**Exploring Math Anxiety in Community Colleges**

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**Abstract**

Math anxiety is a global phenomenon, making it an imperative research topic. This project focuses specifically on the impact of community colleges on students’ levels of math anxiety, and the effect that it has on both students’ success rates and their chosen majors. Community colleges provide a diverse population that has not been extensively investigated. To complete this project, I will conduct a longitudinal study over the course of two years at five community colleges spread out across Los Angeles to measure the levels of math anxiety in community college students. I will measure the initial levels of math anxiety through self-report questionnaires, and I will conduct surveys that consider factors that impact math anxiety. At the end of the study, I will conduct surveys assessing the student’s chosen major and whether they transferred to a four-year institution. I will also measure the students’ levels of math anxiety at this stage to determine whether any changes have occurred. Once I have collected this data, I plan on discussing the impact of math anxiety on community college students and proposing ways to mitigate any negative effects in order to increase the number of students pursuing STEM-related majors.

1. **Introduction**

Students often choose math as their least favorite subject, and many view it in a negative light. Although math is used in everyday life, people fear it because they falsely believe that they are not “math people,” a problem the education system exacerbates (Sparks, 2020). In many schools, higher math is only offered to those who excel in it, strengthening the belief that math is an innate skill (Sparks, 2020). This preconception causes many to fear math, and this fear can manifest itself in physical ways; the mere anticipation of doing math causes pain-related neural activity (Lyons and Beilock, 2012). The overall negative reaction towards math refers to a phenomenon known as math anxiety and about 50% of the U.S. population experiences it (Ashcraft and Ridley, 2005; Crothers, 2015).

Math anxiety is unique because it is different than test anxiety, and other subjects do not elicit the same type of response (Klass, 2017). This singularity poses real questions, namely why this type of response is isolated to mathematics, how this came to be, and how to treat it. STEM jobs are increasing at a faster rate than other careers, making it imperative to foster a positive relationship with mathematics in order to bolster the United States’ presence in the global economy (Beilock, 2019). Community colleges prepare students for the workforce and provide a diverse population, yet have not been extensively studied (Ramirez, Shaw, and Maloney, 2018). A recent meta-analysis found that community college students had higher levels of math anxiety than students at four-year universities, but it did not disclose whether this anxiety stemmed from the community colleges themselves or from external factors, nor did it discuss the long-term impact on students (Sprute and Beilock, 2016). This disparity led me to the following question: How do community colleges impact their students’ levels of math anxiety, and how does this impact their decision to pursue math-related fields at a 4-year college or university?

1. **Background/Related Work and Motivation**

Math anxiety is not a new phenomenon, but it continues to be the subject of academic research because of its persistence. A diverse population is important when studying math anxiety because of the external factors that impact it. Women are more likely to have higher math anxiety than men, and are more susceptible to their teacher’s math anxiety; female teachers who had high math anxiety directly impacted the math achievement of their female students, which is linked to math anxiety, while male students were largely unaffected (Beilock, Gunderson, Ramirez, and Levine, 2010). A parent’s math anxiety can also impact that of their child, but only when they actively help with homework (Maloney, Ramirez, Gunderson, Levine, and Beilock, 2015). The way math is presented to the student, therefore, has a large impact on their overall math anxiety.

Community colleges provide an ideal population to study because they offer more developmental math courses than a traditional four-year institution, and students who attend community colleges have a greater variability in overall math skill (Ramirez, Shaw, and Maloney, 2018). These students are more likely to believe they are “bad” at math because test scores placed them in developmental or remedial courses, and this mindset can lead to a fear of math (Crothers, 2015). Community college students also have more diversity in race, age, economic status, etc., with higher percentages of minorities and students from lower socio-economic backgrounds (Palmer, Wood, and Wang, 2016; Provasnik and Planty, 2008). Students in community colleges come from different high schools and backgrounds; their diversity will allow me to understand whether certain external factors determine their level of math anxiety, or whether the curriculum at community colleges has a substantial impact.

As a math major, I have experienced firsthand the fear surrounding this subject. Math anxiety can impact what people choose to study and pursue a career in because math-anxious individuals often avoid fields involving math (Hembree, 1990). This trepidation towards math, and the consequent avoidance, interests me because I want to know how this impacts the participation in mathematics, and the overall participation in STEM. I propose looking at community college students to understand their impact on student’s math anxiety and the overarching consequences on STEM participation because they provide a diverse population and have not been extensively studied.

1. **Methods**

I will conduct a longitudinal study over the course of the next two years at five different community colleges in Los Angeles—Glendale College, Los Angeles City College, Compton College, Citrus College, and Long Beach City College—to measure the levels of math anxiety in the current students. These colleges span the Los Angeles area, allowing me to understand the impact on different communities and demographics. Conducting a longitudinal study allows me to measure the students’ initial levels of math anxiety when they enter community college, along with the same students’ academic trajectory. I will use self-report questionnaires to measure math anxiety, since this is the most common method used (Ramirez, Shaw, and Maloney, 2018).

Surveys will be administered asking participants to specify how much their parents helped them with homework as a child, their gender, and their age, as these are factors that have been linked to math anxiety (Beilock, Gunderson, Ramirez, and Levine, 2010; Jameson and Fusco, 2014; Maloney, Ramirez, Gunderson, Levine, and Beilock, 2015). I want to ensure that these external factors are accounted for when assessing math anxiety in order to determine whether the levels of math anxiety are primarily linked to these factors, or if they correlate to the community college curriculum specifically.

Finally, I will conduct surveys documenting whether or not the students transfer to a four-year university or college and their subsequent major. These will be administered at the end of the two-year study to determine whether or not students with high math anxiety generally avoided STEM-related fields. Math anxiety will also be re-measured, using the same questionnaires as before, to identify any changes in the levels of math anxiety throughout the students’ time at the community college. Because this project involves human subject research, I will submit it to the Institutional Review Board before administering any questionnaires or surveys.

The data collected from the questionnaires and surveys conducted at the beginning and end of the study will indicate how many community college students have math anxiety, and the external factors impacting it. The results from the survey assessing the impact of potential external factors will reveal whether the community colleges themselves have a large impact on their students’ levels of math anxiety, or whether it is mainly linked to these external factors. The data on the major and transfer rate of each student will illustrate whether or not high levels of math anxiety lead to an avoidance of math-related fields, and the effect on the student’s overall decision to transfer to a four-year institution. Once I have analyzed this data, I will speak with the heads of the community colleges and propose ways to mitigate math anxiety among their students, such as teaching math as a learning subject rather than a performance subject, in order to inspire greater involvement in mathematics and STEM-related majors (Boaler, 2017).

1. **Expected Results**

From this research, I will create a paper outlining the data found and any correlations between them. This paper will include possible ways to mitigate math anxiety at the community college level in order to promote participation in math-related fields, including pedagogical techniques that can be implemented across colleges. I expect the student’s level of math anxiety to increase from the beginning to the end of the two-year study, emphasizing the need to adapt new teaching techniques within community colleges. I also expect to find a correlation with math anxiety and one’s chosen major, specifically that those with higher levels of math anxiety will avoid taking majors with heavy implementations of math.

1. **Conclusions**

The mere mention of math causes fear for many. Math, however, is integral to our society, making it imperative to develop ways to decrease math anxiety. I propose looking at community college students because they represent a more diverse group than students at traditional four-year institutions and prepare students to enter the workforce. These specificities are important because they will allow me to understand the impact of community colleges on their students’ math anxiety, rather than extraneous external factors, and math anxiety’s impact on overall STEM participation.

Through this research, I hope to gain insight into the effect of community colleges on their students’ levels of math anxiety, and whether this effect alters a student’s decision to pursue a math-related field. The results achieved will allow us to understand the main reasons for lower STEM participation than other fields, while also providing a means to increase it. If a student’s major choice can be linked to math anxiety, we can focus on developing techniques that directly address math anxiety, both at the community college level and at lower levels of education, in order to mitigate math anxiety in the next generation and encourage greater participation in mathematics.

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**Budget**

Since this is a longitudinal study, I expect this to take two years. However, I will not be actively collecting data the entire time, so the main costs will be associated with the initial and final surveys conducted. The overarching timeline is as follows:

* Timeline

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| **Function** | **Time Allotted** |
| This project involves human subjects, so the Institutional Review Board (IRB) needs to review my surveys before they are administered | 4 weeks |
| Coordinate surveys with the administration and staff at each community college | 2 weeks (1 week per year) |
| Administer questionnaires and surveys at each college | 2 weeks (1 week per year) |
| Analyze data and write the paper | 2 weeks (1 week per year) |
| Connect with heads of the community colleges, discuss results, and provide feedback on how to mitigate math anxiety among their students and encourage greater STEM participation | 1 week |

**Total**: 11 weeks

* Costs

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| --- | --- | --- |
| **Function** | **Function Specifics** | **Total Cost** |
| Gas  (based off of my car, which gets about 23 miles per gallon, and the average price of gas in LA based off of recent prices, which is about $3 per gallon) | I will drive to 5 different community colleges:   * Compton College (20.1 miles) * Glendale College (30.4 miles) * Citrus College (44 miles) * Los Angeles City College (21.5 miles) * Long Beach City College (26 miles)   Each round trip is 284 miles, and I will need two total round trips (one at the beginning and one at the end of the study). | $74  ($37 per trip) |
| Participant Compensation | I want to have 100 participants from each college, for a total of 500 participants, and each one will receive a $5 gift card for each of the 3 surveys/questionnaires completed. | $7,500  ($15 per participant) |
| Personal Income ($13/hr, based off of the current minimum wage in LA) | I plan to go to one college per day, yielding 10 total days at each college throughout the study.   * I will work 5 hours per day * Total: $650   I will also spend 2 weeks (14 days) analyzing data and writing the paper (1 week per year).   * I will work 2 hours per day * Total: $364   I will spend 5 days meeting with the administration at the community colleges to discuss my findings and suggest ways to decrease math anxiety.   * 1 college per day * I will work 5 hours each day * Total: $325 | $1,339 |

**Total:** $8,913.