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Math Anxiety and Development of an Instructional Material to Improve Performance in Mathematics

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ABSTRACT

In the quest to improve mathematics proficiency, it is worthwhile to emphasize not only enhancing instructional strategies but also developing a positive attitude towards mathematics. One of the things that hinder students' performance is math anxiety, which interferes with cognitive and learning processes. This research determined the level and causes of math anxiety among students and developed an instructional material to improve their performance in mathematics. The study is an educational design research (EDR). Data on the levels of math anxiety were gathered from 307 Mathematics students, and the causes were examined through focus group discussions with 50 students and 4 mathematics specialists. Using this data, an instructional material was developed and pilot implemented in a mathematics class of forty-two (42) students. Findings revealed that 80.13% of the student-respondents had Average to High Math Anxiety. The causes of math anxiety were mainly negative experiences such as past failures, pressure to find the correct answers, embarrassment in front of peers, and strict teachers. Instructional materials that reduce math anxiety are easy to understand, contain varied activities, and incorporate additional online resources. Analysis of paired samples t-test conducted using SPSS resulted to a t-value of -12.513 and a p-value of 0.000, revealing that the instructional material significantly lowered math anxiety and improved the student's performance in mathematics. It is recommended that universities expand guidance and counseling services to recognize math anxiety as an integral factor in students' mental health and conduct a review of the mathematics instructional materials to evaluate their adequacy in lowering the math anxiety.

Keywords: Math Anxiety; Causes of Math Anxiety, Mathematics Instructional Material, Mathematics Learning Approach

INTRODUCTION:

One of the problems plaguing Philippine education is students' poor mathematics performance (Sison, 2022; Filoteo, 2021; Bernardo et al., 2022). According to a UNESCO (2012) study on basic mathematics education, students do not have the expected knowledge and competencies in mathematics across both national and international levels. While many countries struggle in this aspect, the Philippines has lagged way behind other countries, as revealed by the Trends in International Maths and Science Study (TIMSS) 2019 survey. With the country's consistently poor performance in the TIMSS rankings, the UNESCO report describes the condition of mathematics education in the Philippines as being in a "crisis state."

Aside from mathematical competencies, the student's attitude towards mathematics is also a consideration. The UNESCO study adds that even among the students from countries who rank high in the TIMSS survey (Singapore, Korea, Japan), many did not like mathematics or see its usefulness. Therefore, the academe needs to put effort not only into improving mathematical competency but also into fostering a positive attitude towards mathematics itself. When students view math negatively, it impedes their performance in the subject. The correlation between attitude and performance is a global phenomenon: countries with lower levels of math anxiety had higher Program for International Student Assessment (PISA) math scores (Foley et al., 2017). In other words, there is a link between students' attitudes toward mathematics and how well they perform in math tests.

This adverse emotional response towards mathematics is more formally termed math anxiety. Math anxiety is described as the "feeling of tension, apprehension, or fear that interferes with math performance" (Ashcraft, 2002), or "feelings of tension, panic and fear that one experiences in the face of tasks requiring numerical calculations or mathematical problems" (Ilhan, 2015). This is a phenomenon that many people experience. A study by the University of Granada (2009) estimates that about 6 out of 10 university students experience math anxiety, with women experiencing it more than men. The same study details the symptoms of math anxiety as "tension, nervousness, concern, worry, edginess, impatience, confusion, fear, and mental block" when studying mathematics. Further, even people with high IQ experience math anxiety (Ashcraft, 2002). Thus, regardless of their perceived intelligence level, people feel apprehensive towards math.

Notably, math anxiety is not a reaction people are born with but rather a learned emotional response. It has implications for the future employment of students and their overall performance while in school. Math anxiety correlates with other types of anxiety, most significantly with test anxiety, suggesting that a person anxious about mathematics would also feel unease with taking tests in general (Ashcraft, 2002).

This study was based on the Debilitating Anxiety Model (Hembree, 1990), which states that math anxiety leads to poor performance in mathematics for two reasons: math avoidance and cognitive interference. Meta-analysis indicated that adolescents with math anxiety tend to avoid math-related situations, leading to fewer learning opportunities. People with high math anxiety also tend to avoid processing mathematical problems or rush their answers, causing poor performance.

Additionally, the Debilitating Anxiety Model posits that math anxiety causes cognitive interference. Math anxiety activates the neural pain network and impairs the working memory functions of the brain (Ashcraft & Krause, 2007). This is also supported by functional magnetic resonance imaging (fMRI) brain scans of students while solving addition and subtraction problems, which found that math anxiety activates the part of the brain linked with fear while at the same time impairing the working memory and reasoning parts of the brain. Thus, children with high levels of math anxiety felt the same fear as if faced with physically threatening situations, such as seeing a dangerous animal (Young, et. al, 2012).

This is also consistent with the Processing Efficiency Theory (Eysenck & Calvo, 1992), which hypothesizes that general anxiety disrupts ongoing working memory processes because anxious individuals devote more attention to their intru-

sive thoughts and worries rather than the task at hand. This is also supported by a study (Dagaylo-an & Tancinco, 2016), which found that a negative correlation exists between math anxiety and the high school mathematics grade of students.

Given the immense effect of math anxiety on performance, there is a need to address students' qualms about mathematics to improve their math performance. In the quest to improve mathematics proficiency, it is worthwhile to emphasize not only enhancing instructional strategies but also developing a positive attitude towards mathematics. Based on the above-mentioned gap, this study aimed to determine the level and causes of math anxiety among students and develop instructional material to alleviate math anxiety and improve mathematics performance.

Mathematics instructional materials have been viewed as essential resources for learning mathematical content, and teachers are accustomed to using them to guide instruction (Stein & Kim, 2009). Teachers often rely heavily on textbooks for many decisions, such as the content to be discussed, methods to be used, and exercises to assign to their students (Ozgeldi & Cakiroglu, 2011). It is, therefore, reasonable to think that instructional materials such as mathematics textbooks are integral to mathematics teaching and learning.

Instructional materials play a crucial role in mathematics education as they enhance students' academic skills. Several researchers found that using instructional materials can significantly increase students' performance compared to the traditional chalk-and-talk method of teaching (Dahar & Faize, 2011; Andersen, 2002; Selga, 2013; Espinar & Ballado, 2017). Similarly, using workbooks is beneficial, resulting in higher scores in standardized tests and the power of self-direction, retention, fundamental process skills, reasoning ability, and solving problems (Gray, 2007).

The use of instructional materials not only has implications inside the classroom but also in the general math competence of the country. One of the factors for the poor performance of Filipino students in national exams such as the National Elementary Achievement Test and National Secondary Achievement Test is the inadequate and inappropriate instructional materials teachers use (Morella, 2004). The deficiency of instructional materials such as textbooks, manuals, and science equipment is also a factor in the poor quality of education in the country is also (Samonte, 2008). Further, students who were most successful in the TIMSS are more likely to have better instructional materials, such as books, technological support, and supplies (Mullis, et. al, 2016).

However, it is not only the quantity of resources that is a problem in the Philippines but also the quality and appropriateness that is an issue. Dr. Michael Tan (2015), Chancellor of the University of the Philippines Diliman, opines that many university professors prefer to use foreign textbooks rather than develop their own. This results to textbooks that are not appropriate for the local context; for example, having exercises involving gallons and liters instead of local measurements that are still used in daily life, such as gantas and cavans for rice.

Thus, increasing the availability and quality of instructional materials is essential in improving Filipino students' mathematics performance. With the new tertiary curricula resulting from the K-to-12 Education System, it is imperative that new materials be created to address the needs of teachers and students. The instructional material developed from this research study would increase the resources available to Filipino learners.

Methodology

The study utilized educational design research (EDR) to develop the instructional material to address students' math anxiety. The design-based research process, as formalized by Easterday, Lewis & Gerber (2014) follows 6 steps: 1) focus, 2) understand, 3) define, 4) conceive, 5) build, and 6) test.

The study started with the focus phase, wherein the scope of the research was specified to mathematics students at a state university, and the general problem of math anxiety was observed among them. In the understanding phase, the math anxiety levels and causes were investigated using quantitative and qualitative data. The level of math anxiety among students was measured using the

Abbreviated Math Anxiety Rating Scale (A-MARS) created by Alexander and Martray (1989). The A-MARS uses a 5-point Likert scale from 1 (low anxiety) to 5 (high anxiety). The questionnaire has an internal reliability of 0.96, test-retest reliability of 0.90, and in terms of validity, it has a 0.92 correlation with the Math Anxiety Rating Scale. The questionnaire respondents were 307 Mathematics students from the five campuses of a state university, which were randomly selected.

Further, qualitative data on the causes and triggers of math anxiety were examined through focus group discussions (FGDs) following FGD protocol. The key informants for the FGDs were fifty (50) students taking various mathematics courses and four (4) mathematics professors and instructors. The student informants were chosen through random sampling from among the 307 respondents, while the mathematics teachers were selected through purposive sampling. To interpret the mean level of math anxiety from the A-MARS, the researcher constructed the following arbitrary scale: Thematic analysis was employed to interpret the data from focus group discussions. Thematic analysis is a method in qualitative research for "identifying, analyzing, and reporting patterns (themes) within data" (Braun & Clarke, 2006). This method involves searching specific themes or patterns across the whole data set. The study followed the six steps of thematic analysis: 1) familiarization with the data through transcription; 2) coding; 3) searching for themes; 4) reviewing themes; 5) defining and naming themes; and 6) producing the report. Based on the data gathered, the study proceeded to the define phase, where goals and assessments were set, taking into account the concerns that were important to the target population. From these, the conceiving phase involved developing the instructional material itself.

In the build phase, the instructional material was implemented in a mathematics class of 42 students for six (6) weeks. The instructional material was constructed per unit, which allowed iterations and adjustments to the material as it is used over time.

Lastly, the test phase consisted of evaluating the efficacy of the instructional material. The three variables of interest were 1) level of math anxiety, which was measured through the A-MARS; 2) performance of students in mathematics, which was measured through a researcher-made performance test that covered topics included in the instructional material; and 3) acceptability of the developed instructional material, which was measured through an adapted evaluation form.

To determine whether there was a significant decrease in math anxiety and increase in students' mathematics performance, the experimental method of pretest-posttest design was utilized. The research instrument for mathematics performance is a researcher-made test that underwent content validation by external experts and reliability testing, with a KR-20 coefficient of 0.831. The students' pretest and posttest scores were analyzed through paired samples t-test using SPSS.

In addition, acceptability of the developed instructional material was evaluated in terms of physical aspects, mathematics content and processes, instructional design, learning activities, and evaluation procedure. This was done by ten

Mean Math Anxiety Score	Description	Interpretation
1.00 – 1.49	Not at all	Very Low Math Anxiety
1.50 – 2.49	A little	Low Math Anxiety
2.50 – 3.49	A fair amount	Average Math Anxiety
3.50 – 4.49	Much	High Math Anxiety
4.50 – 5.00	Very Much	Very High Math Anxiety

Table 1.
Arbitrary scale used in interpreting the level of math anxiety

(10) purposively chosen mathematics experts who were also handling the same mathematics course. The research instrument was adapted from Navejas (2017), wherein the evaluation form was validated by experts and tested for reliability, with a Cronbach alpha coefficient of 0.994.

Triangulation was conducted to ascertain the validity of qualitative data. After pilot implementation of the instructional material, member checking was done by conducting interviews with the participants. An external audit was also done by having the qualitative data evaluated by two (2) mathematics specialists who were not involved in the research.

Results and Discussions

Level of Math Anxiety Among Students

Level of Math Anxiety	Frequency	Percentage
Very Low Math Anxiety	3	0.98%
Low Math Anxiety	45	14.66%
Average Math Anxiety	144	46.91%
High Math Anxiety	102	33.22%
Very High Math Anxiety	13	4.23%
Total	307	100.00%

Table 2.
Levels of math anxiety among students

Results, as shown in Table 2, reveal that of the 307 respondents, three (3) or 0.98% had Very Low Math Anxiety, forty-five (45) or 14.66%, had Low Math Anxiety, one hundred forty-four (144) or 46.91% had Average Math Anxiety, one hundred two (102) or 33.22% had High Math Anxiety and thirteen (13) or 4.23% had Very High Math Anxiety. This is in line with findings of other research, wherein estimates of the prevalence of math anxiety range from 30% to 70% in a society (Dowker et al., 2016). The estimates vary widely because they are highly dependent on the population being sampled and the measures used. For instance, Hart and Ganley (2019) found that math anxiety is approximately normally distributed in the US population, and adults report only mild to moderate levels of math anxiety. One possible factor for the slightly higher level of math anxiety among the respondents in this study is their different experiences as students in the Philippine education system.

In addition, results of the A-MARS questionnaire, as shown in Table 3, revealed that the situations when students felt High Math Anxiety were taking a final exam in a math course (3.56), thinking about an upcoming math test 1 hour before (3.64), and receiving their final math grade (3.79). This indicates a predisposition for students to put more emphasis on grades rather than the learning process itself. On the other hand, students felt Low Math Anxiety when buying a mathematics textbook (1.89), walking into a math class (2.30), and reading a cash register receipt after a purchase (2.40). Students also reported that their mind goes blank, especially when trying to solve problems or remember formulas. For instance, Denise relates, "Ga-blanko ako sa exam kapag gina-nerbyos." (My mind goes blank in the exam when I'm nervous.) This supports the processing efficiency theory (Eysenck & Calvo, 1992), which states that math anxiety disrupts the ongoing working memory processes and is in concurrence with the Debilitating Anxiety Model (Hembree, 1990), which argues that math anxiety interferes with the pre-processing, processing, and retrieval of information.

Causes of Math Anxiety

Findings from the focus group discussion with students revealed four main themes that underlie their fear towards math: past failures, pressure to find the right answers, fear of being embarrassed in front of peers, and negative experiences with teachers. Table 4 gives an overview of these findings.

Indicator	Average Score	Interpretation
Studying for a math test.	2.89	Average Math Anxiety
Taking a final exam in a math course.	3.56	High Math Anxiety
Picking up math textbook to begin working on a homework.	2.51	Average Math Anxiety
Being given homework assignments of many difficult problems that are due the next class meeting.	3.15	Average Math Anxiety
Thinking about an upcoming math test 1 hour before.	3.64	High Math Anxiety
Receiving your final math grade.	3.79	High Math Anxiety
Opening a math or stat book and seeing a page full of problems.	3.13	Average Math Anxiety
Getting ready to study for a math test.	2.98	Average Math Anxiety
Being given a “pop” quiz in a math class.	3.25	Average Math Anxiety
Reading a cash register receipt after your purchase.	2.40	Low Math Anxiety
Being given a set of numerical problems involving addition to solve on paper.	2.67	Average Math Anxiety
Buying a math textbook.	1.89	Low Math Anxiety
Watching a teacher work on an algebraic equation on the board.	2.93	Average Math Anxiety
Signing up for a math course.	2.84	Average Math Anxiety
Listening to another student explain a math formula.	2.83	Average Math Anxiety
Walking into a math class.	2.30	Low Math Anxiety
Mean	2.93	Average Math Anxiety

Table 3.
Math Anxiety Levels of Students in Various Situations in the A-MARS

Codes	Theme
"getting a grade of 3.0 … traumatized me" "got a 79 in math … I get frustrated" "failed in first year algebra" "got a grade of 2.25 … lowered my self-esteem" "I got a zero. I was scared"	Past Failures
"even if you just miss one, all your answers will be incorrect" "once you don't understand the formula, you can't solve it" "if I don't know the formula, I feel discouraged"	Pressure to Find Right Answers
"you don't even know the answer and you get embarrassed" "once I'm asked to answer on the board, my mind goes blank" "nervous because they can, but I can’t" "once the majority says … I follow suit"	Embarrassment in Front of Peers
"my teacher was a perfectionist" "our teacher said, 'I'll fail you if you don't pass the final exam'" "some teachers who are insulting" "the teacher banged the student's head to the blackboard three times" "my mother trained us in math as if we were in the military"	Negative Experiences with Teachers

Table 4.
Causes of Math Anxiety from the Perspective of Students

Past failures.
Many students felt anxious about mathematics after getting low grades even though they put much effort into studying. Many students felt anxious about mathematics after getting low grades even though they put much effort into studying.

Richard said, "When I received a grade of 3.00 in Contemporary Mathematics. I did my best naman talaga, siguro 'yung teacher lang talaga 'yung ano. Na-trauma lang talaga ako doon." (I did my best, but I guess it depends on the teacher. It traumatized me.)

Janice also related that even though she had done well in math before, she had been discouraged because of failure. "Kat elementary hay nakaka-top 10 pa ako sa subject nga math. Pero kat nag-high school ako, umpisa ko first year algebra hay medyo wa ta eagi, medyo nabagsak eot-a ako hasta fourth year ag college. (In elementary, I was in the top 10 in math. But when I came to high school, I already failed in first year algebra. It continued until fourth year and college.)

Feelings of failure are exacerbated when a student gets a zero, whether on a quiz or an exam. Nancy shared, "Di ba basic lang, pero imo tang score hay zero. Sa sunod dayon hay nakuebaan ka eon gid. Basic pa nga lang, zero ka eon. Paano pa kaya ro next?" (When it's just basic and you get a zero, you'll be really nervous next time. If you got a zero on the basics, how much more in the next ones?)

This result is in consonance with the Psychological/Emotional aspect of Strawderman's (2011) Math Anxiety Model stating that experiencing failure in math exacerbates anxiety and leads to avoidance, thus resulting in more failures. This also ties in with Bandura's (1977) concept of self-efficacy. Receiving a low score, especially a zero, negates a student's efforts and makes them doubt their ability to solve math problems further.

Pressure to find the right answers.
Students also felt anxious about math because, unlike other subjects, there is a need to arrive at a specific answer. Deviating even a little or making a small mistake invalidated their whole solution. Katherine related her experience, "Nakakatakot kasi may time talaga na mali yung formula mo, kahit isa lang kulang, mali lahat ng sagot mo. Kapag mali lahat yung sagot, siyempre babagsak ka talaga no'n kaya magkakaroon ka ng anxiety." (It's scary because there are times when you have the wrong formula, even if you just miss one, all your answers will be incorrect. When all your answers are wrong, of course, you'll fail, so you get anxiety.) Dianne also comfirmed, "Sambilog mo abi nga mali, mali eon dayon tanan ing answer." (If you make just one mistake, your whole answer will be incorrect.)

Added to this, students felt that they have to memorize a lot of formulas in order to get the right answer. Lorraine said, "Para kakon hay nakaka-bobo nga nakakalito. Once abi nga indi mo maintindihan ro formula hay indi ka eon dayon ka-solve." (It makes me feel stupid and confused. Once you don't understand the formula, you can't solve it anymore.) These connect to the Intellectual/Educational aspect of the Math Anxiety Model by Strawderman (2011) stating that cognitive influences such a person's knowledge and skills affect their attitude towards mathematics.

Embarrassment in front of peers.
The fear of making mistakes and embarrassment in front of their classmates makes students more anxious about math. This especially happens when they must solve a problem or recite it in class.

Stacy said she feels most nervous "Kung ginatukso ikaw. Wa ka ngani it sabat tapos pinahiya ka pa." (When you're asked to recite. You don't even know the answer and you get embarrassed.) For her, being asked to answer in front of others was a particularly high-stress situation. "While ga-discuss si Ma'am, ginasundan ko man ro formula; pero once tinukso ka eon sa blackboard, parang wa eon, blangko." (While our teacher discusses, I can follow the formula; but once I'm asked to answer on the board, my mind goes blank.)

Students, especially in their teenage years, are very sensitive to the opinions of their peers. Natalie related, "Ginatukso pa ngani sanda kung amat sa prente kaya ginakuebaan. Nahuhuya sanda sa andang classmate kasi di nanda kaya." (They are asked to recite in front so

they get nervous. They get embarrassed in front of their classmates because they can't do it.)

On the other hand, the negative attitude of peers towards math also affects a student. Lorraine said, "Nadadala ako sa ibang tawo. Syempre iba abi sa aton hay hate gid a ro math, malisod nga subject. Once abi nga majority kanda hay, 'Malisod ro math; di mo kaya i-solve don.' napapasunod ka man." (I get swayed by other people. Of course, many people hate math; it's a difficult subject. Once the majority says, 'Math is difficult; you can't solve that', I follow suit.)

This ties to the Social/Motivational Aspect of the Math Anxiety Model (Strawderman, 2011), which states that negative attitudes towards math of peers strongly influence a person's outlook toward mathematics. A high-pressure environment thus leads to math-avoidant behavior.

Negative experiences with teachers.
Several students relayed that they started to fear math after encountering strict teachers, especially ones who punished them for poor performance. Some students reported receiving verbal insults from teachers. Richard shared, "Yung practice ng teacher namin noong high school because it affected among pag-study sa college. Ro pirming mueay, one hour, bilog nga klase. Tapos pilang adlaw hay quiz dayon, wa ka mat nasayran. Magturo man hay kadasig-dasig." (Maybe the practice of our high school teacher, it really affected us in college. He would chastise us for an hour, the whole class. Then, after a few days, he gave a quiz when we hadn't learned anything. He teaches too fast.) Rachel also shared that they were threatened with failing marks.

"Na-traumatize kasi ako nung time na sinabing, 'Babagsakin ko kayo kapag di nakapasa ng final exam. Sa midterm mababa kayong lahat. Pero pagbibigyan ko kayo sa final. Once na bagsak pa rin kayo, bahala na kayo. Kita-kita nalang tayo next year. Baka wala na 'tong subject na tayo by next year. Bahala kayo.'" (I got traumatized when our teacher said, "I'll fail you if you don't pass the final exam. You all got low scores in the midterms, but I'll give you a chance in the finals. If you still fail, it's your problem. Let's see each other next year. Maybe this course won't be available anymore. It's your problem.") Physical punishments did not only come from teachers but also from parents. Ralph said, "Kat elementary ako gina-pressure ako ni Mama ag Ate nga mataas ang grade. So kung di kaantigo mag-solve sa baeay, may katabi abi ako nga pamalo, so ginapilit ko ang sarili nga magsabat it tama." (When I was in elementary school, my mother and elder sister pressured me to get good grades. At home, when I didn't know how to solve, there was a paddle beside me, so I forced myself to answer correctly.)

Patrick shared his experience with his mother: "Si Mama kasi dati as in parang military gid a anang pag-training kakon sa math. Lahat ng hanger sa bahay nababali." (My mother trained us in math as if we were in the military. All hangers in our house got broken.)

These results match with the study of Caga (2015), which found that math anxiety significantly correlates with teacher factors such as formative and summative assessment practices and personality as to openness, extraversion, agreeableness, and neuroticism.

Acceptability of the Developed Instructional Material
Results presented in Table 5 show the acceptability of the instructional material in terms of physical aspects, mathematics content and processes, instructional design, learning activities, and evaluation procedure. Overall, the instructional material had a rating of 3.72, which is Very Acceptable, and thus, it had excellently met the standards.

Level of Math Anxiety before and after Utilization of Instructional Material
Table 6 shows students' math anxiety level before and after using the developed instructional material. Before utilizing the instructional material, five (5) participants had High Math Anxiety, twenty (20) participants had Average Math Anxiety, and seven (7) had Low Math Anxiety. After utilizing the instructional material, three (3) participants had High Math Anxiety, fourteen (14) had Average Math Anxiety, ten (10) had Low Math Anxiety, and five (5) had Very Low Math Anxiety.

Criteria	Average Score	Description
1. Physical Aspects	3.83	Very Acceptable
2. Mathematics Content and Processes	3.68	Very Acceptable
3. Instructional Design	3.75	Very Acceptable
4. Learning Activities	3.70	Very Acceptable
5. Evaluation Procedure	3.65	Very Acceptable
Overall	**3.72**	**Very Acceptable**

Table 5.
Acceptability of Developed Instructional Material

Level of Math Anxiety	Number of Students		Difference
	Before	After	
Very High	0	0	0
High	5	3	(2)
Average Math Anxiety	20	14	(6)
Low	7	10	3
Very Low	0	5	5
Total	**32**	**32**	

Table 6.
Level of Math Anxiety Before and After Utilizing the Instructional Material

Analysis of paired samples t-test conducted using SPSS resulted in a t-value of 4.179 and a p-value of 0.000, warranting the rejection of the null hypothesis. This indicates a significant decrease in students' math anxiety after utilizing the developed instructional material.

Level of Math Performance before and after Utilization of Instructional Material

Table 7 shows the performance of students in the pretest and posttest scores. Before utilizing the instructional material, one (1) participant scored Very High, three (3) participants scored High, sixteen (16) scored Average, nine (9) scored Low, and three (3) scored Very Low. After utilizing the instructional material, six (6) participants scored Very High, seventeen (17) scored High, eight (8) scored Average, one (1) scored Low, and none scored Very Low. Analysis of paired samples t-test conducted using SPSS resulted in a t-value of -12.513 and a p-value of 0.000, warranting the rejection of

Score		Number of Students		Difference
		Pretest	Posttest	
Very High	(25 - 30)	1	6	5
High	(19 - 24)	3	17	14
Average	(13 - 18)	16	8	(8)
Low	(7 – 12)	9	1	(8)
Very Low	(0)	3	0	(3)
Total		**32**	**32**	

Table 7.
Performance of Students Before and After Utilizing the Instructional Material

the null hypothesis. This showed a significant increase in students' mathematics performance after utilizing the developed instructional material.

Conclusion and Recommendations

This study aimed to determine the level and causes of math anxiety among the students of a state university as a springboard for initiating steps to address their apprehension about the subject and improve performance in mathematics by developing an instructional material.

Findings revealed that 80.13% of the student-respondents have Average to High Math Anxiety. Students felt the most anxiety in high-stakes situations such as final exams, tests, and receiving final grades. The themes that emerged as causes of math anxiety were identified to be mainly: past failures, pressure to find the right answers, fear of being embarrassed in front of peers, and negative experiences with teachers. Instructional materials that reduce math anxiety are ones that are easy to understand, contain varied activities, and incorporate additional online resources.

As teacher factor was reported to play a huge part in the cause of math anxiety, teachers must ensure that their strategies and demeanor towards students will encourage them to study math and lessen their anxiety. To recognize the effort and motivate students to improve, teachers may use grading systems that gauge the student's understanding of the process instead of solely basing points on whether they got the correct answer. Teachers must also be more considerate of students' mental well-being during highly sensitive times such as exam periods. In addition, teachers may create their own instructional materials to ensure that these match the needs and levels of their students.

School administrators may conduct a review of the mathematics instructional materials used by the institution to evaluate their adequacy in lowering the math anxiety of students. Textbook writers for mathematics must ensure that the instructional materials they create are easy to understand, contain diverse activities and feature online resources for the benefit of students. The university's guidance and counseling services should be expanded to recognize math anxiety as an integral factor of students' mental health and offer support systems for students struggling with the subject. Organizing peer tutorial sessions will have the added benefit of fostering a venue where students can seek help from their peers without fear of being embarrassed. Counseling programs may also be conducted to encourage students not to stress about grades but instead about the learning process itself.

On the home front, parents should encourage their children to learn instead of worrying about grades. They must also avoid punishing children for poor performance, as this increases math anxiety.

As the researcher works with college students, this study determined students' math anxiety level only when they are at the tertiary level and have already developed math anxiety. Future researchers may conduct longitudinal studies to examine how students develop math anxiety from preschool, primary, and secondary levels to initiate steps for early intervention.

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