationship between those who feel embarrassed when they make a mistake in mathematics and those with high anxiety towards learning mathematics.

CONFIDENCE & PROCEDURES

Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	270.584 ^a	9	.000	
Likelihood Ratio	55.850 ^a	9	.000	
N of Valid Cases	315			

We can conclude that there is a relationship between the level of confidence that PST's have towards teaching mathematics in the future and if they were taught with an emphasis on procedures.

EMBARRASSED & UNDERSTANDING

Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	29.233 ^a	12	.004	
Likelihood Ratio	27.562 ^a	12	.006	
N of Valid Cases	315			

We can conclude that there is a relationship between those who feel embarrassed when they make a mistake in mathematics and if they were taught with an emphasis on understanding the underlying concepts.

CONFIDENCE & MEMORIZING

Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	273.903 ^a	9	.000	
Likelihood Ratio	59.400 ^a	9	.000	
N of Valid Cases	315			

We can conclude that there is a relationship between the level of confidence that PST's have towards teaching mathematics in the future and if they were taught with an emphasis on memorizing.

In addition to the above information we also found that the level of confidence that PST's have towards teaching mathematics in the future is also related to: if they were taught with an emphasis on finding answers quickly, if they reported that their past teachers have had an impact on them, if they believe that mathematic ability is something you are born with, and if they were taught with an emphasis on understanding the concepts. A majority of the results showed that these factors directly correlated with the PSTs confidence in teaching math, anxiety with learning math and current beliefs about the nature of mathematics.