Measuring Math Self-Efficacy Across Development: Do feelings have an affect on math learning? Anayra Andino University of Cincinnati

Abstract

The purpose of this study is to discuss the process of creating a math self-efficacy scale and discussing how the skills measured in the survey affect math fluency. This scale is intended for any younger students, however; it was administered to students in college for validity and reliability purposes. We looked at math due to the lack of research on mathematics and due to the decreasing amount of students who are at the proper math level for their age. Due to the lack of math skills, many students who enter college are forced to take remedial math classes before taking a regular college level math class. Based on these results, we will also discuss limitations to our study and further findings. Measuring Math Self-Efficacy Across Development: Do feelings have an affect on math learning?

Research on academics and students' progress in academics has been expanding from looking strictly at scores and performance to including soft skills such as self-efficacy, anxiety, mindset, and grit. The research on these skills is still limited, however; current research on these skills found a connection between soft skills and academics. To start, self- efficacy has been studied since the 1990s; Bandura was the main researcher to research self-efficacy. He defines self-efficacy as one's belief in one's ability to succeed in specific situations or accomplish a task (Hayden, 2014). Self-efficacy as a whole is an umbrella term and can be applied to many different things. For example, self-efficacy is often looked at in children or adults an emotions, which is called emotional self-efficacy regulation. This pertains to how healthy people can manage their emotions.

When looking at the relationship between self-efficacy and academics, specifically math, one is trying to measure how confident students are in their ability to perform various math-related tasks. These tasks may include learning new math concepts, taking a math test, doing math homework, and practicing math, etc. Researchers who have focused on math self-efficacy have focused primarily on scale development and how to measure math self-efficacy. Although this study did involved scale development, the main focus will be looking at math self-efficacy and if it relates to math anxiety, mindset, grit and math fact fluency. It will also included analyzing the four skills, math self-efficacy, math anxiety, mindset, and grit are related to math fact fluency. When looking at these skills researchers must first be able to define them.

Math anxiety is defined as the presence of feeling tension, apprehension, or fear, which interferes with math performance (Ashcraft, 2002). Math anxiety is seen typically when students

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are taking math tests or doing math homework. It can include trembling hands, nervous laughter, and avoiding math homework (Ashcraft, 2002). Studies researching math anxiety usually connect it to confidence, which is math self-efficacy. Many believe that math anxiety stems from the lack of confidence one has and students who are more confident tend to feel less anxious in math. According to Ashcraft (2002) students who exhibit higher math anxiety are exposed to less math than those who are not anxious about math. This is because those who do not have math anxiety do not avoid math, whereas students who do have math anxiety do avoid math. This lack of exposure to math can influence students' math fact fluency, which is the ability to recall the answers to basic math facts automatically, without hesitation. Fact fluency is gained through significant practice, with mastery of basic math facts being a goal of both teachers and parents. Math fact fluency is important in students' ability to succeed in more difficult math classes. Without basic math facts, students will continue to struggle throughout middle school, high school, and college.

When students struggle with math facts, they eventually fall behind in school and behind their peers, which can lead to lowered self-esteem, which can also lead to a decrease in effort. This effort is called grit. Grit is defined as perseverance and passion for long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007). Grit is similar to resilience; however, it focuses on not only the amount of effort a person puts in to a task, but how long that person stays interested in that task as well. Perseverance is usually measured as an outcome rather than a predictor; however, when measuring grit perseverance is measured as a predictor (Duckworth & Quinn, 2009). For example, when looking at the cadets at West Point, those who have grittier tend to stay in school and have a lower drop out rate than their peers who are less gritty (Duckworth & Quinn, 2009). This is because they put more effort in for a longer period of time. Grit is a trait that many people have but varies depending on the person. This is similar to mindset, in the fact that people differ in mindset as well. There are two types of mindset, fixed mindset and growth mindset. Fixed mindset is the belief that one's talents or qualities are at a consistent level and never changes (Dweck, 2008). According to Dweck, (2008) this creates a constant urgency in people who have this mindset, an urgency to prove oneself all of the time. Opposite of that is a growth mindset; this is the belief that one can grow the basic qualities one has. People with this mindset believe that change occurs through experience and motivation. Having this mindset allows people to push through challenging times and overcome them. (Dweck, 2008).

The purpose of this study is to see if the measure created measuring math-self efficacy, math anxiety, grit, and mindset is valid and to see if these softer skills are related to each other. We are also hoping to see if any of these softer skills are correlated with math fluency.

Method

Participants

College students at the University of Cincinnati were our sample. These students attend UC Blue Ash and are all taking a remedial math class. There were 51 participants, 31 female and 20 male. These students were primarily between the ages of 18 and 19, with the exception of a few outliers being 50-51. Participants were college students because they were easier for researchers to access and were the best sample to validate the measurement.

Procedure

Researchers created a survey, splitting the survey up into different sections. Each section measured a different skills, one being math self-efficacy, the other three math anxiety, grit, and

mindset, respectively. Each section had a series of statements for students to rate based on time

occurrence. A sample of the questions below:

Table 1

	Rarely	Some- times	Often
17. When I don't understand a math problem, I skip it.			
18. When I do poorly in math, I know I can do better next			
time.			
19. I can get good grades in math.			
20. I know I can learn math.			
21. I am good at math.			
22. Math is easy for me.			
23. When I don't understand a math problem, I ask for			
help.			
24. I can do my math practice on my own.			
25. When I get a math problem wrong, I give up.			
26. I do poorly on math tests.			
27. I like doing a challenging math problem.			
28. When math gets hard, I get mad at my math teacher.			

Questions were created based off of previous literature pertaining to these skills. Once the survey was created, researchers created a survey packet including consent forms, the T10's, which measured math fluency, and the survey. Then two researchers went to Blue Ash campus on two separate days to gather data.

On day 1 researchers went into 4 different remedial math classes, explained what the study was and went through the survey packet with students. This was to ensure students were going through the packet at the same pace to respect class time. The students would first sign the cover page, and then take the T10. The T10's is a 3 minute timed test that has 120 simple math facts, including addition, subtraction, multiplication and division. Students begin the test at the same time and have 3 minutes to answer as many questions as possible within that time frame. Once students finish the T10, they move on to the consent form and then the survey. Students

had an unlimited time to get through those to parts of the packet. On day 2 researchers went to 3 more remedial math classes, taught by the same teachers, but including different students and went through the same process. Once data was collected, data was imputed into an excel sheet and then scored. Once data was scored, a series of correlations were ran.

Results

We found that there is a weak correlation between math self-efficacy and math anxiety, the correlation was r = .039, p < .05. (See appendix a for graph) There was also a week correlation between self-efficacy and grit, r = .18, p < .05. Data also shows a small relationship between math self-efficacy and growth mindset, r = .20, p < .05 and also fixed mindset, r = .04, p < .05. When looking at math self-efficacy, math anxiety, grit, and mindset compared to the T10 there were small correlations between all soft skills and the T10s, r = .004, r = -.04, r = -.08, r = .05, respectively.

When looking at the survey and the validity of the survey, correlations were ran between items in each section. Item analysis shows that in the math self-efficacy section question 10 did not correlate strongly with any of the other questions, suggesting that question 10 did not measure math self-efficacy. In the anxiety section all questions strongly correlated suggesting that they measure the same thing. All questions except for question 2 in the grit section had a strong correlation. When correlating the mindset questions, questions 2, 4 & 5 strongly correlated and questions 1, 3, & 6 strongly correlated.

Discussion

Looking at the results, my hypothesis was proven wrong. Math self-efficacy did not strong correlate with the other skills implying that math self-efficacy is not as closely related to other skills such as anxiety, grit, and mindset as much I thought it would. This is surprising

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because one would think that if one feels more confident in a certain area then they would feel less fearful or nervous in that same area. Results also show that these skills do not predict math fluency. This is also a surprising conclusion because one would think that one of these soft skills would have an impact of students knowing their simple math facts. Although there were weak correlations, it still shows there is some sort of relationship between these skills and it gives researchers more information for future research. Researchers who may study these skills in the future can focus on how these skills affect student's academics more in depth. For example, a pre post test measuring math self-efficacy can be done during a math intervention program to see if confidence does have an affect on math learning or not. Researchers can also look at how these skills may influence students in different academic topics, like reading versus math or language versus art, etc. Scale development and measuring these skills is important when it comes to research, but there needs to be more research on the skills as a whole and how they are seen in students and if they can be changed due to student perceptions. Research should also focus on if this looks different in students depending on their background and if it is more beneficial to focus on these skills depending on their backgrounds.

Limitations

Throughout this study there were many limitations. One being the lack of diversity in our participants; the participants were only college students. Students of all different ages may have given us different results, especially when looking at the skills and math fluency. Another limitation to this study was this being the first run through of the survey. These questions were not administered to another group; this was the first group to take the created survey. Lastly, since questions were created for this study, questions may not be measuring what they are

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intended to measure and survey questions may have been better if already created surveys were used.



Appendix A

Figure 1. Survey scores of math self-efficacy question and math anxiety questions for each individual. There is a weak correlation between math self-efficacy and anxiety (r = .39)



Figure 2. Survey scores of math self-efficacy questions and grit questions for each individual. There is a weak correlation between math self-efficacy and anxiety (r = .18)







Figure 4. The positive scored mindset questions measured growth mindset. This is the correlation between the growth mindset questions and math self-efficacy. As one can see the correlation is a stronger between this mindset and math self-efficacy than between fixed mindset and math self-efficacy, r = .20.



Figure 5. The T10's were scored by how many questions were answered correctly. This is the correlation between how many questions were answered correctly and the math self-efficacy scores. (r = .004)



Figure 6. Math anxiety scores and the T10 scores correlated to each other. There is a stronger correlation between these two, but not much more than math self- efficacy. (r = -.04)



Figure 7. Grit scores and the T10 scores correlated to each other. There is a smaller correlation between these two, compared to math anxiety and the T10's but not by a big amount. (r = -.08)



Figure 8. Mindset scores are combined between the fixed and growth scores. Mindset scores are correlated to T10 scores. (r = .05)

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