

# Elementary Education Majors' Stories About Math: An Analysis of Students' Mathematics Autobiographies

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**Abstract** This paper analyzes 52 preservice elementary education majors' mathematical autobiographies. Participants wrote about their previous experiences with mathematics. Three themes emerged:

- (1) My previous teachers have played a significant role in the formation of my mathematical identity.
- (2) I want to help my future students understand, enjoy, and appreciate mathematics. And
- (3) Mathematics has its ups and downs. Although directed to define mathematics, many participants did not do so. The remaining participants described mathematics as needed for everyday life, as problem solving, or as a study.

**Keywords:** Autobiographies, Mathematics, Preservice elementary teachers

## 1. INTRODUCTION

A written mathematical autobiography is a narrative of a person's experience with mathematics. It describes who the person is *mathematically*. Mathematics autobiographies are an effective tool for telling stories about oneself as a mathematics learner and, in this case, a future teacher.

In a study conducted by Ellsworth and Buss (2000), ninety-eight autobiographies of preservice elementary teachers revealed generally positive attitudes about mathematics. In addition, the preservice elementary teachers felt that teachers and family members have a large effect on their own attitudes about mathematics. They also believed that mathematics is important to real-life.

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In another study (Drake, 2006), twenty elementary teachers provided narrative descriptions of critical events in their experiences of learning mathematics. These descriptions revealed that all twenty had either negative early experiences with mathematics or a mixture of positive and negative early experiences with mathematics. However, only two of the teachers indicated that they currently held a negative view of mathematics.

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Harkness et al (2007) compared the mathematical autobiographies of twenty preservice elementary teachers at the beginning of a semester with their autobiographies at the end of the semester. This comparative analysis demonstrated that, over the course of the semester, the students grew as mathematics learners. This growth was attributed to particular aspects of their experiences in the course. In particular, the researchers reported that students' initial struggles with mathematics subsequently led to success in the course. Students wrote about expanding effort to look for the concept and the meaning behind the method in order to succeed in the course. It was in expanding this effort that students reported learning and growth.

Guillaume and Kirtman (2010) found that the mathematics autobiographies of 144 preservice elementary teachers were mostly positive, but the participants did discuss the nature of mathematics as being made up of "peaks and valleys." Most of the participants discussed early school experiences with mathematics, including the use of flash cards and timed tests. The teacher played an important role in the preservice elementary teachers' memories.

A study of 41 elementary teachers' mathematics autobiographies delineated the up and down nature of their progress (McCulloch et al, 2013). Although seven respondents expressed having had a smooth track, and eight only a minor setback, 22 were either consistently frustrated, on a roller coaster, or ended up with a primarily negative view of mathematics. Another four started out with a negative view, but ended up viewing mathematics positively. This study also described the importance of former teachers in determining how positive or negative students felt.

In contrast to the eventual positive narratives from the previous studies, 214 Slovenian preservice elementary teachers wrote about positive experiences in the elementary grades, but very negative – even fearful – experiences in the secondary grades, including a feeling of panic and viewing the teacher as being "a strict, fear-evoking figure, who speaks in an incomprehensible language and does not care if pupils understand him or not" (Lipovec & Antolin, 2014, p. 187).

In the existing literature, then, mathematical autobiographies have been used to describe preservice elementary teachers' views about mathematics, but to date, no consensus has been reached. A large body of research does

show that elementary teachers have significant influence on how people view mathematics and on their desire and motivation to continue to learn mathematics (DeCorte, 1996; Ferguson, 2008; Gabriele & Joran, 1998; Grant, 1996; Guillaume & Kirtman, 2010; Johnston & Whitenack, 1992; Riedesel & Schwartz, 1994; & Wenglinsky, 2001). The current study adds to the research base by finding consensus in the 52 mathematical autobiographies of the respondents. The purpose is to add to the research base in the hopes of resolving the currently contradictive results in research, and to add a very recent set of data. Because mathematics education is changing rapidly, it is important that researchers and practitioners stay current with findings from recent studies.

## 2. METHOD

The 52 participants in the study were college students enrolled in a mathematics class at a comprehensive regional university in Minnesota in the United States. The university is located in the upper Midwest, less than 200 miles away from the Canadian border. This particular mathematics course is geared toward students majoring in Elementary Education. Sixty-four students were enrolled in the course, which means that 12 students in the course did not turn in an autobiography. The students were offered extra credit for completing the autobiography. Scores were high in the class, and thus some of the students did not need the extra credit. The instructions given to the potential respondents are included as an Appendix. In short, students were asked to describe their experience with mathematics up to this point and, in their narrative, to describe what they think mathematics is.

The overarching research question guiding the study was: What key ideas/themes emerge in the mathematical autobiographies of preservice elementary majors? Because it was not known ahead of time what these themes would be and in order to proceed inductively, detailed or specific research questions (e.g., What do preservice elementary majors think about using calculators when they are teachers?) were not posed ahead of time. The objective of the study was to see what key ideas are held in common among the preservice elementary majors.

Once all of the autobiographies (data) had been collected, each author read each autobiography separately. The authors followed a grounded theory approach in coding the data, allowing themes to emerge (Charmaz, 2006). Since themes were not decided upon ahead of time, the authors did not enter the process with key themes to attempt to find. Rather, it was the purpose of the research to try to see what themes were present. That is to say, the researchers followed an inductive approach in the analysis of the qualitative

data. A theme would result when a certain topic was present in at least 1/5 of the autobiographies. For example, in the first few autobiographies analyzed, the students wrote about teachers from their past and the particular things that the teachers did to influence them. An operational definition was formed of past teachers' influence in this manner: It was determined that the autobiography revealed the theme "My previous teachers have played a significant role in the formation of my mathematical identity" if the student had written fairly extensively about a previous teacher affecting the students' mathematical identity. Thus, it could not just be a mention in the narrative, but at least two paragraphs describing the impact that the teacher had. In this manner, operational definitions of themes were formed inductively.

The authors then met together to discuss the level of agreement on themes or operational definitions and although each person used different wording, there was 100% agreement. Once a wording for the themes was agreed upon, the authors again separately tallied which autobiographies met each theme. Although the authors do not report quantitative results, this did allow the calculation of an interrater reliability score to measure the level of agreement. The original interrater reliability statistic was 98%, and reached 100% after discussion. The definitions of mathematics that participants provided were analyzed similarly, with a 90% interrater reliability before discussion and 100% agreement after discussion.

### **3. RESULTING THEMES**

The narratives written by the participants provided a rich body of data. Three key themes were evident in the majority of the narratives:

1. My previous teachers have played a significant role in the formation of my mathematical identity.
2. I want to help my future students understand, enjoy, and appreciate mathematics.
3. Mathematics has its ups and downs.

#### **3.1 Former Teachers**

Respondents noted that both positive and negative experiences they had with teachers in the past have shaped their feelings and attitudes about mathematics. All but six of the respondents mentioned the influence of teachers. While the respondents were not asked to specifically comment on teachers in the directions for writing their mathematical autobiographies, it was suggested that they comment on "significant" people. Some respondents commented on family members, but the overwhelming majority wrote about their experiences with teachers – both good and bad.

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Good teachers were described as those who related mathematics to their everyday life and devised games and creative activities in the classroom that built mathematics skill. Students wrote about the gallon man (using construction paper to represent the proportion of gallons, pints, quarts, etc.) as well as eating pies to celebrate Pi Day. A student remarked: “the cool part [about the pies] was that we did a bunch of geometry problems about our pie before [the teacher] would let us eat it.” In another class, students made castles and then found the perimeter, area and volume.

It is significant to note that the participants did not mention fun activities unrelated to mathematics. For example, no one wrote that they liked their teacher because he or she was off topic or let the class fool around. The students saw good teachers as actually *teaching mathematics*, often through memorable experiential activities.

The bad teachers were described as those who did not explain things clearly and thoroughly, went too fast, made students work problems on the chalkboard, and otherwise embarrassed or frustrated students. This was demonstrated in participants’ narratives thus:

- In high school I had one teacher whom I really didn’t like, he called on you randomly and made you do problems at the board, which I hated and I think overall it made my math experience very negative.
- All throughout high school, I hated math class, because I had the worst teacher 9-10<sup>th</sup> grade year. He was so boring and didn’t teach us anything. He literally scared the living crap out of me. I found him not approachable and hard to focus in class because I was always afraid of him.
- Another thing that made me stray from math was my terrible (in my opinion) teacher that seems to help everyone else but me.

### 3.2 Future Students

About 88% of the participants commented that they wanted to help their future students not only learn mathematics, but also appreciate that mathematics is used in everyday life. The participants emphasized that it is necessary to learn mathematics. Further, they proclaimed that learning mathematics can be enjoyable. Again, the participants were not asked to comment on their view of future students. However, the participants were asked to make a statement about what they wish for mathematically, in the future. While it’s not surprising that future teachers would comment on being a teacher, their comments about wanting students to learn, appreciate, and see the necessity of mathematics were unexpected. In fact, elementary teachers are generally not all that enthusiastic or positive about math (Tsao, 2014). One participant – an outlier –specifically

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stated that she would not be using mathematics beyond college. This is a confusing statement since she will be an elementary teacher, and elementary teachers teach mathematics. The vast majority of participants, however, reported seeing mathematics as part of their future and expressing a desire for their future students to learn and appreciate it. In the participants' own words:

- In the future, I plan to be an influential math teacher. I want my students to know that I genuinely care about whether they grasp the concept or not.
- I am able to explain problems to kids in the way the curriculum teaches, but also in ways that make sense to different learners who don't always have the best mathematical sense like myself. I can do this and want to do this because of my own experiences, and I feel like the trouble I have gone through and the ways I have learned to teach myself can be really helpful for other students who struggle, not to mention the empathy I will have and willingness to help.
- I know what it is like to feel like a lost cause in the eyes of a teacher and I don't ever want my students to feel like that.

It bears noting that among the 25% who did not comment on wanting to help future students, there was still the acknowledgment that mathematics is a necessary skill for people to have.

### 3.3 Up and Down

A consistent theme present in 100% of the autobiographies is respondents' expressing their ups and downs with mathematics. Perhaps this is the most outstanding theme from the data, given that the participants were not asked to comment on the up and down nature of mathematics. This theme was unprompted and came completely from the participants and, again, was present in 100% of the data. Indeed, a number of respondents used the word "rollercoaster" to describe the experiences they have had with mathematics. This type of experience appears to be explained, in part, by the uneven quality of the teachers the students have had throughout their schooling thus far.

Another contributing factor to the "up and down" experiences they reported is the particular type or branch of mathematics they have been exposed to throughout their educational training. It is clear that these students, for the most part, do not view "mathematics" in a general blanket category kind of way. Rather, they identify some types or aspects of mathematics they like or that resonate with them, and others that they don't care for or with which they have more difficulty. Among this sample of students, Algebra and Geometry were especially identified as either representing mathematics they love, or mathematics they hate:

- I absolutely love algebra... Geometry was harder for me to understand.
- Algebra came easy to me, but I was getting my first C because of geometry.
- Once I was introduced to algebra (my one and only true love) I was so intrigued with math that I was doing it for fun in my free time. I could not get enough of it. But then tenth grade rolled around and we started doing geometry. I personally believe that geometry was created by Satan himself.
- Ever since elementary school I wasn’t the best at math nor have I ever been...In grade school I was placed in the average math class...Then in high school I found a subject in math that I was actually really good at, geometry! Geometry was much different then plugging numbers in and remembering formulas. I loved it so much because it used shapes and finding out areas of these shapes. It was much easier for me to understand this material.
- For most of my life, I’ve found math to be fairly easy...Even though it has been pretty easy, it has never been my favorite subject though. There are subjects in math that I really like and others that I don’t like. My favorite subject that I’ve learned in math was Geometry...I’m not sure why, but constructing shapes, doing proofs, and doing Trig was really fun to me... Unfortunately, when I started getting older and taking hard math classes, like AP Calculus, I started to dislike math more and more.

Another type of mathematics that featured prominently in the narratives was long division; the respondents recall:

- Ever since I was in elementary school, I have enjoyed math. I was always excelling in my math courses...I remember my first math “struggle” was in third or fourth grade when first learning long division...I think this is when math first started being a little harder for me.
- I do remember when I started to dislike math. It was fourth grade...the year I started to struggle [with] long division...My test grades dropped...I began to believe I was bad at math. I continued to believe it right up until about my sophomore year of high school when things started to make sense again.

The word “struggle” appeared repeatedly throughout the data set. In fact, it often appeared in the very first sentence or two of many of the autobiographies. The use of the word “struggle” had such a high frequency of occurrence in the data—strikingly so – that the authors felt compelled to share some examples directly from the autobiographies:

- In life my mathematics experience started out as a struggle.

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- Throughout my entire life I have truly struggled with math.
  - My life with math has always been a struggle for me.
  - I felt like I was always struggling.
  - It was a constant struggle.
  - Math has always been a struggle for me.
  - My math experience has always been a struggle throughout my academic career.
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- I identify as somebody who has always had a fear of and struggles with math.
  - Well fourth grade was the year I started to struggle we began long division...
  - I have always struggled with concepts, equations, and just about any sort of math related curriculum.
  - Math has always been quite the struggle for me.
  - I label it as a necessary evil because it is something that I need in my life but at the same time I struggle with it immensely.

In spite of such statements, when one reads these autobiographies, in their entirety, it is most often the case that “struggle” is not a permanent state.

While discussing the up and down nature of mathematics, most students commented that it is important to study mathematics and to work hard at it. Even when students have had poor teachers, for the most part they take responsibility. That is to say, they don’t completely blame the teachers they have had, as evidenced in the following quotes:

- I hit that problem point and decided to quit when really I should have put in more effort. I would like to think it was the teacher’s fault but it wasn’t, it was my lack of interest and motivation that put an end to my almost excellent math career.
- I don’t want to completely blame my teacher though because I should’ve been better about asking questions.

Consistent with the acknowledgement that they should have put forth greater effort, many of the participants referred to studying mathematics as “practicing.” Participants mentioned that one has to actually work the mathematics problems, and not just memorize things. Furthermore, whether the student has had positive or negative experiences with mathematics, an appreciation for the importance and significance of mathematics was expressed.

Interestingly, participants directly noted that it may have been beneficial for them to have a poor teacher in the sense that they will not teach in the

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same ineffective manner that they experienced as students. In a similar manner, the struggle is seen in a positive light, as it will help them to better understand and be able to work with their future students who might have similar struggles.

#### 4. DEFINITION OF MATHEMATICS

The participants were directly asked to give a definition of mathematics. Regardless, 17 of the 52 either gave no definition ( $n = 13$ ) or gave a very unclear definition ( $n = 4$ ).

Three themes represent the remaining participants' definitions of mathematics. Sixteen participants described *mathematics as needed for everyday life*. Ten described *mathematics as problem solving*. The remaining nine described *mathematics as a study* (e.g., a study of numbers, equations, shapes, functions, etc.).

Those describing mathematics as needed for everyday life tended to also feel it was important that mathematics is taught in such a manner that students recognize that it is needed in life. Representative quotes follow:

- I think math can be many things. We use it in our lives daily, but in such drastically different ways. We use it when we cook, when we use money, and when we play sports and exercise...[M]usicians use math all the time when playing instruments to count the beats and measures. An engineer also uses math often, but for other reasons.
- Math is a way to represent objects with numerical value. Without math there would be many things that could not be done, a house could not be built, there would be no time and a recipe would not exist with measurements like it is now.

Those who described mathematics as problem solving viewed mathematics as the process of finding a solution to a problem, a puzzle, or "something;" that is, mathematics is a way to "figure something out." This definition of mathematics was evidenced in statements such as:

- A numerical way of viewing the world and solving problems.
- The solving of problems using numbers.

Finally, some participants viewed mathematics as a class topic –i.e., something that one studies. It is not viewed as needed in everyday life. In fact, some of these participants went so far as to comment that mathematics is simply not needed at all. In addition, mathematics was not viewed as a problem solving process. Rather, it was viewed as content that one studies as part of going to school. This perspective is represented in the following quotes:

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- Studying numbers and how they relate to each other...measurements, and space, and operations.
- The study of different topics like geometry, algebra, adding, subtracting and etc.

## 5. DISCUSSION

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Consistent with other research involving mathematical autobiographies, in this sample, previous teachers play a significant role in how respondents feel about mathematics. This intuitively makes sense. Another of the findings that resonates with related studies is the respondents' description of their experience with mathematics as being up and down – in some of the respondents' own words, mathematics is like a roller coaster.

Interestingly, the effectiveness of their teachers was not the only factor in accounting for the experience of mathematics as being up and down. Many of the participants explained their level of attraction to particular types or branches of mathematics as well as their difficulty or confusion with other types or branches of mathematics. In this way, some of the participants described a trajectory characterized by understanding and enjoyment followed by misunderstanding and discouragement, or vice versa.

Another prominent theme in the data collected was the respondents' expressed desire to truly help their future students to not only understand mathematics, but to enjoy and appreciate it. In expressing this wish, or vision, for their future classroom, the respondents recalled innovative and creative experiential activities that their previous teachers had used to help students understand – and have fun with – mathematics. It is reasonable to assume that these future elementary school teachers will draw upon those kinds of activities when they embark upon teaching mathematics to their students.

The current study, then, both resonates with, and adds to, related research that has been done employing mathematical autobiographies. It is also significant, however, to address the *absence* of particular themes. For instance, while previous studies have reported a high occurrence of mathematics anxiety among subjects, this was mentioned by only five of the 52 participants. Moreover, among these five participants, one of them emphasized that she really enjoys mathematics, in spite of the anxiety she feels. Another participant noted that she “wants” to like mathematics. Only one participant overtly stated that she hates mathematics.

## 6. LIMITATIONS

While employing qualitative methods allowed the researchers to delve further into the subjective meanings of the data, the approach taken also presents a

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limitation to the study – namely, the possibility that the interpretations of the researchers do not completely match the meanings intended by the research participants. The researchers coded the data separately to address reliability concerns, but it is acknowledged that researcher bias is a limitation, as is the case in research studies generally.

Another limitation is that the sample size in the study, while large for conducting autobiographies, is relatively small ( $n = 52$ ) for generalization, and thus generalization of the findings is limited. Finally, the research instrument itself has some limitations. It is possible that, if the wording of the instrument were different, or if the participants did not know the researchers, their responses may have been different, as well.

## 7. FURTHER STUDY

The limitations lead into suggestions for further study. The study should be replicated with a different sample in a different geographical area, with different researchers doing the coding. If results remained similar, this would be a very powerful result. The study could also be extended to different types of samples, such as secondary mathematics majors, instead of preservice elementary teachers.

## 8. CONCLUDING COMMENTS

Overall, the findings in this study are cause for some optimism about the views of mathematics that future elementary school teachers have and how these views will shape the way they teach mathematics to their students. A prevailing theme was these future teachers' perspective that mathematics is important and necessary. Additionally, they expressed a sincere motivation to teach mathematics in a way that will engage students and will present mathematics in a positive light. Given the weight of negative popular culture views of mathematics over the years, this is an encouraging finding!

## 9. FUNDING

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**Appendix: Assignment: Write your mathematical autobiography**

- Write in first person
- Write about who you are mathematically, how do you identify yourself mathematically
- Include significant people, events, and experiences that have made you what you are mathematically from as early as you remember until now.
- Include also a statement of what you might wish for the future, mathematically.

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- At some point in the narrative, you should directly state what you think mathematics is.
  - It should be at least 700 words.
  - It should be typed.

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