

Math Confidence in an Elementary Mathematics Classroom

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Abstract

I am a fourth- and fifth-grade teacher at a K–12 developmental research school in which I conducted action research examining how instruction impacted student confidence during a mathematics block. I conducted anonymous surveys and student interviews and studied how instructional strategies used for math support positively affect student math confidence and self-perception. The students offered insights into their experiences and suggestions for future implementation. This work developed a unique homework set-up to personalize and support students at their level while targeting specific skills. I will continue to work to increase student self-efficacy.

Keywords: math confidence, math education, growth mindset, elementary school, mathematics, action research

Background

As I walk around during my fifth-grade math block, I notice students busily working on the given activity. As I continue my scan, I become aware that a student, Cat (a pseudonym), is quietly scribbling images of horses and unicorns on the bottom of her math workbook. If I were not walking around, I probably would have believed that she was contently working on the assignment. After approaching her, I ask if I can be of assistance with her getting started or if she needed any further clarification. She politely smiles back at me but insists that her partner can help. I circle the room once more before being stopped by Jacob, Cat's partner. He is visibly upset. Jacob complains that Cat does not do her fair share of the work and is just sitting there copying answers. After some mediation, Cat finally admits that she does not understand and does not want to seem "stupid" in front of her peers.

Previously in the fourth- and fifth-grade learning community, we have focused on explicitly and intentionally developing and fostering a growth mindset in our young students. This included spiraling lessons from second and third grade aimed at changing self-talk and perspective. I focused heavily on what I learned from Dweck (2006) about growth mindset—the brain is much like a muscle; to gain intelligence, you must put forth effort to develop a deeper understanding.

This work and interaction sparked my interest in studying my support during my math block. I knew immediately that I wanted to work on math confidence and growth-mindset around mathematics with my entire class, and even in my other subjects. However, to target students like Cat, I wanted to begin by focusing on my support students. This interaction led me to my inquiry wondering: Which instructional strategies used during tier 2 support positively affect math confidence?

Inquiry Design

To begin my inquiry on math confidence, I knew that I had to adapt my instructional strategies to expand and promote a growth mindset in my students. First and foremost, I wanted to focus on creating a space where we embrace challenges, and perseverance is the typical response in the face of obstacles (Dweck, 2006). I started by researching current literature on math confidence and taking initial data points for my four participants.

My initial data collection explicitly focused on the amount of work completed, the amount of work shown on particular problems, and the amount of revision attempted after an initial prompt. I also tracked how long it took students to begin a task and how much time students exhibited off-task behaviors. I continued to track these data points throughout the inquiry. Figure 1 outlines my initial inquiry data collection plan.

Month	Goals	To Do
December	<ul style="list-style-type: none"> - Literature Review - Analysis of Literature 	<ul style="list-style-type: none"> - Research current literature - Analyze literature found - Write literature review
January	<ul style="list-style-type: none"> - Student opinion survey #1 (four participants only) - Initial student data 	<ul style="list-style-type: none"> - Create student survey - Collect initial student data - Analyze survey results - Compile initial data - Analyze initial data
February	<ul style="list-style-type: none"> - Student interviews (four participants only) - Continue to collect student data 	<ul style="list-style-type: none"> - Create interview questions - Collect & compile student data - Analyze interview results
March	<ul style="list-style-type: none"> - Student opinion survey #2 - Continue to collect data and analyze data - Continue to collect student data 	<ul style="list-style-type: none"> - Create student survey - Continue to collect data and analyze data - Collect student data - Analyze survey results
April	<ul style="list-style-type: none"> - Continue to collect data and analyze data - Continue to collect student data 	<ul style="list-style-type: none"> - Continue to collect data and analyze data - Collect student data
May	<ul style="list-style-type: none"> - Student opinion survey #3 - Final student interview - Analyze data 	<ul style="list-style-type: none"> - Create student survey - Schedule final interview with group - analyze interview results - Analyze data

Figure 1. Initial inquiry data collection timeline

During data collection, I taught a math unit on fractions using the *Investigations in Number, Data, and Space, 3rd Edition* curriculum. My lessons included direct instruction for introductory lessons, followed by guided and independent practice. Although there are practice workbook pages, this curriculum relies on math games to practice new skills with cooperative learning structures. Additionally, I included a workshop model during the math block two days a week. During the workshop, students were given activity options based on learning goals while I held small groups and conferences. It was during this workshop time that I was able to pull my four participants.

I initially used the first workshop day of the week to teach and model growth mindset shifts and goal-setting. Before releasing students to independent practice, we practiced using a non-academic task. For example, when learning about short-term goal setting, we practiced by setting a goal like running for at least 30 minutes a day and then set up a plan together, including

checking in with each other. Once students were accustomed to that, we set an academic goal, such as practicing equivalent fractions for 10 minutes during workshop. The second workshop small group was used to reteach and practice skills and strategies introduced during whole group lessons. Throughout this second type of small group lesson, I would explicitly point out the strategies they used from our previous mindset lessons. For example: “Nice work! I love that you said it was difficult for you at the beginning, but you kept practicing with your partner, and now you’ve got it!” I also asked the students if they noticed any mindset shifts in themselves or their peers while sharing.

Through the follow-up student interviews, I monitored the strategies implemented by students and ways to proceed, as well as to monitor their perception of their growth. The student surveys were to allow my students to share their thoughts throughout the inquiry process anonymously. The survey questions asked about their self-perception of their growth mindset and content-specific feelings. The survey questions remained the same for the duration of the inquiry. Based on feedback from the student surveys, I also initiated optional small group instruction and individualized homework. Students were given a choice to attend one of two small groups based on the learning goals during math workshop. Once routines were in place and practiced, I made small groups completely opt-in for all students.

Participants

My fifth-grade class was comprised of 22 students: 12 females and 10 males. Approximately 36% of the students were White, 32% were Black, 18% were Hispanic, 9% were mixed race, and 5% were Asian. I focused on four students: a Black male, a White female, a Hispanic male, and a Black female. I chose these four students from my tier 2 math support group based on the interactions I had with them in class and previous assessment data.

Literature Review

In my search for literature, I found a plethora of research but struggled to hone in on studies focused on elementary- or middle-grade mathematics specifically. Of the articles I read and ultimately chose to include in my review, all research methods were qualitative.

My search was not a comprehensive review of all the published work on this particular field of knowledge. However, it did produce three major themes around math motivation, self-efficacy, and confidence: social factors, classroom characteristics, and anxiety and stress. In the following discussion, I will examine these areas concerning how they contribute to an elementary student.

Social factors. Denner, Laursen, Dickson, and Hartl’s (2018) study place family values and involvement as a significant social factor for a student’s math confidence. Denner et al. (2018) state that in Latinx households, “when mothers view themselves as more involved in mathematics at home, their children report greater increases in perceived ability as they enter middle school” (p. 522). While this study focused solely on Latinx students and families, the discussion of family involvement in math is still very relevant to other groups of students. Irvin, Byun, Meece, Reed, and Farmer (2016) have concluded that the familial role is essential in students’ self-concept. Furthermore, a student’s educational aspirations, academic experiences, and preparation, especially among African American, Hispanic/Latino, and Native American students, play a crucial role in their math self-efficacy and confidence. Additionally, when minority students from rural schools had their self-concept developed in school, they displayed a definitive increase in achievement.

According to Ganley and Lubienski (2016), female students are significantly less confident in math than male students. Further, we see that this gender difference in confidence and even interest is most substantial during the elementary years. In contrast, Ganley and Lubienski (2016) state that math achievement did not necessarily correlate and justify the female student’s lack of

confidence. This, in turn, led the authors to pose that the student's math confidence was ultimately impacted by a broader range of factors such as family values and stereotypes and have lasting implications on the student's future achievement.

Classroom characteristics. Several themes regarding classroom characteristics and environment emerged while searching within math motivation. Among these themes, teacher attitude about mathematics most affected how students perceived instruction and their ease of comfort when faced with difficult tasks (Linder, Smart, & Cribbs, 2015). Teacher's math knowledge and availability of discourse were also primary factors in student math confidence (Agodini & Harris, 2016; Linder et al., 2015). Teachers that rated their math knowledge higher saw a positive correlation with their student's math confidence and perceived ability (Agodini & Harris, 2016). In classrooms where students regularly engaged in discourse with their peers, students indicated they felt more confident in sharing their work as well as finding various ways to solve problems (Linder et al., 2015).

Anxiety and stress. Anxiety in mathematics is, by far, one of the most reliable links to math confidence. Several studies have found that anxiety directly impacts motivation and self-efficacy in elementary math students and could be a predictor of student achievement (Henschel & Roick, 2017; Jameson, 2014). The inverse is also true; students who exhibited lower levels of anxiety reported higher confidence and perceived achievement (Anis, Krause, & Blum, 2016; Haciomeroglu, 2017; Roos, Bieg, Goetz, Frenzel, Taxer, & Zeidner, 2015).

Once anxiety is exhibited by a student, provisions should be taken to alleviate or lighten the issue or stress. Rufo (2017) discovered that providing students with creative freedom during math lessons in the form of choice of homework pages and personal messages allowed students to express their discomfort, but ultimately uncover ways to ease anxiety. Sorvo et al. (2017) suggest that some anxiety in elementary students can be eliminated with more exposure and practice of basic arithmetic coupled with a classroom environment that values "healthy achievement" (p. 323) over perfection.

Findings

Through initial data collection to answer my research question (i.e., Which instructional strategies used during tier two support positively affects math confidence?), I saw a clear pattern emerge. Unsurprisingly, my four participants were far behind their peers in every category. I further noted that the two male participants lagged behind even my two female participants in work shown and revision, with most problems being attempted only once with minimal work shown. During the student interviews and surveys, the four participants' lack of math confidence began to show a connection to their math work. Students did not feel confident in their ability to complete the work correctly; therefore, they delayed working or avoided the problems altogether. While the two male participants' revision improved significantly, by the end of the inquiry, my four participants were still behind their peers in the amount of work they completed in a given time but had made significant gains in the amount of work shown for each problem and their willingness to revise their work. In addition to this improvement, students reported that they felt more confident in their own abilities and knew the steps to take if they got stuck.

Three significant discoveries stood out in my inquiry: self-efficacy varies greatly; students are likely to rate themselves as having a growth mindset, even if they do not display that attitude; and targeted work choice yielded the highest growth.

Self-Efficacy

Upon analysis of the interviews and surveys I conducted, I saw that my students generally entered each topic with varying levels of confidence. Their confidence ranged from "I think this is going

to be terrible” to “I feel ok about this topic.” There was even an “I don’t know anything about this topic yet.” Only one student, Alex, tended to mark that he had low confidence in all of the math topics. However, for our fractions unit, all students stated they did not feel at all confident going into that mathematics unit.

Growth Mindset

Before beginning any part of my interventions, I asked each student if they believed that they had a growth mindset. All four students responded yes. However, when asked to describe why they believed that they had a growth mindset, half did not know, and the other half related that growth mindset meant trying your best. To push on their understanding of what a growth mindset is and looks like, I included an interview question that asked each student to provide an example of a time that they had displayed a growth mindset, both inside and outside of school.

When asked during an interview to give an example of a time you displayed a growth mindset in school, even if it was not this year, none of the students could recall a time that they displayed a growth mindset. With this information, I worked to develop lessons that solely focused on shifting to a growth mindset and enacting it. After two lessons on growth mindset, each participant was able to describe what growth mindset in class would look like. As the year went on, students were able to reflect on their progress and became better at identifying when they displayed this attitude in class. Figure 2 below includes a participant’s response to one of the final interview questions about giving an example of overcoming a struggle. She was able to transfer what she had learned about growth mindset in math workshop to a test that she felt anxious about.

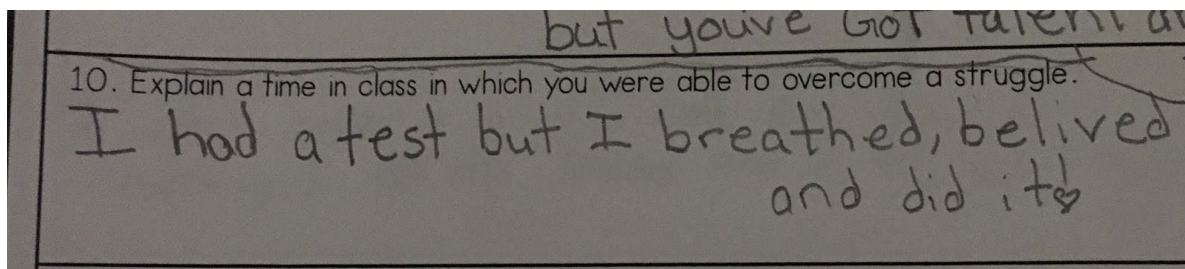


Figure 2. Final interview response on student growth mindset

Targeted Work Choice

After my focus group meeting in February, students mentioned that “sometimes in math workshop, I don’t know what to do even if I know what goal I want to work on.” From this, I modified how I laid out workshop choices for all students on the workshop slides and how I released my participants from small group. Based on my participants’ suggestions, I listed the workshop options under the corresponding learning goal instead of just listing the current learning goal at the bottom of the slide. Figures 3 and 4 show the workshop slides before and after switching, respectively, the workshop options layout.

Workshop

1. **Converting Measurements –pgs. 52A–52C**
2. **Area of Rectangles – pg. 67–68 (also find PERIMETER)**
3. **Finding the Area of Rectangles – pg. 74 (also find PERIMETER)**
4. **Any page in SAB up to page 74**

LB: I can convert units of measurements.

Figure 3. Beginning of the year workshop slide¹

5TH MATH WORKSHOP

Unit 4 Learning Goals:

I can convert units of measurement.

- Converting Measurements - pgs. 52A-52C

I can find the area and perimeter of rectangles.

- Area of Rectangles - pg. 67-68 (also find PERIMETER)
- Finding the Area of Rectangles - pg. 74 (also find PERIMETER)

I can identify and use points, lines, line segments, rays, angles, and perpendicular and parallel lines to classify two dimensional figures.

- Is It a Polygon? - pg. 16
- Find the Polygons - pg. 17
- 2D Geometry - pgs. 22A-22D
- **Guess My Rule**

Figure 4. Workshop slide after layout shift²

After the workshop slide switch, I was more intentional about how I released my students after our small group. Before they started work on their own, I would point out which goal we had worked on for that group and recommended a math page to match what we had been working on in our small group. Using what I learned from Rufo (2017), I offered them an optional homework page after the workshop that targeted our specific skill for the day and would review their work with them once they completed the page or had questions on the problems.

In my final individual interviews, I asked each student about their take on the switch of slides and the homework pages. Each of the students said they liked the change, making it easier for them to focus on the skill they had just practiced. Additionally, each student progressed toward goal mastery faster with the inclusion of targeted work.

¹ All workshop options for the day are displayed in order from newest to oldest. The current learning goal(s) is displayed at the bottom of the slide.

² Workshop options for the day are listed under the learning goals that they match. Any math games are written in pink font.

Implications for My Practice

Continued Development of Mathematics Workshop

Based on my findings, I will continue developing a mathematics workshop model that supports students towards goal mastery and sharing this model with my learning community teachers. Additionally, within this development, I plan to continue using the updated workshop slides to identify which activities match each learning goal. I also plan to continue to evolve my workshop small group work to better support each learner. I believe that opt-in, instead of assigned groups, will develop each child's self-perception of their math skill, which will increase their confidence in making workshop choices. Additionally, I would like to include even more differentiation in the targeted homework provided after the small groups.

Improve Lesson Follow Up for All Students

After reflecting on this inquiry, I plan to investigate how I follow up each lesson with my students, not just workshop lessons. I also plan to work with my students to create a support system that does not rely on me to support them completely.

Developing Self-Efficacy and Confidence in My Students

As an ongoing expansion of this inquiry, I plan to develop a lesson on self-efficacy and confidence that I can weave into my morning meeting classes, but also my workshop model. I want to push this further than teaching my students about growth mindset and work more towards evolving their confidence and self-efficacy in all aspects of their lives, not just mathematics. Furthermore, I want to eliminate stress and anxiety induced by math wherever and whenever possible.

New Questions

Many questions have come up for me throughout my inquiry journey. Could upper elementary students tutor each other during a revised math workshop if they were trained and coached? Based on what I learned in the literature review, how can I support families to work on math confidence in their student(s)? How does increased math confidence impact students outside of mathematics? How is math self-efficacy linked to what students choose to work on during math workshop? Ultimately, I would like to study how I can eliminate students' stress and anxiety created by mathematics. By investigating these questions, I can continue to support the development of math self-confidence in my young students.

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