Factors Influencing Mathematics Anxiety and Mathematics Performance: A Scoping Review towards Learning Optimization Directives

Jovy C. Cullano

Cebu Technological University- Main Campus, Cangawa National High School

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ABSTRACT

This scoping review determined the factors contributing to the mathematics anxiety and its effect on the mathematics performance among Filipino high school students. This aimed to describe the extent and nature of the literature on math anxiety and math performance, and to identify gaps to guide future directions in Math teaching and learning optimization in the Philippines. The keywords used to search existing evidence on Google Scholar, PubMed, Scopus, Semantic Scholar, Crossref, and Web of Science databases were mathematics anxiety, mathematics performance, factors, high school, and Philippines. A review of 13 out of 950 published studies in indexed journals from 2014 to 2024, in the English language, were selected for this scoping review using the Joanna Briggs Institute guidelines. Of the 13 included studies, a number of studies were published between 2014-2019 (n=5, 38%) and 2020-2024 (n=8, 62%). There were 10 (77%) quantitative, 1 (8%) qualitative article, and 2 (15%) mixed methods, with sample sizes ranging from 8 to 379. It is concluded that there is an inverse relationship between Math anxiety and Math performance - the higher the math anxiety level, the poorer the math performance. Furthermore, there are multidimensional factors contributing to Math Anxiety and Performance including student factors, teacher factors, home environment and relationship, Learning environment, subject factors, cultural orientation, and Peer factor. Identifying the most common contributory factors is crucial in developing targeted interventions. An evidence-based dedicated learning optimization plan is needed to provide information that will guide the teachers for Math performance enhancements.

Keywords: mathematics anxiety, mathematics performance, Philippines, scoping review, young learners

INTRODUCTION

Filipino students commonly perceived mathematics as a tough subject. Though seemed to be disliked, the importance of mathematics is primarily found as a tool in solving problems in mathematics and in providing solutions to concerns in real life (Unlu et al., 2017). Despite the great significance of such a course, many students appear to experience anxiety about it. Thus, the proponent conducted this study to explore mathematics anxiety with the primary aim of determining what causes it and how to lessen it and how it is associated with mathematics performance.

Mathematics Anxiety (MA) is defined in many ways. MA is more than the feeling of not liking math; instead, it is a response characterized to be negative when doing mathematics-related tasks (Vinson, 2001). As claimed by the other authors, MA is a multiple unpleasurable feeling such as, but not limited to, worry,

frustration, tension and fear (Eden et al, 2013) while others referred to it as a form of panic (Buxton, 1981). On the other lens, it is explained that MA is an illogical fear that distresses students, hindering performance and learning (Morris, 1981). Hence, MA is one of the emotional aspects that hinders students' performance and has been identified to negatively impact mathematics performance of learners (Ablian & Parangat, 2022) further affecting students 'overall academic performance (Ma & Kishor, 1997).

There are several factors affecting MA. One paper concluded that the abstract mathematical concepts, the teaching style and attitude of the teacher, and the poor comprehension and analytical skills of the students were the major factors that caused the mathematics anxiety of the high school Filipino students (Estonanto & Di, 2019). It has also been found that some factors included the nature of the subject, students' factor and parents' factor (Estonanto, 2018).

High math anxiety is often associated with poorer students' performance in mathematics (Estonanto, 2017; Ma & Kishor, 1997; Ablian & Parangat, 2022; Jolejole-Caube, 2019). In fact, according to the Programme for International Student Assessment (PISA, 2022), 16% of students of the Philippines attained at least Level 2 proficiency in mathematics, significantly less than on average across OECD countries (OECD average: 69%). Only in 16 out of 81 countries and economies participating in PISA 2022 did more than 10% of students attain Level 5 or 6 proficiency (OECD, 2023).

It is therefore imperative that teachers need to recognize the variables influencing mathematics anxiety and mathematics performance to create effective interventions and instructional strategies. Although there are existing studies about these in the Philippines, there are very limited articles on integrative literature and systematic reviews. This scoping review could be the first to describe the extent of literature on the multidimensionality of causes that have contributed to the math anxiety and then, the effect of MA to math performance among the Filipino high school learners. The startling PISA Math performance of the Philippines calls for a dedicated intervention program and targeted interventions to address the needs of the teachers and learners. This scoping review aimed to analyze the extent of current literature on factors contributing to the math anxiety in the country in order to identify the gaps and serve as a benchmark for the development of math anxiety reduction initiatives or programs.

Theoretical Background

This study is anchored on the Debilitating Anxiety Model or Cognitive Interference Theory by Wine (1980), Achievement Motivation Theory by McClelland (1961), and Social Learning Theory by Bandura (1977a). Furthermore, it is also using the legal bases namely, RA 11036 on Mental Health Act, DepEd Order No. 39, s. 2012 on the Policy Guidelines on Addressing Learning Gaps in Secondary Schools; DepEd Memo. 110, s. 2022 on the creation of the Steering Committee and Technical Working Group for the Development of the National Mathematics Program, and DepEd Memo No. 118 series of 2017 on the creation of Mental Health Program in Schools; DepEd No. 55, 2023 Policy Guidelines on the Implementation of the K-12 Basic Education Curriculum.

Scoping reviews are essential in mapping the current literature on a topic and in identifying gaps in the literature (Mak & Thomas, 2022). In this review, we sought to answer the review question: What individual, social, cultural, economic, political, educational, and environmental factors influenced the mathematics anxiety among the young Filipino students and how MA affects the math performance? Several databases such as Google Scholar, PubMed, Scopus, Semantic Scholar, Crossref, and Web of Science databases were used to search for evidence using the keywords: mathematics anxiety, mathematics performance, factors, high school, and Philippines. The Population-Concept-Context (PCC) framework was used to determine the eligibility criteria of the evidence (Pollock et al., 2023).

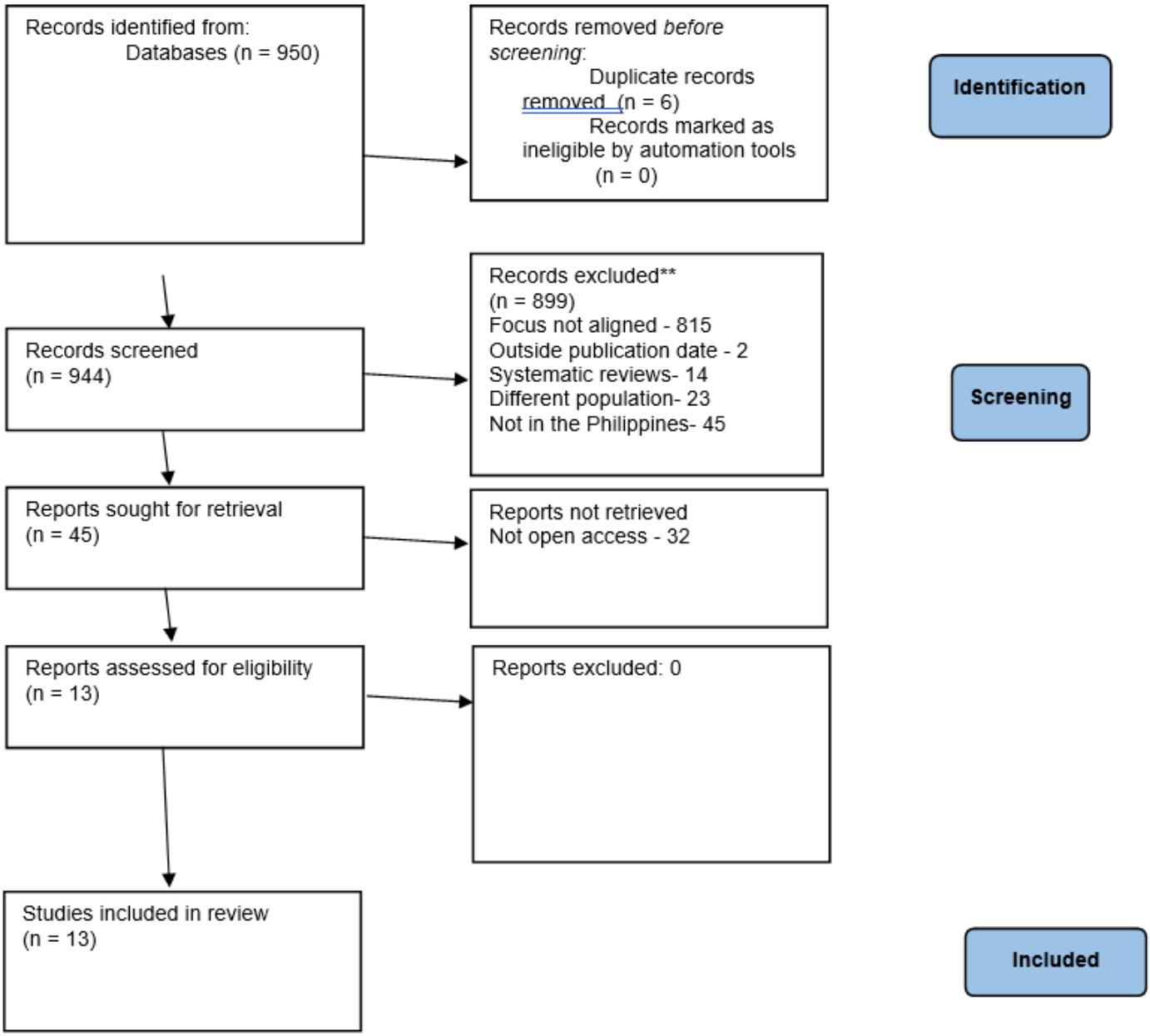

Figure 1. PRISMA search strategy for Factors affecting Math Anxiety and Math Performance

The Population involves Philippine-based participants or Filipino high school students, Concept refers to the factors contributing to high math anxiety and math performance, and Context focuses on Philippine-based studies or studies on Math anxiety and math performance. Relevant research articles in the context of this study from 2014 up to the second quarter of 2024 were analyzed. Specifically, the criteria for inclusion have been established for selecting journal articles, 1) quality - must be a research article published in an indexed journal, 2) recency - must be published between 2014 to 2024, 3) language - must be in English language only, and 4) relevance - must focus on factors affecting math anxiety and performance in the Philippines. Exclusion criteria includes studies published in 2013 or earlier and systematic reviews or literature reviews.

The significance of this endeavor cannot be overstated. Math performance is not merely an academic issue but a socioecological phenomenon deeply rooted in the fabric of society. Its impacts are influenced by a myriad of factors operating at multiple levels, from individual behaviors to broader structural determinants. Understanding these factors is crucial for designing effective interventions that address the very causes of mathematics anxiety and performance among Filipino learners.

In light of these complexities, this study seeks to analyze the existing literature on the factors affecting math anxiety and math performance in the Philippines and identify gaps to guide future research, policy, and

practice. By synthesizing evidence from diverse disciplines and perspectives, the researcher aims to generate insights that inform the innovation and execution of targeted interventions that address the structural determinants of math anxiety and math performance and promote better education quality.

Preferred Reporting Items for Systematic Reviews and Meta-analyses or PRISMA was utilized (Moher et al., 2009). Before searching for peer-reviewed online journal articles, the researcher established the criteria for inclusion and exclusion. Various meta-search engines were utilized to collect journal articles including Google Scholar, PubMed, Scopus, Semantic Scholar, Crossref, and Web of Science databases.

The researcher used the software program Publish or Perish (Harzing, 2007) to find lists of journal articles and analyze academic citations. The search was intentionally restricted to the period from 2014 through the second quarter of 2024. Additionally, the following descriptors were used in the meta-search engines: mathematics anxiety, mathematics performance, factors, high school, and Philippines. These terms were entered randomly and interchangeably into the meta-search engine until no further studies could be found. Filtering strategies included keywords, publication dates (2014-2024), availability of full text and abstracts, journal articles, and English language.

The database search strategy yielded 950 articles. The proponent conducted the initial appraisal of articles based on Math anxiety and Math performance titles, which yielded 944 articles. Secondary appraisal of the 944 articles with relevant titles were done and 899 articles were excluded due to the following reasons: setting (i.e., conducted outside the Philippines, n=45), review papers (n=14), different population (n=23), outside publication date (n=2), and different focus (n=815). These results were finally narrowed down to 13 studies through an in-depth full-text and abstract analysis of each article using identified inclusion criteria.

The Debilitating Anxiety Model, also referred to as the Cognitive Interference Theory (Wine, 1980), posits that math anxiety results in reduced performance in mathematics. This model indicates that math anxiety affects three stages of performance: pre-processing, processing, and retrieval of mathematical knowledge (Carey et al., 2016). Additionally, the model suggests that math anxiety impedes mathematical problem-solving by diminishing the processing and storage capacity of working memory due to worry (Ashcraft & Moore, 2009; Eysenck & Calvo, 1992).

In addition, McClelland's theory of Achievement Motivation emphasizes how the drive to achieve, bond, and lead shapes human behavior. The need for achievement refers to a person's drive to excel, succeed, and achieve goals. In this study, learners who want to achieve and perform better in Math are more motivated by challenging math tasks and obtaining a high grade in Math.

Additionally, social learning theory, developed by psychologist Albert Bandura, suggests that individuals learn by observing the behaviors of others (models). This learning is influenced by factors such as attention, motivation, attitudes, and emotions. People then assess the impact of these behaviors by observing the positive and negative outcomes that result. In this study, if they see their teachers in Math who really have a good attitude towards Math, then the students will also have a good attitude towards it and will have less anxiety.

These assumptions have been backed by a series of empirical studies examining the relationship between math anxiety and performance (e.g., Ashcraft & Kirk, 2001; Justicia-Galiano, Martín-Puga, Linares & Pelegrina, 2017; Ramirez et al., 2018; Skagerlund et al., 2019; Vukovic et al., 2013). Ashcraft and Krause (2007), for example, reported that individuals with high MA performed significantly lower in arithmetic problems of high working memory demand than their peers with low or moderate MA. Therefore, it appears that math anxiety impairs the functioning of working memory, resulting in lower mathematics performance among individuals with high levels of math anxiety.

Furthermore, it is also using the legal bases namely, RA 11036 on Mental Health Act, DepEd Order No. 39, s. 2012 on the Policy Guidelines on Addressing Learning Gaps in Secondary Schools; DepEd Memo. 110, s.

2022 on the creation of the Steering Committee and Technical Working Group For the Development of the National Mathematics Program, and DepEd Memo No. 118 series of 2017 on the creation of Mental Health Program in Schools; DepEd No. 55, 2023 Policy Guidelines on the Implementation of the K-12 Basic Education Curriculum. These legal bases help shape the direction of the study and support that DepEd shall take initiatives aiming towards enhancement of Mathematics performance among the students by enhancing mental health and reducing Math anxiety.

REPUBLIC ACT No. 11036 is an Act Establishing a National Mental Health Policy for the Purpose of Enhancing the Delivery of Integrated Mental Health Services, Promoting and Protecting the Rights of Persons Utilizing Psychosocial Health Services. Indicated in its Chapter V is the education, promotion of mental health in educational institutions and in the workplace wherein in Section 23, the integration of Mental Health into the Educational System is provided stating to ensure the integration of mental health into the educational system, as follows: (a) Age-appropriate content pertaining to mental health shall be integrated into the curriculum at all educational levels; and (b) Psychiatry and neurology shall be required subjects in all medical and allied health courses, including post-graduate courses in health. Lastly, section 24 on Mental Health Promotion in Educational Institutions mandates that schools, colleges, universities, and technical schools create policies and programs for students, educators, and other staff. These initiatives should aim to: increase awareness of mental health issues, identify and offer support and services for at-risk individuals, and facilitate access to treatment and psychosocial support through referral mechanisms for those with mental health conditions. Such Republic Act, along with the relevant Department of Education orders previously mentioned, help shape the direction of the study and support that Dep Ed shall take initiatives aiming towards enhancement of Mathematics performance among the students by enhancing mental health and reducing Math anxiety.

Statement of the Problem

This study primarily aimed to search, extract, appraise, and analyze peer-reviewed studies in order to determine the factors contributing to math anxiety and math performance using internationally published articles on math anxiety and math performance from 2014- 2024, towards directives for learning optimization.

Specifically, the researcher aimed to address the following questions:

1. What factors contribute to math anxiety among Filipino high school students?
2. Is there a significant correlation between math anxiety and math performance?
3. What evidenced-based learning optimization plan may be crafted?

RESEARCH METHODOLOGY

Design. The Joanna Briggs Institute Scoping Review (JBI-ScR) protocol guided this scoping review (Pollock, 2023) and was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses or PRISMA (Moher et al., 2009). Before searching for peer-reviewed online journal articles, the researcher established criteria for inclusion and exclusion. Various meta-search engines and databases were used to collect journal articles, including Google Scholar, PubMed, Scopus, Semantic Scholar, Crossref, and Web of Science.

Flow of the Study. The researcher utilized the software program Publish or Perish (Harzing, 2007) to find lists of journal articles and analyze academic citations. The search was intentionally restricted to the period from 2014 through the second quarter of 2024. Additionally, the following descriptors were used in the meta-search engines: mathematics anxiety, mathematics performance, factors, high school, and Philippines. These terms were entered randomly and interchangeably into the meta-search engine until no further studies could be found. Filtering strategies include keywords, publication dates (2014-2024), availability of full text and abstracts, journal articles, and English language. Though not required for scoping reviews, these articles

were subjected to quality assessment using the Critical Appraisal Skills Programme (CASP, 2018) indicators to add rigor to the search and selection process.

Databases. The researcher utilized the software Publish or Perish (Harzing, 2007) to find lists of journal articles and analyze academic citations. Several meta-search engines and databases were utilized to collect journal articles, including Google Scholar, PubMed, Scopus, Semantic Scholar, Crossref, and Web of Science.

Population. The Population-Concept-Context (PCC) framework was used to determine the eligibility criteria of the evidence (Pollock et al., 2023). The Population involved Philippine-based participants or Filipino high school students. Concept refers to the factors contributing to high math anxiety and math performance, and Context focused on Philippine-based studies or studies on Math anxiety and math performance. Research articles pertinent to the context of this study, from 2014 through the second quarter of 2024, were examined. Specifically, criteria for inclusion were established for selecting journal articles, 1) quality - must be a research article published in a peer-reviewed journal, 2) recency - must be published between 2014 to 2024, 3) language - must be in English language only, and 4) relevance - must focus on factors affecting math anxiety and math performance in the Philippines. Exclusion criteria includes studies published in 2013 or earlier and systematic reviews or literature reviews.

Data Extraction and Synthesis. Based on the data needs, the following data were extracted from each of the articles namely, 1) title and publication year, 2) study purpose, 3) authors, 4) abstract, and 5) results on the factors contributing to the high math anxiety and math performance.

Data Gathering Procedure. A letter requesting permission to conduct the study was submitted to the school head. Once the permit was approved, the administration and data collection processes commenced.

Coding Procedures. The data collected from the eligible journal articles were coded using the following: 1) article identifier (author's last name and year of publication), 2) methods (research design, sample size, and population), 3) relevant findings, and 4) factors affecting MA and Math performance.

Statistical Treatment/ Data Analysis. Descriptive analysis of the review variables (e.g., year of publication, research design, unit of analysis, population, and factors contributing to the high MA and Math Performance) was made using frequency and percentage distribution. Common findings, as well as unusual, unexpected, and contradictory results were highlighted. A narrative analysis and discussion of the review findings from the included articles were presented.

Ethical Considerations. The study is exempted for Ethics Review since the study analyzed published and publicly available articles.

RESULTS AND DISCUSSIONS

The database search strategy yielded 950 articles. The proponent conducted the initial appraisal of articles based on Math anxiety and Math performance titles, which yielded 944 articles. Secondary appraisal of the 944 articles with relevant titles were done and 899 articles were excluded due to the following reasons: setting (i.e., conducted outside the Philippines, n=45), review papers (n=14), different population (n=23), outside publication date (n=2), and different focus (n=815). These results were finally narrowed down to 13 studies through an in-depth full-text and abstract analysis of each article using identified inclusion criteria (Figure 1). Though not required for scoping reviews, these articles were subjected to quality assessment using the Critical Appraisal Skills Programme (CASP, 2018) indicators to add rigor to the search and selection process.

Of the 13 included studies, a number of studies were published between 2014-2019 (n=5, 38%) and 2020-2024 (n=8, 62%). There were 10 (77%) quantitative, 1 (8%) qualitative article, and 2 (15%) mixed methods,

with sample sizes ranging from nine (9) to three hundred seventy-nine (379). The population of the studies all high school students in varying year levels.

Contributing Factors to the Mathematics Anxiety and Mathematics Performance in the Philippines

Based on the 13 available evidence/articles from 2014 to 2024, 8 (62%) examined the relationship between Math anxiety and Math performance, 8 (62%) explored the factors contributing to Math Anxiety and Performance, and 3 (23%) examined both the factors and the relationship of Math anxiety and math performance. In terms of the factors contributing to Math Anxiety and Performance, multilevel individual student factors, teacher factors, home environment and relationship, learning environmental factors, subject factors, cultural orientation, and Peer factor have contributed to the Math anxiety and Math Performance in the Philippines.

Individual Student factors. Eight (8) pieces of evidence were critical in understanding the students' factors of Math Anxiety and its role in the Philippine Math performance. Of the factors identified at the individual level, many factors influenced Math Anxiety and Math Performance including physical and emotional feelings (Reyes, 2019) or affective aspect (Pinugu et al., 2023), personal motivation to succeed (Guro and Guro, 2015) and interest (Gonzales, 2024), poor comprehension and poor analytical skills, critical thinking (Delosa and Ong, 2021) or cognitive capacity (Estonanto et al., 2019; Pinugu et al., 2023), past academic performance (Reyes, 2019). Little confidence to do mathematics is the result for many students who suffer from mathematical anxiety (Scarpello, 2005). Unwanted past experiences of students in mathematics classroom, a boring and useless subject as conveyed by the parents, or even the attitudes of the teachers may serve as factors that might affect students' mathematical anxiety (Barnes, 2006). According to Ashcraft and Krause (2007) that if a student has difficulty in working memory and a math anxious person. Examining these results suggests that stressful situations clearly affect math performance. Also, studies do show that low self-esteem, confidence and efficacy are closely related to mathematics anxiety (Uusimaki & Nason, 2004; Woodard, 2004).

Poor Skills in Comprehension and Analysis are also linked to their math anxiety (Estonanto et al., 2019). Learners recognized that excelling in mathematics necessitates a deep understanding and analytical approach to various word problems. Students need to analyze the situation and apply the appropriate mathematical principles and formulas to address it effectively.

According to Estonanto (2018), twenty-one respondents or 24 % determined Student Factor as the second primary cause of their anxiety. This indicates that students with anxiety are not afraid of mathematics due to external factors but rather because they consciously choose to avoid the subject. Consequently, it can be inferred that these students do not perceive the importance and relevance of mathematics in their lives.

Reyes (2019) the learning environment and past academic performance of the respondents in Math anxiety. According to the study results, three respondents reported fear of embarrassment, one felt shy and nervous about solving math problems, and two occasionally struggled to understand the lesson. All respondents acknowledged that their previous math teachers significantly influenced their attitudes toward studying mathematics. They noted difficulties in understanding lessons presented by their former teachers and a fear of being embarrassed. One respondent mentioned that a negative past experience with math was influenced by their teacher.

Teacher factors. Four (4) articles found that teachers' factors contributed to Math anxiety and Math performance. These referred to teacher's attitude (Estonanto et al., 2019), teaching style (Estonanto et al., 2019)/use of non-traditional strategy (Gonzales, 2024), teacher's mastery (Gonzales, 2024), and teacher' approachability (Gonzales, 2024).

In the study of Estonanto et al., (2019), the participants identified Teacher Factor (rank 2) as a major cause of their math anxiety. This factor encompasses both teaching strategies and pedagogical practices, as well as the

teacher's personality and attitude within the classroom environment. For the participants, mathematics anxiety developed because of unconstructive teacher practices in traditional mathematics classrooms (Finlayson, 2014). The commonly used directive-authoritarian approach by many teachers also contributed to the issue. This approach turns the learning process into a one-way communication, where the teacher imparts lessons through chalkboard lectures while students passively receive the information. Participants noted that most of their mathematics teachers rarely employed colorful instructional materials, information communication technology, or other interactive learning activities. Instead, they relied heavily on discussions, board works, drills, assignments, projects, worksheets, graded recitations, and surprise quizzes under time pressure. Other classroom practices the participants associated to their mathematics avoidance were the common teachers' routines of get- your- book- copy- this approach, bombarding students with quizzes and seat works every day, insisting that the textbook is always right or bookishness, prohibiting students from using software and calculators, and giving more tasks as punishment for misbehaviors of students which is similar to the conclusions of Oberlin (1982). Another frequent practice reported by students was the "cover-to-cover approach" used by teachers. According to the students, in mathematics classes, they were often required to study all topics outlined for the entire grading period, regardless of whether they had mastered the target competencies. To meet the demands of their periodic learning plans, many teachers tended to delay discussing the remaining topics, aiming to complete the full coverage.

As stressed by Finlayson (2014), the teaching style of mathematics educators in traditional classrooms is a major cause of the anxiety of the students. When teachers prioritize covering all the required topics set by the curriculum over ensuring students fully understand the material, the mathematical skills students acquire tend to be incomplete. These daily routines and common practices among traditional mathematics teachers contribute to students developing a more negative attitude toward mathematics.

Findings of Gonzales (2024) underscores the critical role of teachers and instructional strategies in influencing students' math anxiety levels and their subsequent performance in mathematics. Improving teaching skills, fostering positive teaching personalities, and utilizing effective instructional materials are essential strategies for enhancing student outcomes in mathematics education. Being a great teacher is a crucial factor in students' development particularly in addressing students' anxiety towards Mathematics. Along with being great, the teacher must be an expert in the field of discipline. In addition, it concludes that Mathematics teachers enjoy teaching the said subject as the respondents disagree on the statement that their teacher appears to lack enthusiasm for teaching mathematics. As mentioned by Woolfolk (2021) intrinsic motivation is an internal personal factor that motivates the learners towards learning. Thus, teachers need to enjoy intrinsic motivation towards work to be great and attain great outcomes through teaching capability and skills.

Home factors. Three (3) articles found that parents and the close relationship between the student and their family can contribute to Math anxiety and Math Performance (Anabo, 2023; Guro and Guro, 2015; Estonanto, 2018). A study by Anabo (2023) revealed that parents' educational attainment can be the motivation of their children to perform better in school because parents can serve as role models to their children.

According to Estonanto (2018), 16 respondents or 18 % said that the cause of their anxiety was the Parents Factor. This 18% reflects the group of students whose parents were less actively engaged in overseeing their academic needs, particularly in mathematics. As a result, these students lacked confidence in their ability to excel, feeling uncertain about the level of support and assistance from their parents. This situation may be linked to a significant number of parents being Overseas Filipino Workers (OFWs). Some students reported feeling pressured to achieve higher grades in mathematics because their parents, who work abroad as engineers, have high expectations.

Learning Environmental factors. Three (3) articles found that facilitating a learning environment affects the math anxiety and Math performance among high school learners in the Philippines. These included the

availability of instructional facilities, facilitating school environments (Guro and Guro, 2015); Reyes, 2019; Pinugu et al., 2023).

Franci and Scheel (2005) revealed that teaching methods can be measured through classroom climate. Their study demonstrated that collaborative learning and inquiry-based activities significantly contribute to students' development. Bandura also concluded in his research that cooperative learning strategies can enhance students' academic performance.

Reyes (2019) the learning environment and past academic performance of the respondents in Math anxiety. According to the study results, three respondents reported fearing embarrassment, one felt shy and nervous about solving math problems, and two occasionally struggled to understand the lessons. All respondents acknowledged the significant impact of their previous math teachers on their experiences with mathematics. They mentioned difficulties in understanding lessons presented by their former teachers and a fear of being embarrassed. One respondent noted that a negative past experience with math was influenced by their teacher.

Subject/Course factors. Two (2) articles found that the nature of math as a subject itself affects the math anxiety and Math performance among high school learners in the Philippines (Estonanto, 2018 and Estonanto et al., 2019).

According to Estonanto et al., (2019), subjects that have many abstract concepts like Math are most difficult to comprehend for the students. The fear of abstract mathematical concepts was identified by the respondents as the leading cause of their anxiety, ranking first. Newstead (1995) referred to this factor as the “innate characteristics of mathematics” which encompass the general nature of mathematics as a subject that requires critical thinking, logic, problem solving, and analysis of abstract concepts.

The participants predominantly remarked that Calculus is very challenging for them due to the numerous notations, symbols, variables, expressions, equations, laws, theorems, and unfamiliar mathematical terminology involved in understanding Calculus lessons.

Based on the responses, it can be inferred that the participants were anxious about the subject due to a lack of conceptual understanding of mathematical principles, especially the foundational language and basics of algebra.

Most students reported that as soon as they encounter equations and variables, they begin to feel anxious, describing it as if they are "swallowing their saliva." During the focus group discussions, some participants admitted that hearing terms like "differentiation" and "integrals" triggers feelings of nervousness, restlessness, worry, and anxiety. Additionally, some students mentioned that they frequently struggle to concentrate during board work and graded recitations, often feeling tense and experiencing a mental block when asked to solve equations in front of the class. These students must have learned computational skills such as memorization of formulae and manipulation of symbols, but had not fully understood the concepts themselves and their practical applications (Das & Das, 2013; Skemp, 1986). It is also possible that the participants did not fully understand or master either the conceptual skills or the computational and manipulative skills related to equations in mathematics, as indicated by their responses.

Participants also identified difficult, lengthy, multi-step word problems—often seen as irrelevant, unrealistic, complex, sophisticated, and time-consuming—as another source of their anxiety. For the respondents, a word problem that takes them three hours to solve makes them feel irritable, impatient, confused, and easily frustrated.

Peer Influence. An article found that peer influence affects the math anxiety and Math performance among high school learners in the Philippines (Guro and Guro, 2015). Learning is a lifelong process that influences nearly every aspect of individuals' lives. It involves continually acquiring new knowledge while revising or

discarding old information. Studying is crucial across various fields. Teachers must grasp effective methods for educating children, while psychologists, social workers, criminologists, and other professionals in human services need to understand how experiences impact behavior. Employers, politicians, and advertisers make use of the principles of learning to influence the behavior of workers, voters, and consumers (Encarta 2006).

Table 1 Summary of relevant findings from selected evidence

Author	**Year**	**Title of the Article**	**Methods** *(Research design, sample size, population)*	**Relevant findings**	**Factors contributing to MA and MP / Relationship between MA and MP**
Estonanto, A et al.	2019	Factors causing Mathematics Anxiety of Senior High School Students in Calculus	Mixed method | Sixty-nine(69) senior high school students	The paper concludes that the primary factors contributing to the participants' mathematics anxiety are the abstract mathematical concepts of Calculus, the teacher's teaching style and attitude, and the students' weak comprehension and analytical skills.	- ***Factors Identified:*** Nature of Math, Teaching Style, Teacher's attitude, Poor comprehension and Poor analytical skills
Estonanto, A	2018	Impact of Math Anxiety on Academic Performance in Pre-Calculus of Senior High School	Descriptive-correlational | Eighty-eight (88) high school students.	A significant relationship exists between math anxiety and students' performance in pre-calculus. The primary causes of this anxiety were identified as the nature of the subject, factors related to students, and factors related to parents.	- ***Relationship:*** There is a significant relationship between math anxiety and performance of students. - ***Factors Identified:*** Nature of the Subject, Students Factor and Parents Factor
Ablian et al	2022	Mathematics Anxiety and Mathematics SelfEfficacy among Senior High School Students in Public Secondary Schools	Descriptive study with 225 grade 11 students	The paper also concludes that both mathematics anxiety and self-efficacy in mathematics impact students' academic performance.	- ***Relationship:*** Mathematics anxiety influences students' academic performance.

Reyes , J	2019	Mathematics Anxiety and Self-Efficacy: A Phenomenological Dimension	Descriptive phenomenological research with 9 students	Math anxiety is linked to physical and emotional feelings, the learning environment, and past academic performance among the participants.	- ***Factors Identified:*** Personal physical and emotional feelings, learning environment and past academic performance
Escarez et al	2022	Math Anxiety and Mathematical Representations of Grade 7 Students	Descriptive-correlational research with 42 grade 7 students	These two opposing results were supported by the lack of a significant relationship between math anxiety and students' performance in mathematics. While the inverse relationship indicated an impact of anxiety on test scores, the null hypothesis regarding the relationship between the variables was rejected.	- ***Relationship:*** There is no relationship between Mathematics anxiety students' Math academic performance.
Flores, I	2019	Correlates of Mathematics Performance of Students in Public Secondary Schools in the Division of Batangas, Philippines: Basis for Mathematics Intervention Programs	Descriptive-correlational with 379 high school students	The study revealed that study habits, levels of fear/anxiety, and parental involvement were key factors influencing students' performance in elementary Mathematics and Geometry.	- ***Relationship:*** Mathematics anxiety influences students' math performance.
Dela Cruz et al	2022	Parental Roles, Learners' Attitudes, ad Mathematics Performance	Descriptive-correlational with 328 students	Mathematics performance can be predicted based on attitudes towards the subject, including enjoyment, anxiety, and confidence, as well as the extent of practice as a Mathematics learning counselor, accounting for an explained variance of 20.80%.	- ***Relationship:*** Mathematics performance can be predicted by Math anxiety.

Pinugu et al	2023	Mathematics Self-Efficacy, Mathematics Anxiety, Community of Inquiry, and Mathematics Engagement of Performance in Mathematics among Students using an Online Learning Modality	Cross-sectional explanatory method with 168 students	The findings showed that Mathematics Anxiety has the greatest impact on Mathematics performance, with a beta coefficient of .927, followed by Mathematics Engagement at .875. Mathematics Efficacy ranked third with a beta coefficient of .669, while Community of Inquiry was the least influential, with a beta coefficient of .187. The results indicate that cognitive and affective factors play a significant role in mathematics performance, along with the environmental factor of Community of Inquiry.	- ***Relationship:*** There is a significant relationship between math anxiety and performance of students. - ***Factors Identified:*** cognitive and affective thoughts contribute much to mathematics performance as well as community of inquiry as an environmental factor.
Macabodbod, J.	2023	On Mathematics Anxiety and Achievement of Students in Surigao City, Philippines	Descriptive-correlational with 109 students	The results showed that mathematics anxiety has a significant negative correlation with mathematics achievement.	- ***Relationship:*** The higher the mathematics anxiety, the poorer the students' math performance.
Anabo, R.	2023	Correlates Of Mathematics Performance Of Grade 9 Learners In Secondary Schools Division Of Eastern Samar Amidst Pandemic	Descriptive-correlational with 300 grade 9 students	It was found that learner and home factors had a significant impact on mathematics performance, whereas school factors did not have a significant effect.	- ***Factors Identified:*** learners and home factors
Omensalam P. Guro, Johaira P. Guro	2015	Factors Associated with Muslim High School Studentsâ€™ Mathematics Performance in Three Selected Regions in Mindanao: Basis for Intervention	Mixed method	It can be concluded that cultural orientation and high school context factors likely contribute to explaining the positive but modest math performance observed among selected respondents. These factors include Maratabat, fidelity to Islam, motivation to succeed, the school and home environment, close kinship, peer influence, and the availability of instructional facilities.	- ***Factors Identified:*** cultural orientation and high school context factors - motivation to succeed, school and home environment, close kinship, peer influence, as well as availability of instructional facilities.

Delosa and Ong	2021	Factors Determining Mathematics Performance of High School Students: Implications for Teacher Education	Descriptive-correlational with 236 secondary student participants	Critical thinking skills should be taught alongside Mathematics content. Teachers must fulfill multiple roles, both delivering the content and simultaneously developing students' critical thinking abilities.	- ***Factors Identified:*** Critical thinking teachers' factor
Marie Ann S. Gonzales	2024	Factors Affecting the Senior High School Students' Math Anxiety on their Mathematics Performance	Descriptive research design and included 130 senior high school students	The results revealed a significant impact of student and teacher-related factors on the experience of anxiety, which, in turn, affects mathematics performance. The findings suggest that teachers' personalities are crucial in managing mathematical anxiety and fostering students' interest in the subject. Mastery of lesson content by teachers enhances learners' performance. Approachable teachers make it easier for students to complete tasks and feel more comfortable asking questions. Additionally, the use of manipulatives and other non-traditional tools engages students in the learning process.	- ***Relationship:*** There is a significant relationship between math anxiety and performance of students. - ***Factors Identified:*** Teachers mastery, approachable - student interest - Use of non-traditional strategies

Cultural Orientation. An article found that cultural orientation affects the math anxiety and Math performance among high school learners in the Philippines (Guro and Guro, 2015). In their study, thirteen Mathematics teachers responded to the statement: "Behavior of Muslim students in Mathematics class that makes them happy as a teacher," with the following answers: They are pleased when Muslim students perform well and exhibit positive behaviors, such as being responsible, creative, organized, and proactive. Teachers appreciate when students are enthusiastic, patient in solving problems, and proud of their correct solutions. They value students who are cooperative, attentive, and show genuine interest. Many teachers find satisfaction in students who excel in math, participate actively, and express gratitude for what they have learned. Additionally, teachers are gratified when students are responsible, follow instructions, and display honesty, diligence, kindness, and curiosity.

Fourteen Mathematics teachers provided feedback on the statement: "Problems encountered by teachers in teaching Mathematics to Muslim students," with the following responses: issues included students not studying, practicing, or reciting; limited participation; shyness; lack of response; neglect of assignments; misbehavior; lack of interest; taking the subject for granted; poor reading comprehension; weak foundation

in fundamental operations and concepts like decimals, fractions, and integers; limited proficiency in English; absence of necessary materials such as graphing paper, rulers, pencils, protractors, and calculators; inattentiveness during discussions; impoliteness; laxity; mischievous behavior; poor retention and comprehension; inability to recall basic concepts, rules, and laws of math; lack of mastery in fundamental operations; negative attitudes towards the subject; very low retention of fundamental operations; excessive noise; and issues with punctuality.

These problems can be categorized into six clusters: classroom management issues, language barriers, motivational and attitudinal problems, lack of materials for classroom activities, overcrowded classes, and poor foundational knowledge. These issues are interconnected, such as overcrowded classes contributing to most classroom management problems, and motivational and attitudinal challenges stemming from a lack of essential materials and a weak foundation.

Table 2 Relationship between Mathematics Anxiety and Mathematics Performance

Author	**Year**	**Title of the Article**	**Methods**	**Relevant findings**	**Relationship between MA and MP**
Estonanto, A	2018	Impact of Math Anxiety on Academic Performance in Pre-Calculus of Senior High School	Descriptive-correlational | Eighty-eight (88) high school students.	A significant relationship exists between math anxiety and students' performance in pre-calculus. The primary causes of students' anxiety were identified as the nature of the subject, student-related factors, and parent-related factors.	Computed T=5.89 Critical T= 2.02 R value=-0.66 There is a significant inverse relationship between math anxiety and performance of students.
Ablian et al	2022	Mathematics Anxiety and Mathematics Self Efficacy among Senior High School Students in Public Secondary Schools	Descriptive study with 225 grade 11 students	The paper also concludes that both mathematics anxiety and mathematics self-efficacy affect students' academic performance.	P value= 0.003 R value= -0.198 Mathematics anxiety influences students' academic performance inversely.
Flores, I	2019	Correlates of Mathematics Performance of Students in Public Secondary Schools in the Division of Batangas, Philippines: Basis for Mathematics Intervention Programs	Descriptive-correlational with 379 high school students	It was found that study habits, levels of fear/anxiety, and parental involvement were key factors influencing performance in elementary Mathematics and Geometry.	P value = .003 T value = -3.18 Mathematics anxiety influences students' math performance.
Dela Cruz et al	2022	Parental Roles, Learners' Attitudes, ad Mathematics Performance	Descriptive-correlational with 328 students	Mathematics performance can be predicted based on attitudes towards the subject, including enjoyment, anxiety, and confidence, as well as the extent of practice as a Mathematics learning counselor, with an explained variance of 20.80%.	P value= 0.00 R value -.311 Mathematics performance can be predicted by Math anxiety.

Pinugu et al	2023	Mathematics Self-Efficacy, Mathematics Anxiety, Community of Inquiry, and Mathematics Engagement of Performance in Mathematics among Students using an Online Learning Modality	Cross-sectional explanatory method with 168 students	The results revealed that Mathematics Anxiety has the greatest impact on Mathematics performance, with a beta coefficient of .927, followed by Mathematics Engagement at .875. Mathematics Efficacy was ranked third with a beta coefficient of .669, while Community of Inquiry had the smallest effect, with a beta coefficient of .187. These findings indicate that cognitive and affective factors, along with the environmental factor of Community of Inquiry, significantly contribute to mathematics performance.	There is a significant relationship between math anxiety and performance of students.
Macabodbod, J.	2023	On Mathematics Anxiety and Achievement of Students in Surigao City, Philippines	Descriptive-correlational with 109 students	The results indicated that mathematics anxiety is significantly negatively correlated with mathematics achievement.	P value = 0.00 The higher the mathematics anxiety, the poorer the students' math performance.
Marie Ann S. Gonzales	2024	Factors Affecting the Senior High School Students' Math Anxiety on their Mathematics Performance	Descriptive research design and included 130 senior high school students	The results revealed that factors related to both students and teachers significantly impact the experience of anxiety, which, in turn, affects students' performance in mathematics. The findings suggest that teachers' personalities are crucial in managing mathematical anxiety and fostering students' interest in the subject. Mastery of lesson content by teachers enhances student performance. Approachable teachers facilitate task completion and make students feel more comfortable asking questions. Additionally, the use of manipulatives and other non-traditional tools engages students more effectively in the learning process.	There is a significant relationship between math anxiety and performance of students.

Eight (8) papers explored the relationship between Math Anxiety and Performance. Of these articles, the majority or 88% (7 articles) of the published papers found that indeed, there is a significant relationship between Math Anxiety and Performance among high school Filipino students (Estonanto, 2018; Ablian et al., 2022; Flores, 2019; Dela Cruz et al., 2022; Pinugu et al., 2023, Macabodbod, 2023; Gonzales, 2024).

This is negated by the Escarez et al., (2022) stating that there is no relationship between Math Anxiety and Performance.

The Debilitating Anxiety Model, also known as Cognitive Interference Theory (Wine, 1980), suggests that math anxiety (MA) results in lower mathematics performance. This model suggests that MA impacts three stages of performance; pre-processing, processing, and retrieval of mathematics knowledge (Carey et al., 2016). Further, the model proposes that MA obstructs mathematical problem solving by reducing the processing and storage capacity of working memory due to worrying (Ashcraft & Moore, 2009; Eysenck & Calvo, 1992). This assumption is supported by a series of empirical studies exploring the link between math anxiety (MA) and performance (e.g., Ashcraft & Kirk, 2001; Justicia-Galiano, Martín-Puga, Linares & Pelegrina, 2017; Ramirez et al., 2018; Skagerlund et al., 2019; Vukovic et al., 2013). Ashcraft and Krause (2007), for example, reported that individuals with high MA performed significantly lower in arithmetic problems of high working memory demand than their peers with low or moderate MA. Thus, it appears that math anxiety (MA) impairs working memory function, resulting in diminished mathematics performance among individuals with high levels of MA.

EVIDENCE-BASED LEARNING OPTIMIZATION PLAN FOR HIGH SCHOOL FILIPINO STUDENTS

The output of the study is the proposed evidence-based learning optimization plan for high school Filipino students. An implementation of this plan can be done in schools which will help mathematics teachers in conducting the interventions. Periodic assessment and evaluation shall be done in the improvement of the intervention tools and revision of the intervention schedule. This will help students improve their math performance especially students who are at risk of failing in mathematics and eventually academic performance. In addition, the adoption may greatly help students who are struggling in mathematics.

Rationale

This aims to address the Math Anxiety reduction and consequently the improvement of Math performance, particularly those who are at risk of failing. This rationale is grounded in the recognition that math anxiety reduction significantly improves math performance and is fundamental for success in various academic disciplines and essential for navigating real-world situations.

The implementation of this plan seeks to provide targeted support and intervention for students who are at risk of high math anxiety and poor math performance. These students may have encountered challenges in grasping mathematical concepts, understanding problem-solving strategies, or applying mathematical skills to real-life scenarios. By focusing on this specific group of students, the program aims to address their individual needs, bridge learning gaps, and foster a solid foundation in math teaching. This plan acknowledges that a one-size-fits-all approach may not effectively meet the diverse learning needs of students. By tailoring interventions, instructional strategies, and learning materials, this can provide personalized support to students at risk of higher math anxiety and poorer math performance. This approach recognizes the importance of differentiating instruction and providing individualized learning experiences to ensure optimal growth and academic progress.

Moreover, this aligns with the goal of inclusive education, which emphasizes providing equitable opportunities for all learners, regardless of their academic background or proficiency level. By offering targeted support, the program aims to empower students who may have been marginalized or struggled with math, enabling them to catch up, bridge gaps, and experience academic success. Reducing math anxiety and improving math performance also contributes to the overall educational development of students. Strong math skills not only enhance problem-solving abilities but also foster critical thinking, logical reasoning, and analytical skills that are valuable across various disciplines and in the workplace. By strengthening these foundational skills, students can develop a solid academic foundation and become more confident, independent learners.

Furthermore, the implementation of this plan aligns with the broader objectives of the educational institutions to provide quality education and ensure that all students have equal opportunities to succeed academically. By implementing this, these schools demonstrate their commitment to supporting students' holistic development and preparing them for future academic pursuits and career pathways.

In conclusion, this initiative is justified by the need to improve academic performance, particularly in math anxiety reduction, among students at risk of failing. The program recognizes the importance of math skills for academic success and real-world applications. By providing targeted support, personalized instruction, and individualized learning experiences, this aims to address the specific needs of students, bridge learning gaps, and foster a solid foundation. This initiative aligns with the goals of inclusive education and contributes to students' overall educational development, empowering them to become confident, independent learners equipped with essential skills for future endeavors.

Objectives

To address the unique demands and difficulties that students have in this crucial academic area, math anxiety reduction strategies for the enhancement of math performance must be put into place. Since this study revealed that the higher the math anxiety, the poorer the math performance becomes, then, there is a stronger ground on the significance of reducing the math anxiety levels, which can have an impact on many areas of life, including math performance, overall academic performance, decision-making, problem-solving, and critical thinking. Students can build a solid foundation in mathematics, which is essential for their academic and future job success.

The first objective is evaluating students' level of math Anxiety is a necessary step in putting reduction measures into place. Using an available standardized tool to measure Math Anxiety, educators can learn more about the precise subject areas in which students struggle or are underachievers. By identifying these gaps, MA activities can be customized to meet the individual needs of each student, resulting in a more focused and efficient approach to the development of math skills.

Second objective is to improve students' Math conceptual knowledge. Memorization and procedural knowledge should not be the only priorities. The focus should be on conceptual understanding, which will help pupils understand the underpinning ideas and relationships of mathematical concepts. Students can use their knowledge in numerous real-life circumstances, develop critical thinking abilities, and confidently handle challenging problems by building a comprehensive understanding of numeracy concepts.

Third objective is to encourage interactive and fun learning experiences. Activities that actively include students in the learning process should be incorporated into MA reduction plans. Manipulatives, educational games, technological resources, and real-world examples can all be used in this regard. Students are more likely to stay motivated, adopt a good attitude about math, and actively engage in their own skill development when learning environments are interesting and participative.

Lastly, the final objective is to monitor progress and provide ongoing support. Regular assessment and progress monitoring are crucial components of MA reduction measures. By continuously evaluating students' progress, educators can track their growth, identify areas that require further attention, and make necessary adjustments to the remediation strategies. Ongoing support, feedback, and encouragement are also essential to keep students motivated, build their confidence, and foster a growth mindset towards math skills.

Scheme of Implementation

The scheme of implementation for the enhancement of the plan will follow a systematic process to ensure proper approval, collaboration, and implementation within the identified public secondary schools. The steps are as follows:

1. Presentation to Thesis Advisory Committee and Dean of the College of Education. The researcher will first present the enhanced Math Anxiety Reduction Program to the Chairman of the Thesis

Advisory Committee and the Dean of the College of Education in Cebu Technological University – Main Campus. The researcher will seek their recommendation and support for the program's enhancement implementation. The insights and feedback from these academic authorities will contribute to the program's refinement and strengthen its validity.

2. Proposal submission to Principals' Office. Once the program has received the endorsement from the Thesis Advisory Committee and Dean of the College of Education in Cebu Technological University - Main Campus, the researcher will submit the proposal to the principals' office of Cangawa National High School CNHS). The proposal will outline the goals, objectives, and implementation plan of the enhanced program.
3. Approval from Principal. The researcher will seek approval from the Principal of the CNHS. This approval ensures that the program aligns with the schools' vision, mission, and educational objectives. The principal's support is crucial for the successful implementation and integration of the program into the schools' curriculum and activities.
4. Collaboration with Mathematics Teachers through Learning Action Cell (LAC) sessions. Once the approval is obtained, the researcher will encourage and collaborate with the mathematics teachers in the identified schools through Learning Action Cell (LAC) sessions. LAC sessions provide a platform for collaborative professional development and knowledge sharing among teachers. During these sessions, the researchers will introduce the program, explain its objectives, share instructional strategies, and discuss its implementation process. The mathematics teachers' input and feedback will be sought to ensure their active participation and ownership of the program.
5. Informing School Administrators. The researcher will work closely with the mathematics teachers to inform the school administrators about the inclusion and implementation of the proposed remediation measures. The researcher will present the program's details, expected outcomes, and implementation timeline to the school administrators, seeking their support and cooperation. Open communication and collaboration between the researchers, teachers, and school administrators will facilitate a smooth implementation process and create a supportive environment for the program.
6. Implementation of the Math Anxiety Reduction Program. Once all necessary approvals and collaborations are in place, the enhanced remediation program will be implemented in the identified public secondary school. The program's activities, instructional materials, and assessment tools will be employed to provide targeted support and interventions for students at risk of high MA. Regular monitoring and evaluation will be conducted to assess the program's effectiveness and make necessary adjustments as needed.

Math in Action: A Practical Math Experience

Objective: To showcase the relevance and practical applications of math in everyday life, making the subject more relatable and reducing student anxiety.

Innovative Activities	**Materials Needed**	**Persons To be involved**
Introduction to Math Anxiety and Relevance: Math Anxiety Workshop Steps: Conduct a Survey: Start with a survey to gauge students' current feelings about math and their anxiety levels. Presentation: Offer a presentation explaining math anxiety and its impact. Guest Speakers: Invite professionals to discuss how math is integral to their work.	Survey forms for self-assessment Presentation slides on math anxiety Personal anecdotes from professionals using math in various fields	Math teacher or counselor Guest speakers (professionals in fields where math is used) Math students
Practical Math Activities Activity 1: Cooking with Fractions	Recipe ingredients (measured in fractions) Measuring cups and spoons	Cooking instructor or chef Students

Steps: Recipe Selection: Choose recipes that require fraction conversions (e.g., doubling or halving recipes). Cooking Session: Have students prepare a dish, using fractions for measurements and conversions. Discussion: Discuss how fractions are used in cooking and the importance of precision.	Recipe cards	
Building a Miniature Model Steps: Design Brief: Provide students with a simple architectural design challenge (e.g., building a model house). Planning: Students create scaled drawings on graph paper. Construction: Using measurements, students build a miniature model. Reflection: Discuss how geometry and measurement play a role in architecture and design.	Graph paper Rulers Cardboard or foam board Scissors, glue, and markers Persons Involved:	Math teacher Art teacher or local architect
Math and Technology Integration Math in Video Games Steps: Demo Games: Introduce students to educational video games that emphasize math skills. Play Session: Allow students to play games and solve math-related challenges. Discussion: Discuss the math concepts used in game design and how math enhances gameplay.	Computers or tablets with gaming software Game-based learning apps (e.g., Prodigy Math, DragonBox	Tech specialist or game developer Students
Data Analysis with Excel Steps: Introduction: Teach students basic data analysis techniques using Excel or Google Sheets. Hands-On Activity: Analyze sample datasets, create charts, and interpret results. Reflection: Discuss how data analysis is used in various fields such as business, research, and sports.	Computers with Microsoft Excel or Google Sheets Sample datasets (e.g., sports statistics, environmental data)	IT teacher or data analyst Students
Math in the Community Local Business Math Challenge Steps: Business Brief: Collaborate with local businesses to create math-related challenges (e.g., budgeting for a small business). Challenge: Students solve real-life math problems related to the businesses' operations. Presentation: Have students present their solutions and discuss the practical applications of the math involved.	Information from local businesses (e.g., pricing, inventory) Worksheets and calculators	Representatives from local businesses Students
Math Scavenger Hunt Steps: Create Clues: Develop a scavenger hunt with clues that involve solving math problems (e.g., using	Materials Needed: Scavenger hunt clues and worksheets Prizes or certificates	Persons Involved: Math teacher Students

coordinates, calculating distances). Scavenger Hunt: Organize a hunt around the school or community. Debrief: Review the problems encountered and discuss their practical applications.		
Reflect and Celebrate Activity: Math Showcase Event Steps: Prepare Projects: Have students prepare presentations or displays of the projects they completed during the activities. Showcase Event: Organize an event where students present their work and explain how math was used. Celebrate: Provide certificates or awards to recognize students' efforts and achievements.	Materials Needed: Display boards for projects Certificates of participation Refreshments	Persons Involved: Students Teachers Parents and community members

Math Wonderland: A Journey into the Magic of Mathematics

Objective: To cultivate a genuine interest and appreciation for math by engaging students in creative, hands-on activities that highlight the beauty and utility of mathematics.

Innovative Activities	**Materials Needed**	**Persons To be involved**
Math Exploration Days Activity: Math Adventure Week Steps: Daily Themes: Design each day of the week around different math themes such as geometry, algebra, statistics, and number theory. Engaging Activities: Plan activities for each theme, including: Geometry Day: Build 3D shapes and explore their properties. Algebra Day: Solve real-world problems using algebraic equations. Statistics Day: Conduct surveys, collect data, and create graphs. Number Theory Day: Explore patterns and sequences in nature. Guest Speakers: Invite guest speakers to share how math is used in their professions and hobbies. Showcase: End the week with a showcase where students present their projects and discoveries.	Various math puzzles and games Materials for hands-on projects (e.g., building materials, art supplies) Computers or tablets with math apps	Math teachers Guest speakers (e.g., mathematicians, artists) Students
Math in the Arts: Math and Music Steps: Music and Rhythm: Explore the mathematical aspects of music such as rhythm, beat, and scales. Create Music: Have students create their own music compositions using mathematical patterns (e.g., rhythmic sequences, intervals). Perform: Students perform their compositions and discuss the math involved.	Materials Needed: Musical instruments Software for music creation Graph paper and rulers	Persons Involved: Music teacher or musician Math teacher Students

Mathematical Art Steps: Art Creation: Use mathematical concepts to create artwork, such as fractals, tessellations, or geometric patterns. Gallery Walk: Organize a gallery walk where students display and explain their mathematical art. Reflection: Discuss how math and art intersect and inspire each other.	Materials Needed: Art supplies (e.g., colored pencils, markers, paper) Templates for geometric shapes Software for digital art	Persons Involved: Art teacher Math teacher Students
Real-World Math Challenges Math in the Community Steps: Problem Solving: Collaborate with local businesses or community projects to create math challenges related to real-world problems (e.g., budgeting for a local event). Project Work: Students work on solving these challenges and present their solutions. Community Involvement: Invite community members to review and discuss students' work.	Materials Needed: Information from local businesses or community projects Worksheets and calculators	Persons Involved: Local business owners Community project leaders Students
Math and Technology Fair Steps: Tech Projects: Have students develop tech projects that involve math, such as coding simple games or apps. Fair: Host a technology fair where students showcase their projects. Discussion: Discuss how math is fundamental in technology and innovation.	Materials Needed: Computers and tablets Coding software or apps Display materials for projects	Persons Involved: IT teacher or coder Math teacher Students
Math Game Day Steps: Game Stations: Set up stations with different math games and activities. Play and Learn: Students rotate between stations, playing games and solving puzzles. Competitions: Organize friendly competitions or tournaments with math-themed games.	Materials Needed: Math board games (e.g., Math Bingo, Math Jeopardy) Interactive math apps	Persons Involved: Math teacher Students
Escape Room Challenge Steps: Create Puzzles: Design escape room challenges that require solving math problems to unlock clues. Escape Room: Students work in teams to solve puzzles and “escape” from the room. Debrief: Reflect on the math concepts used and the problem-solving strategies.	Materials Needed: Escape room puzzles and clues Locks and keys (for physical escape rooms) or digital escape room software	Persons Involved: Math teacher Students
Math Carnival Steps:	Materials Needed: Booths for math-	Persons Involved: Students

Carnival Setup: Create booths with various math games, puzzles, and interactive activities. Participation: Students and families participate in the carnival, earning tickets or stamps for each activity. Awards: Recognize participants with certificates and prizes for their enthusiasm and achievements.	related games and activities Prizes and certificates	Teachers Parents and community members

Innovative Professional Development Plan for Math Teachers

Objective: To enhance math teaching strategies through targeted professional development, collaborative practices, and the integration of innovative tools and methodologies.

Innovative Activities	**Materials Needed**	**Persons To be involved**
Personalized Professional Development Activity: Tailored Training Workshops Steps: Needs Assessment: Conduct surveys or interviews to identify specific areas where teachers feel they need improvement or support. Customized Workshops: Organize workshops based on the identified needs, such as differentiated instruction, technology integration, or advanced pedagogical strategies. Follow-Up Support: Provide follow-up sessions or one-on-one coaching to help teachers implement new strategies and address challenges.	Materials Needed: Needs assessment surveys Workshop materials (presentations, handouts, interactive tools) Access to educational research and resources	Persons Involved: Math education experts Professional development coordinators Math teachers
Integration of Technology Activity: Tech-Enhanced Math Classroom Steps: Technology Training: Offer training sessions on using educational technology effectively in the math classroom. Classroom Implementation: Assist teachers in incorporating technology into their lesson plans, such as using digital tools for graphing, simulations, or interactive activities. Evaluation and Feedback: Collect feedback on the effectiveness of technology integration and provide additional support as needed.	Materials Needed: Interactive whiteboards or digital projectors Math software and apps (e.g., Desmos, GeoGebra) Tablets or laptops	Persons Involved: Tech integration specialists Math teachers Students
Collaborative Learning Communities Activity: Math Teacher Learning Circles Steps: Form Learning Circles: Establish small groups of math teachers who meet regularly to discuss teaching practices, share experiences, and solve common challenges. Focus Topics: Address specific topics in each meeting, such as inquiry-based learning, formative assessment techniques, or effective use of manipulatives. Action Research: Encourage teachers to conduct action research projects in their classrooms and share their findings with the group.	Materials Needed: Meeting space (physical or virtual) Collaborative tools (e.g., shared documents, discussion forums) Resources for lesson planning and teaching strategies	Persons Involved: Math teachers Facilitators (experienced educators or coaches) Math education researchers

Innovative Teaching Methods Activity: Exploring New Pedagogies Steps: Workshop Series: Host a series of workshops on innovative teaching methods, such as flipped classrooms, project-based learning, or gamification. Pilot Programs: Allow teachers to pilot new teaching methods in their classrooms and provide support and resources for implementation. Reflect and Share: Facilitate reflection sessions where teachers share their experiences, challenges, and successes with new pedagogies.	Materials Needed: Research articles and case studies Interactive lesson plans Classroom materials for new methodologies	Persons Involved: Pedagogical experts Math teachers Educational researchers
Data-Driven Instruction Activity: Using Data to Inform Teaching Steps: Data Workshops: Conduct workshops on analyzing and interpreting student assessment data to inform instructional decisions. Data Tools: Provide training on using data analysis tools to track student progress and identify areas for improvement. Action Plans: Help teachers develop action plans based on data insights, including targeted interventions and differentiated instruction strategies.	Materials Needed: Student assessment data Data analysis tools and software Professional development materials on data interpretation	Persons Involved: Data analysts Math teachers Educational leaders
Cross-Disciplinary Collaboration Activity: Math-Science Integration Projects Steps: Collaborative Planning: Organize planning sessions where math and science teachers collaborate to create interdisciplinary projects and lessons. Project Implementation: Implement projects that integrate math with science topics, such as data analysis in scientific experiments or mathematical modeling of physical phenomena. Evaluation: Assess the impact of interdisciplinary projects on student engagement and learning outcomes.	Materials Needed: Cross-disciplinary project guides Collaborative planning tools Resources for interdisciplinary lessons	Persons Involved: Math and science teachers Curriculum developers Students
Reflective Practice and Continuous Improvement Activity: Teacher Reflection and Feedback Sessions Steps: Structured Reflection: Encourage teachers to keep reflection journals documenting their teaching practices, challenges, and growth. Peer Observations: Implement a peer observation system where teachers observe each other's lessons and provide constructive feedback. Feedback Integration: Use feedback from observations and student input to refine teaching strategies and practices continuously.	Materials Needed: Reflection journals Feedback forms Peer observation tools	Persons Involved: Math teachers Observers or mentors Students (for feedback)
Celebrating Success and Best Practices Activity: Math Teaching Excellence Awards Steps: Nomination Process: Allow teachers to nominate peers for	Materials Needed: Award certificates and prizes Celebration event materials	Persons Involved: School leaders Math teachers Students and parents

awards based on innovative teaching practices, student impact, or contributions to the math community. Award Ceremony: Host an event to celebrate and recognize teachers' achievements and share best practices with the broader school community. Showcase: Provide a platform for award winners to present their successful strategies and inspire others.	(e.g., presentations, refreshments) Nomination and evaluation forms	
Mentorship and Coaching Activity: Math Mentorship Program Steps: Pairing: Pair experienced math teachers with less experienced teachers to provide guidance and support. Regular Meetings: Schedule regular meetings for mentors and mentees to discuss teaching challenges, set goals, and reflect on progress. Support Resources: Provide mentors with resources and training on effective mentorship practices and support them in their role.	Materials Needed: Mentorship agreements and guidelines Resources for professional growth (e.g., books, articles) Reflection and goal-setting tools	Persons Involved: Experienced math teachers (mentors) Less experienced teachers (mentees) Mentorship coordinators
Innovative Teaching Showcases Activity: Math Teaching Expo Steps: Event Planning: Organize an expo where teachers can showcase their innovative teaching methods, tools, and classroom activities. Interactive Sessions: Include interactive sessions where attendees can observe and participate in different teaching strategies and approaches. Feedback and Discussion: Collect feedback from participants and facilitate discussions on how to implement showcased practices in their own classrooms.	Materials Needed: Presentation materials (posters, slides) Space for exhibits and demonstrations Evaluation forms and feedback tools	Persons Involved: Math teachers Students (optional, for demonstration purposes) School community (administrators, parents)
Recognition and Incentives Activity: Peer Recognition Program Steps: Nomination Process: Develop a system for teachers to nominate peers who have demonstrated outstanding teaching practices, innovation, or collaboration. Award Ceremony: Host an event to recognize and celebrate the achievements of nominated teachers. Publicize Success: Share success stories and effective practices with the broader school community to inspire others.	Materials Needed: Recognition certificates or awards Celebration materials (e.g., event space, refreshments) Nomination forms	School administrators Math teachers Students (optional, for involvement)

Innovative Plan for Enhancing Administrative and Parents' Support for Math Education

Objective: To strengthen the parent's and administration's role in supporting math education by developing strategic initiatives, fostering a culture of collaboration, and ensuring the allocation of resources effectively.

Innovative Activities	**Materials Needed**	**Persons To be involved**
Resource Allocation and Infrastructure Activity: Optimizing Resource Allocation Steps: Resource Inventory: Conduct an inventory of current math resources, including textbooks, technology, and manipulatives. Budget Planning: Develop a budget plan that prioritizes the acquisition of essential resources and technology for math education. Grant Applications: Seek grants or additional funding to support math programs and resources, and streamline the process for teachers to request resources.	Materials Needed: Budget planning tools Inventory of current math resources and technology Proposal templates for additional resources	Persons Involved: Budget officers Math department heads Teachers
Collaborative and Supportive Culture Activity: Building a Collaborative Math Culture Steps: Collaboration Platforms: Create platforms for math teachers to collaborate and share best practices, such as online forums or regular meetings. Community Involvement: Engage community partners and parents in supporting math education through events, tutoring programs, or mentorship. Recognition: Develop a recognition program to celebrate outstanding contributions to math education and foster a positive and supportive environment.	Materials Needed: Collaboration tools (e.g., shared digital platforms) Meeting schedules and agendas Recognition programs	Persons Involved: Math teachers School leaders Community partners
Parent and Community Engagement Activity: Math Engagement Initiatives Steps: Outreach: Develop outreach materials to inform parents and the community about the importance of math education and how they can support it. Engagement Events: Host events such as math nights, workshops, and family math activities to engage parents and the community in math education. Feedback: Collect feedback from parents and community members to gauge the effectiveness of engagement initiatives and make improvements.	Materials Needed: Outreach materials (newsletters, flyers) Event planning resources Feedback mechanisms	Persons Involved: Parent-teacher associations Community leaders Math educators
Monitoring and Evaluation Activity: Continuous Improvement Process Steps: Evaluation Plan: Develop an evaluation plan to assess the effectiveness of math programs, initiatives, and support systems. Regular Assessments: Conduct regular assessments and gather feedback from teachers, students, and parents to evaluate progress. Adjustments: Use evaluation results to make data-driven adjustments and improvements to math education strategies and support.	Materials Needed: Evaluation tools (surveys, assessment forms) Performance metrics Reporting systems	Persons Involved: Evaluation teams School administrators Math teachers

Peer-Driven Excellence in Math Education: A Collaborative Approach

Objective: To create a dynamic and supportive network among math teachers, promoting collaboration, professional growth, and the sharing of effective teaching strategies.

Innovative Activities	**Materials Needed**	**Persons To be involved**
Establish Collaborative Learning Communities Activity: Math Teacher Learning Circles Steps: Form Circles: Create small groups of math teachers who meet regularly to discuss teaching practices, challenges, and solutions. Focus Topics: Organize meetings around specific themes, such as differentiated instruction, integrating technology, or teaching complex concepts. Shared Resources: Encourage members to share lesson plans, resources, and ideas, and provide a platform for collaborative document sharing.	Materials Needed: Meeting spaces (physical or virtual) Collaborative tools (e.g., shared documents, discussion boards) Resource materials (e.g., lesson plans, research articles)	Persons Involved: Math teachers Facilitators (experienced educators or instructional coaches) Administrators
Peer Observation and Feedback Activity: Classroom Observation Program Steps: Observation Schedule: Develop a schedule for peer observations, allowing teachers to observe each other's classes. Feedback Framework: Provide a structured framework for feedback that focuses on specific aspects of teaching, such as student engagement, instructional techniques, and use of resources. Reflective Discussions: Hold follow-up meetings where observers and the observed discuss observations, share insights, and plan improvements.	Materials Needed: Observation checklists and feedback forms Scheduling tools for observations Training materials for giving and receiving constructive feedback	Persons Involved: Math teachers Peer observers School administrators

Transforming the Culture of Math Education: An Innovative Approach

Objective: To create a positive, engaging, and collaborative culture in math education that promotes enthusiasm for learning, encourages professional growth, and integrates math seamlessly into the school community.

Innovative Activities	**Materials Needed**	**Persons To be involved**
Cultivate a Growth Mindset Activity: Growth Mindset Workshops and Campaigns Steps: Workshops for Teachers: Conduct workshops for math teachers on fostering a growth mindset in their students, emphasizing perseverance, and celebrating effort and progress. Student Campaigns: Launch a school-wide campaign to promote a growth mindset, including posters, inspirational quotes, and success stories. Classroom Integration: Encourage teachers to integrate growth mindset principles into their teaching practices and student interactions.	Materials Needed: Workshop materials (presentations, handouts, videos) Growth mindset literature Visual displays (posters, bulletin boards)	Persons Involved: Math teachers School counselors or psychologists Students

Create a Supportive and Inclusive Math Environment Activity: Math Support and Inclusion Programs Steps: Support Programs: Develop programs to provide additional support for students who may struggle with math, including tutoring, mentoring, and enrichment opportunities. Inclusive Practices: Train teachers on inclusive teaching practices and differentiated instruction to meet the diverse needs of all students. Resource Accessibility: Ensure that all students have access to necessary resources and support to succeed in math.	Materials Needed: Support materials (e.g., tutoring resources, inclusive teaching strategies) Training on inclusivity and differentiated instruction Resources for creating an inclusive classroom	Persons Involved: Math teachers Special education staff Students
Promote a Positive and Inspiring Math Culture Activity: Math Culture Initiatives Steps: Inspiration Campaign: Create a campaign to highlight the importance and excitement of math, including inspirational stories of mathematicians and real-world applications. Math Clubs and Events: Establish math clubs and events that promote a positive math culture and provide students with opportunities to engage with math outside the classroom. Guest Speakers: Invite guest speakers from various math-related fields to inspire and engage students with real-world applications of math.	Materials Needed: Inspirational materials (e.g., posters, success stories) Cultural initiatives (e.g., math clubs, guest speakers) Celebration tools	Persons Involved: Math teachers School leaders Students

In the evaluation phase, feedback forms and reflection journals can be very helpful.The teachers should gather feedback from students on their experience and how their perception of math has changed and encourage students to write in reflection journals about what they learned and how their anxiety levels have changed.

By following this scheme of implementation, the researcher can ensure that the enhanced remediation program receives the necessary approvals, engages the collaboration of mathematics teachers, and is successfully implemented in Cangawa National High School, Buenavista Bohol. The involvement of school administrators, teachers, and the researcher will foster a cohesive and supportive environment for the implementation of the program, ultimately benefiting the students and improving their academic performance in Math.

CONCLUSION

It is concluded that there is an inverse relationship between Math anxiety and Math performance, wherein, the higher the math anxiety level, the poorer the math performance will be. Furthermore, there are multidimensional factors contributing to Math Anxiety and Performance including individual student factors, teacher factors, home environment and relationship, Learning environmental factors, subject factors, cultural orientation, and Peer factor.

RECOMMENDATIONS

Based on the findings of the scoping review, the following are hereby recommended:

1. That the Department of Education shall create new or strengthen existing relevant program/s that will address the reduction of Math anxiety among Filipino high school students to facilitate better Math performance.

2. That the Department of Education creates a system that will periodically evaluate the Math anxiety and the actual factors contributing to it in various basic educational institutions to promptly assist the needs of the learners in their contexts.
3. That an action plan be created based on these findings so basic education institutions can adopt and implement.

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