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Dealing with Mathematics Anxiety in this Time of COVID-19: A Mixed-Methods Study

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Abstract. *Mathematics anxiety is a problem that continues to plague students. As the pandemic forced education to the online platform, how would students deal with their anxiety? This paper explored the Mathematics anxiety levels of 112 randomly sampled Grade 11 students, the reasons for their anxiety, how the COVID-19 pandemic affected their anxiety, and their coping mechanisms. This mixed-methods study employed the explanatory sequential design to answer the problems presented in this paper. Quantitative data were analyzed through Weighted Mean, Pearson Product Moment Correlation, and Chi-Square Test of Independence, while qualitative data were analyzed thematically and narratively. It was found that students had an overall neutral response towards having Mathematics anxiety and that it had no significant relationship with age and sex. The following were identified as reasons for their anxiety: differences in discussions and activities, fear of failure, numbers and variables, comprehension, teacher's expressions, and short discussion time frame. The students acknowledged that the pandemic had positive, negative, and no effects on their anxiety. As for coping mechanisms, the students turned to calming down, organizing, having a good support system, studying, and passive acceptance. Regardless of the coping mechanisms employed, students should make use of mechanisms that enable them to do better in Mathematics. Parents, teachers, and schools have important roles in helping students manage their anxieties. Further studies on the effectiveness of coping mechanisms ought to be undertaken.*

Keywords: *Anxiety, Mathematics anxiety, Mathematics education, online learning, Mathematics online learning*

I. INTRODUCTION

Mathematics is an indispensable discipline in life. Hence, one needs to possess adequate mathematical skills. Despite this reality, not all can grasp its essence due to its complicated and challenging nature (Skagerlund et al., 2019). Making matters worse, many feel stressed and anxious when they have to deal with the said discipline (Kiss & Vukovic, 2017). One can also feel physically and emotionally uncomfortable when presented with numbers or when given mathematical tasks (Dowker, 2016; Reyes, 2019; Brewster & Miller, 2020). These negative experiences lead to low academic performance in Mathematics and even failure (Casinillo, 2019). People with such experiences may be experiencing Mathematics anxiety (Sokolowski & Ansari, 2017).

Mathematics anxiety or MA has negative impacts on individuals and is rooted in the fear of meeting Mathematics in the form of classes, homework, tests, and day-to-day life (Khasawneh et al., 2021; Mendoza et al., 2021; Lanius et al., 2022). MA has been a common problem in K-12 and university education (Rozgonjuk et al., 2020; Khasawneh et al., 2021). Large percentages of students with MA have also been reported (Dowker et al., 2016;

Brewster & Miller, 2020) and the Philippines also has its own shares of cases of students with MA (Segumpan & Tan, 2018; Reyes, 2019; Salimaco, 2020). Having MA meant that students would be hostile to learning the discipline and that they would eventually tend to take fewer mathematical courses and would show fewer intention of taking more college mathematical courses, limiting their career options (Buckley et al., 2016; Puteh & Khalin, 2016; Foley et al., 2017; Lanius et al., 2022). Thus, any sign of MA must be accounted for because they will affect students' learning and would threaten careers in fields requiring mathematical competence (Brewster & Miller, 2020; Lau et al., 2021; Lailiyah et al., 2021).

MA has affected and continues to affect multiple countries, sectors, and disciplines (Khasawneh et al., 2021) and the COVID-19 pandemic has become a catalyst that had severely affected the Philippines (Caldwell et al., 2021). The COVID-19 pandemic led to a sudden shutdown of schools in 2020, affecting more than 1.6 billion students worldwide (Spitzer & Musslick, 2021). Teachers, professors, educational managers, and schools, were eventually pressured to develop Mathematics education online (Borba, 2021; Soysal et al., 2022).

Despite the efforts, the transition to online learning was met with an increase in the number of students who had experienced MA worldwide, making it higher than it already was (Lailiyah et al., 2021; Lanius et al., 2022). Many continue to be affected by anxiety as this pandemic has made it more difficult to redirect stress (Marpa, 2021; Soysal et al., 2022). Fortunately, there are certain strategies that can help prevent MA from occurring (Rozgonjuk et al., 2020; Khasawneh et al., 2021; Lailiyah et al., 2021). While there is no one-size-fits-all cure for MA, many anxiety reduction approaches require the mathematically anxious student to take some initiative in their learning process (Lanius et al., 2022). This is feasible since there are students who have MA but can still manage their fears and can perform well enough in class for them to pass their subjects (Nipaz et al., 2016). Similar to various forms of anxiety, recognizing the symptoms and developing coping strategies can help control anxiety (Lanius et al., 2022).

The University of the Cordilleras in Baguio City, Philippines is one of these institutions that have adapted to the academic demands caused by this pandemic. In particular, the said university invested on a learning management system or LMS called Canvas where relevant materials and assignments, quizzes and examinations, and relevant videos are given, taken, and shown respectively. Coupled with the said LMS, lectures are administered via Zoom and Google Meet. It is likely that students of the said institution also have their own experiences of MA in this time of the COVID-19 pandemic. Thus, research on MA during this pandemic is needed to determine students' readiness during this new normal time (Lailiyah et al., 2021). It is high time that students step up in dealing with their MA, especially now that they have been separated from their peers and teachers. As research confirmed an increase in MA during this pandemic, several questions remain unanswered (Soysal et al., 2022). One of these questions is on the specific coping mechanisms students employ in overcoming their MA. This current study looked into that.

This study is significant in ensuring and upholding the quality of Mathematics education in this time of COVID-19 since it will serve as an aid for teachers, parents, and schools to help students and for students to help themselves in dealing with their MA. This study sought to answer the following questions:

(1) What is the overall mean of students' responses across all items in the questionnaire?
(2) What is the relationship between age and MA level?
(3) What is the relationship between sex and MA level?
(4) Why did students choose their academic strands given their high exposure to Mathematics?
(5) What are students' reasons for MA?
(6) What are the manifestations of students' MA?

(7) How did the COVID-19 pandemic affect students' MA?
(8) How do students cope with their MA?
(9) Do students find their coping mechanisms effective in becoming better in Mathematics?

The following hypotheses were also made:
(1)There is no significant relationship between age and MA level.
(2)There is no significant relationship between sex and MA level.

II. RELATED LITERATURE

Informally called "Mathemaphobia", mathematics anxiety or MA is a feeling of tension, apprehension, and stress that interferes with mathematical abilities, the manipulation of numbers, and the solving of mathematical problems in academics and life (Salimaco, 2020; Khasawneh et al., 2021). According to Casinillo et al. (2020), one who has high stress levels is less likely to enjoy the learning process. MA causes individuals to have little confidence in their abilities to undertake mathematical problems (Lanius et al., 2022). MA causes a decline in academic performance and achievement, regardless of one's mathematical competence (Foley et al., Lanius et al., 2022). All of these meant that the higher the level of MA, the lower the level of Mathematics achievement and performance (Guita & Tan, 2018; Lailiyah et al., 2021). Although it often occurs in students, MA can affect people of any age (Lailiyah et al., 2021; Soysal et al., 2022). This strengthens the implication that MA can and will plague career lives.

According to Brewster & Miller (2020), MA has been studied since the mid-1950s when it was called number anxiety. However, it was not until the 1970s that a scale was developed to measure MA. They cited Tobias (1978), who defined MA as the panic, helplessness, paralysis, and mental disorganization that arises in some people when they are obliged to solve mathematical problems. Tobias continued to play a crucial role in MA in the 1990s as she focused on understanding why female college students, who stopped pursuing Mathematics courses, held strong beliefs in the assumption that females are not capable of performing higher level Mathematics. They added that the work of Ashcraft and Faust (1994) led MA studies in a new direction with their research findings demonstrating differential mathematical processing due to MA. Starting in the 2000s up to the present, research focused on how MA can negatively affect an individual's academic performance and career opportunities (Puteh & Khalin, 2016; Zhang et al., 2019; Brewster & Miller, 2020; Velazco et al., 2021; Mamolo, 2022).

Several factors cause MA: the individual, the interpersonal, and the environmental factors (Brewster & Miller, 2020; Lailiyah et al., 2021; Lau et al., 2021). Examples of individual factors include genetics, working memory capacity, attentional bias, affective, physiological responses, one's unpleasant experiences in Mathematics, and problems they may have experienced in learning Mathematics in the past (Lailiyah et al., 2021; Lau et al., 2021). In terms of interpersonal factors, this includes societal beliefs, cultural influences, gender issues, parental support, expectations, and attitudes toward Mathematics, and teachers' own MA, self-efficacy, and expectations of students (Soni & Kumari, 2017; Brewster & Miller, 2020; Lailiyah et al., 2021; Lau et al., 2021). As for environmental factors, this includes Mathematics activities at home, classroom atmosphere, and cultural background (Lau et al., 2021).

Along with these factors, it is evident that culture affects the level of MA in society (Brewster & Miller, 2020; Lanius et al., 2022). Brewster and Miller cited the example of students in Asian countries that had high MA but still managed to perform well in Mathematics. They added that the high value placed on academic achievement in Asian

cultures may be responsible for this finding. This showed the complex effect of culture on MA and performance and shed light on the social dimension of MA.

Brewster and Miller (2020) added another cluster of factors that caused MA – the missed opportunity factors. This includes the fact that students probably have little to no Mathematics knowledge resulting in MA. Missed opportunity would also account for individuals who do well in other academic areas but struggle with Mathematics due to MA. These students have not had an opportunity to learn the foundations of Mathematics that are required in learning higher levels of Mathematics. This could also pertain to a lack of learning experience due to poor Mathematics teaching and understanding and class absences.

According to Lailiyah et al. (2021), MA has several aspects – the physiological, the affective, the cognitive, and the behavioral. The physiological aspect takes the form of over sweating, trembling hands and lips, stomachaches, headaches, and increased heart rates, while the affective aspect takes the form of nervousness, frights, tensions, and anxieties. The cognitive aspect takes the form of difficulties in concentration, decision-making, and sleeping, while the behavioral aspect takes the form of purposeful attempts to avoid Mathematics classes, walking up and down, and snapping fingers.

Teachers also need to be concerned about the effects of MA on the Mathematics achievement of students (Puteh & Khalin, 2016). As a matter of fact, teachers have an important role in recognizing, reducing, preventing, and raising awareness on students' MA, guarding them against negative classroom environments, and helping them build confidence (Nipaz et al., 2016; Suárez-Pellicioni et al., 2016; Lanius et al., 2022). A cluster of factors that affect students' Mathematics achievement is teacher-related since some problems that students encountered in learning Mathematics have been attributed to their strategies (Tularam & Machisella, 2018; Salimaco, 2020). Hence, teachers need to foster positive learning experiences for students for them to develop positive attitudes toward Mathematics. These positive learning experiences would engage students more with mathematical lessons and activities Casinillo et al., 2020). Teachers must support students by making them feel comfortable and by encouraging them to ask for help when they need it (Lanius et al., 2022). Mathematics teachers need to know the characteristics of students who experience MA (Lailiyah et al., 2021). After all, when students experience their Mathematics teachers' support, they become less anxious and more confident in their abilities (Segumpan & Tan, 2018). When it comes to students' learning, applying a more active approach may reduce MA (Rozgonjuk et al., 2020). According to Ruzek and Schenke (2019) and Casinillo et al. (2020), cooperative and interactive learning strategies would help promote higher-order thinking for both students and teachers. Casinillo et al. (2020) added that Mathematics should be taught with effective strategies that will make students interact with the teachers. Utilizing various teaching strategies and approaches can address different learning styles and developmental stages of students and can enhance meaningful learning of mathematical concepts (Casinillo & Guarte, 2018; Casinillo et al., 2020). When schools were forced to shift online, teachers were vigilant to quickly adapting their teaching methods (Midcalf & Boatwright, 2020). This showed that teachers still aspired to yield meaningful learning experiences, even in the online setting (Cortez, 2020). However, even if teachers do all they can to help their students, there will still be students who will have a hard time with Mathematics (Cerbito, 2020).

This could be because online learning had altered the learning environment most students were accustomed to which meant that they were not satisfied with it (Serhan, 2020; Soysal et al., 2022). Online learning made students less motivated from watching lectures synchronously (Soysal et al., 2022). Communication, or the lack thereof, also played a significant role in how much a student's MA changed during the transition to online learning (Lanius et al., 2022). The pandemic made students feel isolated since they were used to the collaborative approach used in Mathematics classes (Soysal et al., 2022). The dependence on

teachers had also made students afraid of doing tasks on their own since they believed that the sole source of learning is the teacher (Segumpan & Tan, 2018). This also implies that teachers are effective channels for students to divert their MA. After all, students' development of motivation, self-efficacy, and confidence depends on their teachers' capacity to help their students in learning Mathematics (Voica et al., 2020).

It is therefore true that MA has become an important topic to study (Lailiyah, 2021). Hence, the need for studies on coping strategies is deemed necessary. Although Skaalvik (2018) had a glimpse of coping strategies for MA, this had been undertaken before the pandemic. The need for research on MA during this time of pandemic is imperative because everything may become outdated due to a lack of capabilities of predicting the evolution of the COVID-19 crisis or whether a new crisis will follow it (Borba, 2021).

III. METHODOLOGY

Research Design

A mixed-methods design was used to answer all the problems targeted in this study. In particular, the explanatory sequential design was used since quantitative data were obtained first and were supplemented by qualitative data (Creswell & Plano Clark, 2018).

Data Gathering

Two instruments were used for data collection. The first was a questionnaire, adopted from Carter et al. (2013), which consisted of 10 items on a 5-point Likert scale that tasked the respondents to express their agreement or disagreement with the said items. The response ranged from Strongly Disagree (1) to Strongly Agree (5). The questionnaire's validity was tested using Cronbach's alpha which resulted in a coefficient of 0.83. This meant that the questionnaire has high validity. The questionnaire was circulated to respondents through Google Forms.

The second instrument was a structured interview that followed up on the responses to the questionnaire of the 5 students with the highest MA levels. The said interview consisted of questions validated by the research committee who had checked the relevance and appropriateness of each question. The structured interviews were administered through Facebook Messenger.

Selection of Respondents

This mixed-methods study involved 112 randomly sampled Grade 11 Accountancy, Business, and Management (ABM) and Science, Technology, Engineering, and Mathematics (STEM) students from the University of the Cordilleras in Baguio City, Philippines. The said academic strands were targeted due to their curricula's high exposure to Mathematics. Once data were gathered through a questionnaire, the 5 respondents with the highest MA levels were selected for interviews. These 5 were chosen since they all belonged to the highest level defined in Table 2.

Data Analysis

As data from the questionnaire were obtained, it was vital to obtain the weighted mean for each of the 10 items in the questionnaire and the overall mean to determine their corresponding responses. Table 1 presents the 5-point interval scale that was used to categorize and interpret the mean across each item.

Table 1
Interpretation of Mean Responses for Each Item

Descriptor	Numerical Weight	Statistical Range
Strongly Disagree	1	1.00 – 1.80
Disagree	2	1.81 – 2.60
Neutral	3	2.61 – 3.40
Agree	4	3.41 – 4.20
Strongly Agree	5	4.21 – 5.00

Each student's responses were summed separately to determine their respective total scores and corresponding MA levels based on Table 2. These scores were then correlated to age and sex separately. These scores later on determined those who were to be scheduled for the structured interviews.

Table 2
Interpretation of Students' Total Scores

Mathematics Anxiety Level	Score Interval
Wow! Loose as a goose!	10 – 19
On the fence!	20 – 29
No doubt! You are still fearful about Math!	30 – 39
Sure thing, you have Math anxiety.	40 – 50

The Pearson Product Moment Correlation was used to determine the relationship between age and MA level since both variables corresponded to numerical data.

The Chi-Square Test of Independence was used to determine the relationship between sex and MA level since both variables fall in different categories. Sex is the nominal variable while MA level is the categorical variable.

The students whose scores fell on the highest level of MA were chosen for the structured interviews. Responses from the structured interviews were analyzed both thematically and narratively to answer the rest of the problems presented earlier. Themes were drawn from their responses as they were narrated.

IV. RESULTS

Mean Responses for All Items in the Questionnaire

Table 3 shows the students' mean responses across all items in the questionnaire and the overall mean response with their corresponding interpretations. It could be seen that students had a neutral response to items 2, 3, 4, 6, 7, 9, and 10, had disagreed with items 1 and 8, and had agreed with item 5. Overall, students had a neutral response towards having MA.

Table 3
Mean Responses for Questionnaire Items

Items	Weighted Mean	Descriptive Equivalent
I cringe when I have to go to Math class.	2.29	Disagree
I am uneasy about going to the board in Math class or having to solve problems publicly online.	3.33	Neutral
I am afraid to ask questions in Math	2.98	Neutral

class.		
I am always worried about being called in Math class.	3.37	Neutral
I understand now, but I worry that it's going to get difficult really soon.	3.79	Agree
I tend to zone out in Math class.	2.86	Neutral
I fear Math tests more than any other kind.	2.94	Neutral
I don't know how to study for Math tests.	2.59	Disagree
It's clear to me in Math class, but when I go home or leave online class, it's like I was never there.	3.13	Neutral
I am afraid I won't be able to keep up with the rest of the class.	3.37	Neutral
General Weighted Mean	**3.07**	**Neutral**

4.2 Relationship Between Age and Mathematics Anxiety Level

Table 4 shows the values obtained from the Pearson Correlation Coefficient calculations. It was found that $r(110) = .12$, $p = .202$. The result was not significant since $p > .05$. Hence, there is no significant relationship between age and MA level.

Table 4
Relationship Between Age and Mathematics Anxiety Level

	r	*N*	*df*	*p*
Pearson Correlation	.12	112	110	.202

4.3 Relationship Between Sex and Mathematics Anxiety Level

Table 5 shows the values obtained from the Chi-Square Test of Independence calculations. It was found that $\chi^2(3, N = 112) = 1.45$, $p = .694$. This meant that the result was not significant as $p > .05$. Furthermore, the results implied that sex had nothing to do with one's MA level. Hence, there is no significant relationship between sex and MA level.

Table 5
Relationship Between Sex and Mathematics Anxiety Level

	χ^2	*N*	*df*	*p*
Chi-Square Test	1.45	112	3	.694

Table 6 shows the number of students according to their MA levels. It could be seen that 9 students scored within 10 – 19 points, 48 students scored within 20 – 29 points, 50 students scored within 30 – 39 points, and 5 students scored within 40 – 50 points. These 5 students were chosen for the structured interviews since they fell on the highest level of MA.

Table 6
Number of Students According to Mathematics Anxiety Level

Mathematics Anxiety Level	Number of Students
Wow! Loose as a goose!	9
On the fence!	48
No doubt! You are still fearful about Math!	50
Sure thing, you have Math anxiety.	5
Total Number of Students	**112**

4.4 Students' Reasons for Choosing Their Respective Academic Strands

Students were asked why they chose their respective academic strands despite their high exposure to Mathematics. Their responses all pointed to the same reason – *Career Opportunity*. The students narrated:

> *"I chose my academic strand because I dream to be a doctor."* [Student A]
>
> *"I plan on taking up Nursing in college."* [Student B]
>
> *"I heard that it will be easier to choose a course in college if I am in it. I want to take up Aviation."* [Student C]
>
> *"I only chose my academic strand because of the course I am getting when I enter college. I want to take up Medicine."* [Student D]
>
> *"I chose my academic strand to be eligible in getting an Engineering course."* [Student E]

4.5 Students' Reasons for Mathematics Anxiety

The students specified the following reasons: differences in lectures and tasks, fear of failure, numbers and variables, comprehension, teacher's expressions, and short discussion time frame. Their responses were as follows:

4.5.1 Differences in Lectures and Tasks

> *"I get anxious about Mathematics when the written works and performance tasks' equations are different from those discussed by the teacher. Given these situations, students experience difficulties in applying the lessons taught to them which make them even more anxious to answer these tasks.*" [Student A]

4.5.2 Fear of Failure

> *"Most of the time, I am scared of the possibility that my answers are incorrect."* [Student C]

4.5.3 Numbers and Variables

> *"I do not exactly know why, but when I see those unfamiliar numbers and letters, they make me anxious because I cannot process them."* [Student D]

4.5.4 Comprehension

> *"I usually do not understand the lesson."* [Student D]

"I get anxious because of my level of comprehension." [Student E]

4.5.5 Teacher's Expressions

"I am sometimes afraid of the teacher's expressions." [Student C]

4.5.6 Short Discussion Time Frame

"What makes me anxious about Mathematics is having difficult lessons with short time discussions." [Student B]

4.6 Students' Manifestations of Mathematics Anxiety

The students specified the following manifestations of their MA: sweatiness, stomach discomfort, blanking out, distractedness, nervousness, lack of confidence, overthinking, and shame. Their responses were as follows:

4.6.1 Sweatiness

"Sweat is dripping from the palms of my hands, my forehead, and the soles of my feet." [Student C]

"[I get] sweaty palms." [Student E]

4.6.2 Stomach Discomfort

"[I] get sick in the stomach." [Student D]

4.6.3 Blanking Out

"I blank out." [Students A and D]

4.6.4 Distractedness

"I get distracted with the slightest disturbance." [Student B]

4.6.5 Nervousness

"I get extremely nervous." [Student C]

"These (Mathematics tasks) make me feel nervous..." [Student D]

"I get cold feet." [Student E]

4.6.6 Lack of Confidence

"What mostly comes to my mind is that I cannot do nor answer them (Mathematics tasks)." [Student D]

"I get cold feet." [Student E]

4.6.7 Overthinking

"It (Mathematics tasks) makes me overthink as I end up feeling that all my answers are wrong." [Student B]

4.6.8 Shame

"These (Mathematics tasks) make me feel bad about myself because my classmates can understand the lesson, while I cannot." [Student D]

4.7 Students' Mathematics Anxiety and the COVID-19 Pandemic

The students identified that the COVID-19 pandemic led to separation from teachers, classmates, and peers, a better environment for learning, and no perceived effect. Their responses were as follows:

4.7.1 Separation

"The COVID-19 pandemic affected my anxieties because it caused students to be separated from their teachers, setting up a situation where students were not as fully supported. Online classes make me feel alone in understanding the lessons since there are lesser interactions between students and teachers. Friends are also a big influence for me when it comes to learning lessons in Math." [Student A]

"Yes, because one of the ways I can deal with my anxieties is being surrounded by my learning buddies. However, I was more anxious in the face-to-face setting than in the online classes now." [Student B]

"Yes, since it got harder for me to communicate with other people, making it harder for me to be able to communicate and ask my teacher because of my worsening anxiety. My anxieties became more prominent when online classes started. Since then, it was harder for me to keep up in class since no teacher was explaining the lessons physically. The teachings in the face-to-face setting are still different from online classes." [Student D]

4.7.2 Better Environment

"Yes. I got a little calmer since my teacher and [my] classmates are not going to throw their judgmental eyes on me if I make a mistake." [Student C]

"I simply prefer the online setting because I do not have to show my embarrassment…" [Student E]

4.7.3 No Perceived Effect

"…but my anxiety is still the same." [Student E]

4.8 Students' Coping Mechanisms

The students specified the following coping mechanisms: calming down, organizing, having a good support system, studying, and passive acceptance. Their responses were as follows:

4.8.1 Calming Down

"I take time-outs and meditate." [Student A]

"During online classes, I soak my feet into a bucket of water to keep cool." [Student C]

"I talk to myself to make myself feel better and eat some food to calm me down." [Student D]

4.8.2 Organizing

"[I] organize my notes and my schedule." [Student A]

4.8.3 Having a Good Support System

"I deal with my anxieties by asking help from my parents, friends, or classmates when I get anxious with my subjects." [Student B]

4.8.4 Studying

"[I] ask questions in class." [Student A]

"[I] try to study more to understand the equations. [Student D]

4.8.5 Passive Acceptance

"I simply say, 'It is what it is.'" [Student E]

4.9 Students' Perceived Effectiveness of Coping Mechanisms

Students were asked if they found their coping mechanisms effective in doing better in Mathematics. Although some said yes, their perceived class standing in Mathematics said otherwise. Regardless, their responses were as follows:

4.9.1 Yes

"Yes, but I am still at a point where I find it challenging to keep up with the rest of the class." [Student A]

"Yes, because it can help me in focusing and looking on the bright side. I see myself in the middle where Mathematics is not that easy nor hard for me because I have my family and my friends to help me." [Student B]

"I think so. In terms of where I stand, I guess I am still a little far from what my classmates are now." [Student C]

4.9.2 Sometimes

"Sometimes. There are times that these help me. However, when I am having an anxiety attack, I have to be alone because talking to myself to calm me down does not help me anymore. These anxiety attacks are far more than having normal anxieties. As for my class standing, I am at the lowest, which makes me feel bad about myself." [Student D]

4.9.3 No

"No, but I do hope so. I see myself at the average or lowest." [Student E]

V. DISCUSSION

Mathematics anxiety or MA is the state of restlessness that yields a lack of confidence to undertake mathematical problems (Mendoza et al., 2021; Lanius et al., 2022). This would lead to students taking the minimum number of required Mathematics courses, eventually limiting career opportunities (Khasawneh et al., 2021). However, some manage to perform well despite their acknowledgment of having MA (Nipaz et al., 2016). Perhaps a majority of the respondents perceived themselves to having MA but at the same time, still manage to

perform well. This could account for why the respondents had an overall neutral disposition towards MA.

It was reported in 2012 that 33% of 15-year-old students had MA (Brewster & Miller, 2020). Moreover, a higher MA is associated with older age in Science, Technology, Engineering, and Mathematics (STEM) students (Rozgonjuk et al., 2020). This increase in MA that came with age is backed by Dowker et al. (2016). Despite these, the findings in this study have pointed out that there is no significant relationship between MA and age. Regardless, it is still true that MA can affect people at any age (Soysal et al., 2022). This deterioration may begin even during primary school and up to adulthood (Dowker et al., 2016; Rozgonjuk et al., 2020). Even some Mathematics teachers suffer from MA (Rozgonjuk et al., 2020).

Studies have shown that females rated their ability to perform Mathematics lower than males (Brewster & Miller, 2020). This made sense since female students tend to have MA more than male students (Dowker et al., 2016; Luttenberger et al., 2018; Xie et al., 2019; Rozgonjuk et al., 2020; Wang & Zhao, 2020). According to Brewster and Miller (2020), all these could be attributed to societal beliefs and gender issues and lead to higher rates of MA among females. They added that female teachers' negative self-belief about their Mathematics ability may be carried on to students and possibly create missed opportunities for them to learn Mathematics. This fear may have long-term and devastating consequences for female students since it gives the message that females should not consider embarking on studies and careers in Mathematics-related fields (Brewster & Miller, 2020). However, Capinding (2022) found that male students had a higher rate of MA than female students which would tend to them being less eager to learn Mathematics. Despite all these, the findings in this study agreed with Khasawneh et al., (2021) who pointed out that there is no significant relationship between MA and sex. Hence, sex stereotypes should be shattered.

The thing about students with MA is that they would tend to avoid courses that have high exposure to Mathematics (Foley et al., 2017). Moreover, MA would thereby limit employment opportunities (Lanius et al., 2022). Interestingly, it was found that the students shared one reason for pursuing their respective academic strands despite their high exposure to Mathematics – Career Opportunity. Regardless of this outcome, it remains valid as students can still perform well in Mathematics despite having MA (Nipaz et al., 2016). The students simply need to be self-aware of their MA and their consequences so that their abilities to overcome them might increase (Khasawneh et al., 2021).

Studying Mathematics simply makes students nervous and uneasy and many factors cause MA such as insufficient mathematical background, curriculum weakness, negative experiences in Mathematics, fear of making mistakes and failure, pressure, family's dreams, expectations, comments on performance, and perceptions of Mathematics, teachers' personality, teaching style, and comments on performance, peer influences, classroom climate, mathematical abstraction, and so on (Puteh & Khalin, 2016; Reyes, 2019; Capinding, 2022; Soysal et al., 2022).

Among the reasons that students have indicated, it was acknowledged that the differences between lectures and tasks were responsible for causing MA. The types of questions given do contribute to the presence of MA among students (Puteh & Khalin, 2016). This could account for why the frequency of homework given and the upcoming exams are associated with higher levels of MA (Lau et al., 2021; Soysal et al., 2022). This now leads to another reason for students' MA - the fear of failure. If left unaddressed, students would tend to avoid solving mathematical problems because it could mean failure (Luttenberger et al., 2018). The avoidance of failure would still result in failure for not trying. However, even if students wanted to try solving some problems, there are students whose minds would tend to go blank which makes them unable to think clearly when working with numbers (Capinding, 2022).

There is fear among students when it comes to algebraic and word forms compared to abstract questions and activities (Puteh & Khalin, 2016). This was yet another reason indicated. All these implied difficulties in the development of Higher Order Thinking Skills (HOTS) since mathematical tasks required critical and creative thinking, decision making, and the production of solutions to problems (Suárez-Pellicioni et al., 2016; Yusoff & Seman, 2018). Needless to say, these students lack comprehension – another reason cited for their MA.

Students have admitted that their MA stems from their lack of understanding of the lessons (Reyes, 2019). This lack of understanding is also rooted in their lack of understanding of former lessons presented by former teachers in former classes (Reyes, 2019). This implied that students who cannot understand what the teacher is saying do not have the capacity to learn Mathematics (Segumpan & Tan, 2018). Moreover, negative feelings toward learning Mathematics arise due to a range of encounters relating to the way Mathematics is presented, taught, and learned by individuals (Reyes, 2019). All of these imply that comprehension of Mathematics is affected by teachers' expressions and even attitudes and teaching styles – yet another reason for students' MA. Simply put, some negative experiences in Mathematics are in working with teachers (Reyes, 2019).

Teachers with argumentative or aggressive communication styles can increase their students' MA levels (Lin et al., 2017). Moreover, intimidating teachers frequently produce students with MA (Nipaz et al., 2016). Students who felt uncomfortable approaching their teachers and felt that they were not available for communication are likely to experience higher MA (Lanius et al., 2022). Furthermore, the availability of the teachers to answer questions, either during or outside class, played a significant role in how students perceived their MA. A teacher with high levels of MA or a negative attitude toward Mathematics can pass these on to their students, resulting in poor learning outcomes (Lanius et al., 2022). Unpleasant teaching and assessment strategies like time testing and assigning Mathematics as punishment may influence the spread of MA (Rozgonjuk et al., 2020). Moreover, the teachers' incompetence in Mathematics would hinder their abilities in providing necessary instructions to students (Brewster & Miller, 2020).

Time played a crucial role in all these reasons – yet again another reason cited by the students. In particular, it was the short time frames for discussions that caused MA – especially for difficult topics. It could be noted that even with the intervention of technology, time is still not enough – again, especially with heavy topics (Segumpan & Tan, 2018). All these reasons could be attributed to the implementation of weak curricula (Puteh & Khalin, 2016).

Manifestations of MA were also given notice. For example, when given Mathematical tasks, students would exhibit symptoms such as sweatiness, dizziness, nervousness, and rapid heartbeats (Puteh & Khalin, 2016). These manifestations, which could be clustered within the physiological and affective aspects, would influence Mathematics performance (Buckley et al., 2016; Lailiyah et al., 2021). Among those that students have specified, the physiological aspect would account for sweatiness and stomach discomfort. Most manifestations that students have shared would fall into the affective aspect. These are blanking out, distractedness, nervousness, lack of confidence, overthinking, and shame. These solidify the fact that MA has negative effects and relations with performance, achievement, learning motivation, decision-making abilities, and positive attitudes toward Mathematics (Huang et al., 2019; Lewis, 2020; Lailiyah et al., 2021). Regardless, all signs of MA must be taken into account as they will interfere with the functions of the physical organs and will yield negative impacts on learning achievement (Lailiyah et al., 2021).

The COVID-19 pandemic did have effects on students' MA. COVID-19 significantly increased the level of MA among students due to changes in coursework, modality, and poor

perceived health (Perz et al., 2020; Soysal et al., 2022). Notably, the pandemic shifted classes online and has earned mixed reactions among students.

Students who did not believe that the transition to online learning brought about by COVID-19 went well had an increase in MA (Serhan, 2020; Lanius et al., 2022). Notably, the decrease in students' academic motivation caused by the online modality may be the reason for the increased incidence of MA during this time of pandemic (Serhan, 2020; Soysal et al., 2022). In online learning, MA is caused by a low level of interactivities, online evaluation with no remedies, and low learning habits (Allen & Vallée-Tourangeau, 2016; Lewis, 2020; Lailiyah et al., 2021). The online learning system is limited and instruction cannot be executed according to the curriculum (Tanujaya et al., 2021). The instruction does not take place in the same way as it does in the face-to-face setting (Tanujaya et al., 2021). Students were expected to have access to technology that would allow them to attend class or watch materials online (Lanius et al., 2022). Quality technology and reliable internet became a necessity for classes and tasks. Consequently, students who had rare access to the internet or to computers had a much greater increase in MA than those who were well-equipped with resources (Lanius et al., 2022). Although the ability to attend class does not completely alleviate MA, students' MA levels were likely to increase if they missed classes (Lanius et al., 2022; Soysal et al., 2022).

Many students are affected by MA because they lack the proper stress outlets (Soysal et al., 2022). Speaking of these proper channels, the students acknowledged that the pandemic had separated them from their peers and teachers. This limited communication and worsened their MA (Mamolo, 2022). Some students are peer learners which meant that they learn better with the help of their peers (Segumpan & Tan, 2018). When students discuss and spend time working together on Mathematics, they feel excited and happy (Capinding, 2022). They also feel good when they receive praises and good comments from one another (Reyes, 2019). Unfortunately, social interaction does not occur between students in the current online setting (Tanujaya et al., 2021). Difficulties in contacting and interacting with teachers was another barrier to hurdle (Bringula et al., 2021). Again, the availability of teachers in answering students' questions played a role in their MA (Lanius et al., 2022). All these communication difficulties made it easier for information to be misunderstood and made it more difficult to answer questions (Soysal et al., 2022). Moreover, since teachers usually set the pace of learning, the student's inability to study at their own pace had posed another barrier to online learning (Bringula et al., 2021). Somehow, the development of overdependence between the Mathematics teachers and the students may be the root of MA (Segumpan & Tan, 2018).

Looking into the positive side, it was acknowledged that the online setup had provided a better learning environment. This works best for people who feel nervous when tasked to perform calculations in front of the class and for those who have stage fright when tasked to explain their solutions (Reyes, 2019). After all, it may reduce the students' fear of looking stupid in front of their teachers and classmates (Khasawneh et al., 2021). Notably, there were students who managed to retain their eagerness to learn amidst a pandemic and this motivation comes from various personal, societal, and environmental areas (Rahiem, 2021).

It was also acknowledged that the online learning modality brought by the pandemic did not have any impacts on the students' MA. After all, studying Mathematics is still perceived to be difficult regardless if it be done face-to-face or online (Lailiyah et al., 2021). Even in the online setting, students get the impression that Mathematics is a dreaded subject (Capinding, 2022).

Along with all the difficulties that MA presented, the students have shared their coping mechanisms. According to Skaalvik (2018), there are two types of coping mechanisms – the adaptive and the maladaptive. The adaptive coping mechanisms were those that would likely increase learning and improve one's skills through continuous attempts. Majority of those

students have mentioned fall under this category. These are calming down, organizing, studying, and having a good support system. All these enable students to reframe their thinking. After all, reducing students' MA can be done through self-regulated learning, parental involvement, and conducive learning environments (Skaalvik, 2018; McMinn & Aldridge, 2020; Demirtaş & Uygun-Eryurt, 2020; Lailiyah et al., 2021). The maladaptive coping mechanisms, on the other hand, direct attention away from students' failures and the impression of them having low abilities (Skaalvik, 2018). The lone response that would fall into this category is passive acceptance or simply saying *"It is what it is."* By doing so, students simply move on without doing anything about it.

Along with the practices mentioned, Khasawneh et al. (2021) asserted that students would benefit from the following interventions: accepting that Mathematics skills are learnable and not innate, assessing current skills, believing in their development capabilities, being taught specific strategies to solve Mathematics problems, and keeping self-regulatory records to track development in overcoming MA. Students should also embrace the idea that working hard in Mathematics is the only way to succeed, especially since hard work does not depend on any special mathematical gifts (Lanius et al., 2022). Students should also be comfortable with the idea that everyone makes mistakes (Nipaz et al., 2016). Regardless of the coping mechanisms employed and their perceived effectiveness, students must be engaged in exploring, thinking, practicing, and using knowledge rather than listening to verbal descriptions of concepts. Moreover, their self-efficacy can be developed through paying attention to prior successes and failures through evaluation and through direct encouragement and reinforcement from people who are important to them (Nipaz et al., 2016).

Parents can also help in the prevention and minimization of students' MA (Demirtaş & Uygun-Eryurt, 2020; Lailiyah et al., 2021). Parental support is efficient in helping students whenever they experience problems in understanding mathematical problems (Lailiyah et al., 2021).

Teachers need to be concerned about the effects of MA on the Mathematics achievement of students (Puteh & Khalin, 2016). The teachers' effect on the students' pre-existing MA could result in higher levels of MA which would hinder Mathematics learning and would result to poor attention (Brewster & Miller, 2020). Moreover, the reduction of teachers' own MA is also crucial in reducing their students' MA (Rozgonjuk et al., 2020). Do take note as well that female teachers could transfer their MA to students (Brewster & Miller, 2020). Teachers who want to motivate students to learn should provide a classroom climate that will make them feel comfortable during academic activities and support their learning efforts (Nipaz et al., 2016). Thus, if the teacher encourages students, their MA can be lessened (Nipaz et al., 2016).

According to Lanius et al. (2022), schools should also provide technology services that provide students regular access to quality technology, such as laptop rentals, in reducing MA during an emergency remote class. They added that access to quality internet connections could yield a substantial decrease in MA. After all, internet access has become a human right (Tanujaya et al., 2021).

VI. CONCLUSION

Mathematics anxiety or MA can hinder people from realizing their full potential. It can affect people of any age whether male or female. Nevertheless, it is manageable. Interestingly, even with the fact that students would stray away from courses with high exposure to Mathematics, some students still pursued them in the name of career opportunities. These students have shared the following reasons for their MA: differences in lectures and tasks, fear of failure, numbers and variables, comprehension, teacher's

expressions, and short discussion time frame. All these could be attributed to weak implementations of curricula. Students have manifested sweatiness and stomach discomfort in the physiological aspect, while they have experienced blanking out, distractedness, nervousness, overthinking, lack of confidence, and shame in the affective aspect. The students had contrasting views when asked about the effects of the pandemic on their MA. Some acknowledged that it negatively affected their MA since it separated them from peers and teachers. Some acknowledged that it positively affected their MA since it did set up a better learning environment through the transition to the online setup. However, another student perceived no effects despite acknowledging the positive effect. These students had the following adaptive coping mechanisms: calming down, organizing, studying, and having a good support system. As for the maladaptive, it was only passive acceptance. Students should engage in coping mechanisms that would help them face Mathematics and develop the necessary skills. Parents, teachers, and schools have significant roles in helping students cope with their MA. The study only focused on 112 Grade 11 ABM and STEM students from the University of the Cordilleras in Baguio City and does not imply generalized findings for all Grade 11 ABM and STEM students in the Philippines. Further studies focusing on the effectiveness of coping mechanisms must be done.

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