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From Anxiety to Understanding: A Phenomenological Study of Middle School Students' Mathematics Learning Experiences

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ABSTRACT

This study explores the lived experiences of junior high school students in learning mathematics, particularly focusing on the transformation from mathematics anxiety to understanding. Mathematics anxiety is widely recognized as a significant factor affecting students' cognitive performance and emotional well-being. However, limited research has examined how students experience and interpret this anxiety in their learning process. This study aims to describe how mathematics anxiety is experienced, constructed, and transformed into understanding from a phenomenological perspective. This research employed a qualitative approach with a descriptive phenomenological design. Ten eighth-grade students were purposively selected based on varying levels of mathematics anxiety. Data were collected through in-depth semi-structured interviews and analyzed using transcendental phenomenological methods, including epoche, horizontalization, and synthesis of meaning. The findings reveal that students' learning experiences evolve through four essential themes: initial construction of anxiety, cognitive disruption, coping strategies and meaning negotiation, and transformation toward understanding. Mathematics anxiety emerges as an emotional and social experience that interferes with cognitive processes but can be reconstructed through supportive learning environments and adaptive strategies. This study highlights that mathematics learning is not solely a cognitive process but also an emotional journey. The transformation from anxiety to understanding demonstrates the importance of integrating affective and cognitive dimensions in teaching practices. These findings provide implications for developing more humanistic and responsive mathematics instruction.

Informasi Artikel

Kata Kunci:
Kecemasan matematika, fenomenologi, pengalaman siswa, pemahaman konseptual, pembelajaran matematika

ABSTRAK

Penelitian ini mengeksplorasi pengalaman belajar siswa SMP dalam pembelajaran matematika, khususnya terkait transformasi dari kecemasan matematika menjadi pemahaman. Kecemasan matematika dikenal sebagai faktor yang memengaruhi performa kognitif dan kesejahteraan emosional siswa. Namun, masih terbatas penelitian yang mengkaji bagaimana siswa mengalami dan memaknai kecemasan tersebut dalam proses belajar mereka. Penelitian ini bertujuan untuk mendeskripsikan bagaimana kecemasan matematika dialami, dikonstruksi, dan bertransformasi menjadi pemahaman dari perspektif fenomenologis. Penelitian ini menggunakan pendekatan kualitatif dengan desain fenomenologi deskriptif. Sepuluh siswa kelas VIII dipilih secara purposive berdasarkan variasi tingkat kecemasan matematika. Data dikumpulkan melalui wawancara mendalam semi-terstruktur dan dianalisis menggunakan pendekatan fenomenologi transendental yang meliputi epoche, horizontalisasi, dan sintesis makna. Hasil penelitian menunjukkan bahwa pengalaman belajar siswa berkembang melalui empat tema utama, yaitu konstruksi awal kecemasan, disrupsi kognitif, strategi koping dan negosiasi makna, serta transformasi menuju pemahaman. Kecemasan matematika muncul sebagai pengalaman emosional dan sosial yang mengganggu proses kognitif, namun dapat direkonstruksi melalui lingkungan belajar yang suportif dan strategi adaptif. Penelitian ini menegaskan bahwa pembelajaran matematika tidak hanya bersifat kognitif, tetapi juga merupakan proses emosional. Transformasi dari kecemasan menjadi pemahaman menunjukkan pentingnya integrasi aspek afektif dan kognitif dalam praktik pembelajaran matematika.

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1. Introduction

Mathematics is one of the key competencies in 21st-century education, playing a crucial role in the development of critical thinking, problem-solving skills, and numeracy literacy. However, mathematics learning involves not only cognitive aspects but also affective dimensions, one of which is mathematics anxiety. Globally, mathematics anxiety has been recognized as a widespread phenomenon with significant impacts on students' academic performance, psychological well-being, and career choices. Studies indicate that approximately 20% of students across various educational systems worldwide experience mathematics anxiety at a level that interferes with their learning process (Stella, 2021). The manifestation of mathematics anxiety is not limited to the deterioration of cognitive performance; rather, it systematically disrupts information-processing efficiency and reduces students' psychological resilience when facing mathematical complexity (Khasawneh et al., 2021).

In the context of junior high school education, this stage represents a critical period in which students begin to encounter more abstract mathematical concepts, such as algebra and mathematical modeling. At this level, negative learning experiences may reinforce anxiety and shape long-term attitudes toward mathematics. Research has shown that students with high levels of anxiety tend to avoid mathematical tasks, experience confusion in understanding problems, and demonstrate lower problem-solving performance compared to students with lower levels of anxiety (Nuraeni et al., 2023).

In Indonesia, mathematics anxiety has also become a matter of serious concern. Empirical studies reveal that most junior high school students experience mathematics anxiety at moderate to high levels. For example, one study found that 96% of students exhibited mathematics anxiety within the moderate category, influenced by low self-confidence and limited mathematical ability (Sholichah & Aini, 2022). Another study reported that approximately 37% of students experienced high levels of mathematics anxiety, indicating that this issue is substantial within the national educational context (Juniardi et al., 2024). Furthermore, mathematics anxiety has been found to correlate with various aspects of learning, including problem-solving ability, metacognition, and algebraic thinking processes (Lamote et al., 2025 ; Wibowo et al., 2025)

Although mathematics anxiety has been widely investigated in various regions of Indonesia, studies specifically focusing on the learning experiences of junior high school students in Papua remain limited. Yet, differing social and educational contexts may shape unique mathematical learning experiences in each region. Therefore, it is important to understand how students within a local context experience, interpret, and manage mathematics anxiety throughout the learning process.

Despite the growing body of research on mathematics anxiety, most studies have relied on quantitative approaches that measure anxiety levels and their relationships with other variables, such as academic achievement or cognitive abilities. While quantitative approaches provide a broad overview, they may overlook the depth of students' lived experiences, which can only be revealed through intensive phenomenological exploration. From a phenomenological perspective, understanding students' lived experiences is essential for uncovering how mathematics anxiety is experienced and interpreted during the learning process. (Hajar, 2025)

Recent studies have also shown that mathematics learning anxiety influences students' computational thinking abilities, particularly in problem-solving processes and the organization of mathematical reasoning steps. (Latifah et al., 2024). Furthermore, research in Indonesia has generally been limited to identifying causal factors or examining relationships among variables, such as the influence of anxiety on problem-solving skills or metacognitive abilities. (Wibowo et al., 2025). Few studies have employed phenomenological approaches to explore in depth the dynamics of students' learning experiences as they transition from a state of "anxiety" to one of "understanding." In other words, there is a research gap in understanding the transformation of mathematical learning experiences from the students' own perspectives.

Research on mathematics anxiety continues to be dominated by quantitative approaches focusing on the measurement of anxiety levels and their relationship with academic achievement. Meanwhile, students' subjective experiences in transforming anxiety into mathematical understanding remain relatively underexplored, particularly within the context of Indonesian junior high school education. Therefore, this study offers novelty through the application of a transcendental phenomenological approach to explore the dynamics of students' lived experiences in reconstructing mathematical understanding through emotional, cognitive, and social negotiation processes during mathematics learning.

Based on the foregoing discussion, this study aims to explore and describe junior high school students' experiences in learning mathematics from a phenomenological perspective, particularly regarding how mathematics anxiety is experienced, interpreted, and transformed into understanding. The findings are expected to contribute theoretically by expanding the literature on affective dimensions in mathematics education, especially within contexts that have received limited scholarly attention.

Although numerous studies have examined mathematics anxiety among junior high school students in Indonesia, investigations conducted within the educational context of Papua, particularly in Jayapura City, remain relatively scarce. In fact, the social, cultural, and educational characteristics of Papua possess unique features that may influence students' learning experiences. Furthermore, preliminary observations and communication with mathematics teachers at the research site revealed that some students exhibited symptoms of anxiety when engaging in mathematics learning, such as hesitation in answering questions, fear of making mistakes, and a tendency to avoid mathematical tasks. These conditions make the research setting particularly relevant for exploring students' subjective experiences in confronting and interpreting mathematics anxiety during the learning process.

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Table 1. Review of Research Focus, Methods, Key Findings, and Research Gaps

Researchers	Research Focus	Method	Main findings	Gap

Carey et al. (2016)	The relationship between mathematics anxiety and achievement	Meta-analysis	Mathematics anxiety is negatively associated with mathematics achievement	Does not explore students' subjective experiences
Luttenberger et al. (2018)	Factors shaping mathematics anxiety	Literature review	Learning environments influence mathematics anxiety	Does not examine the transformation of understanding
Ramirez et al. (2018)	Mathematics anxiety intervention	Theoretical review	Emotion regulation helps improve mathematics performance	Does not focus on students' lived experiences
Hajar (2025)	Students' experiences of mathematics anxiety	Phenomenology	Emotional experiences influence learning	Does not examine the transformation from anxiety to understanding
This study	Transformation of mathematics learning experiences	Transcendental phenomenology	Reconstruction of mathematical understanding through learning experiences	Fills the gaps left by previous studies

2. Methods

This study adopted a qualitative approach employing a transcendental phenomenological design to explore the depth of participants' subjective meanings and lived experiences. Phenomenology is utilized to understand how individuals experience, interpret, and reflect upon phenomena encountered in their everyday lives. Rather than measuring experiences, phenomenology seeks to uncover the essence of experiences as consciously perceived and lived by participants (Neubauer et al., 2019).

The transcendental phenomenological paradigm was employed to gain an in-depth understanding of participants' lived experiences. In phenomenological research, the primary focus is on understanding experiences as directly lived by individuals and how such experiences are interpreted within their consciousness (Rodriguez & Smith, 2018 ; Mash et al., 2025). Through the process of bracketing, researchers attempt to suspend personal assumptions and preconceptions to allow the essence of participants' experiences to emerge more authentically.

Participants

The participants of this study were eighth-grade students from a public junior high school in Indonesia. Participants were selected using purposive sampling based on the following criteria:

(1) Students who exhibited indications of mathematics anxiety, as identified through an initial screening process using a validated mathematics anxiety questionnaire.
(2) Students who were willing to participate in in-depth interviews.
(3) Students representing varying levels of mathematics anxiety (low, moderate, and high) to ensure diverse experiential perspectives.

The number of participants in phenomenological studies is generally relatively small to preserve data depth and is determined based on the principle of data saturation. In this study, ten participants were selected because data saturation had been achieved, meaning that no new themes or information emerged from the collected data. Previous studies have indicated that saturation in qualitative research is often reached within approximately 9–17 interviews, depending on participant homogeneity and research focus (Hennink & Kaiser, 2022), and serves as a primary basis for justifying qualitative sample size (Vasileiou et al., 2018).

Data Collection Techniques

Research Instruments

Consistent with the qualitative paradigm, the researcher served as the primary research instrument, requiring theoretical sensitivity and a high degree of reflexivity in capturing the essence of participants' experiences. Supporting instruments included:

(1) Mathematics Anxiety Questionnaire, the initial screening stage employed a mathematics anxiety questionnaire based on the construct of mathematics anxiety, encompassing emotional tension, avoidance of mathematics, cognitive processing disruption, and low self-confidence in completing mathematical tasks. The instrument was adapted to suit the Indonesian educational context (Hopko et al., 2003)
(2) mi-Structured Interview Guide, the interview protocol was designed to explore students' experiences regarding:
   - Feelings during mathematics learning;
   - Experiences when encountering learning difficulties;
   - Strategies used to cope with anxiety;
   - Turning points that facilitated movement toward understanding.
(3) Field Notes, were used to document non-verbal expressions and contextual aspects of interview situations.

Data Collection Procedures

Data collection was conducted in three main stages:

(1) Initial Screening Stage, students completed the mathematics anxiety questionnaire to identify their anxiety levels.
(2) Participant Selection Stage, participants were selected based on the screening results and the established inclusion criteria.
(3) In-Depth Interview Stage, face-to-face interviews were conducted for approximately 30–60 minutes per participant. All interviews were audio-recorded with

participants' consent.

All interview recordings were transcribed verbatim to ensure data accuracy. To enhance credibility, member checking was conducted by inviting participants to review and verify interview transcripts as well as the researcher's preliminary interpretations.

Data Analysis

Phenomenological data analysis was conducted to obtain an essential description of participants' experiences through phenomenological reduction and reflection on the meaning structures underlying those experiences (Neubauer et al., 2019). The analytical process consisted of the following steps:

(1) Epoche (Bracketing), before and throughout the study, the researcher engaged in reflexive journaling to identify and suspend assumptions, personal experiences, and prior knowledge regarding mathematics anxiety. Reflective notes were utilized during data analysis to ensure that emerging themes originated from participants' narratives rather than researcher bias. Interpretive consistency was further examined through peer debriefing with fellow researchers.
(2) Horizontalization, significant statements were identified from interview transcripts.
(3) Phenomenological Reduction, significant statements were grouped into meaning units.
(4) Textural Description (What), descriptions were developed to explain what participants experienced.
(5) Structural Description (How), descriptions were constructed to explain how the experiences occurred.
(6) Synthesis of Meaning and Essence, textural and structural descriptions were integrated to identify the essential nature of students' mathematics learning experiences.

The analytical process was conducted iteratively using open and thematic coding techniques. To enhance reliability, data analysis was subjected to peer debriefing with fellow researchers.

Trustworthiness

The trustworthiness of the study was established based on the criteria proposed by (Shenton, 2004) :

(1) Credibility; was enhanced through methodological and temporal triangulation. Methodological triangulation involved comparing data obtained from the mathematics anxiety questionnaire, in-depth interviews, and field notes. Temporal triangulation was achieved by collecting data at different stages of the research process, namely during the initial screening phase and the in-depth interview phase. The use of different data collection points enabled the researcher to assess the consistency of participants' responses regarding their mathematics learning experiences and mathematics anxiety.
(2) Transferability, was ensured through the provision of rich and detailed contextual descriptions.
(3) Dependability, was maintained through an audit trail documenting all stages of the research process.
(4) Confirmability, was strengthened by maintaining objectivity through continuous researcher reflexivity.

Ethical Considerations

This study received approval from the school administration and was conducted in accordance with established research ethics principles. Participants were provided with informed consent, assured of the confidentiality of their information, and informed of their right to withdraw from the study at any time without any consequences.

3. Results and Discussion

Results

Based on the transcendental phenomenological analysis of in-depth interview data, students' mathematics learning experiences in the context of anxiety were found to develop through four essential themes:

(1) Initial Experiences of Mathematics Anxiety
(2) Internal Dynamics When Facing Difficulties
(3) Coping Strategies and Meaning Negotiation
(4) Transformation Toward Understanding

The four essential themes are described as follows

(1) The Initial Construction of Anxiety: Mathematics as a Space of Pressure

Participants consistently interpreted mathematics as an emotionally stressful experience. Anxiety manifested in the form of:

- Fear of making mistakes;
- Evaluative pressure (e.g., examinations and teacher questioning);
- Perceptions of mathematics as a "difficult and exclusive" domain.

As expressed by Participant 2 (P2), *"Whenever mathematics class starts, I immediately feel tense and afraid of making mistakes."* This statement indicates that anxiety had become internalized as an anticipatory response even before cognitive activity began. Similarly, Participant 6 (P6) stated, *"I am often afraid to answer, even though I actually want to try."* These accounts suggest that anxiety does not emerge only when students begin solving mathematical problems; rather, it is already present before the learning process takes place. The tension experienced by participants reflects an anticipation of possible failure that has become embedded within their consciousness. In this experience, mathematics is no longer perceived merely as a school subject but as a space associated with the risk of error, social judgment, and threats to academic self-worth..

These findings provide strong evidence that mathematics anxiety is a relational phenomenon constructed through social interactions within the classroom rather than merely a manifestation of individual cognitive deficits. Mathematics anxiety develops through the interaction of learning experiences, classroom environments, and students' self-perceptions (Luttenberger et al., 2018).

Furthermore, these initial experiences reveal the formation of a negative mathematical identity, whereby students begin to internalize beliefs that they are "not capable" in mathematics. Repeated experiences of anxiety contribute to the development of such negative mathematical identities, characterized by the perception that one lacks adequate mathematical ability. Mathematical identity has been shown to influence how students perceive themselves as learners of mathematics (Kurniawati et al., 2025).

(2) Cognitive Disruption: When Emotions Interfere with Thinking

The second theme demonstrates that anxiety extends beyond the emotional level and directly affects students' cognitive processes. Participants described several phenomena, including:

- Overthinking about potential mistakes;
- Dependence on examples without conceptual understanding;

- Difficulty initiating problem-solving processes.

Participant 4 (P4) explained, *"Sometimes I have already studied, but when I see the problem, my mind just goes blank." The experience of "going blank"* reflects more than difficulty recalling information; it represents a disruption in the connection between existing knowledge and the ability to access that knowledge under pressure. At such moments, participants reported losing control over their own thinking processes. In other words, what they experienced was not merely a lack of knowledge but a subjective sense of helplessness when confronted with mathematical demands.

Mathematics anxiety functions as a mechanism of cognitive interference that reduces students' working memory capacity when facing mathematical situations perceived as threatening. In this context, students do not simply lack mathematical competence; rather, they experience difficulty accessing knowledge they already possess because of overwhelming emotional pressure (Finell et al., 2022). Moreover, students with high levels of anxiety tend to engage in over-monitoring, focusing excessively on the possibility of making mistakes, which further inhibits flexible thinking processes.

(3) Meaning Negotiation: From Avoidance to Engagement

The third theme reveals that students are not entirely passive in responding to anxiety. Instead, they develop various coping strategies that can be categorized into maladaptive and adaptive forms.

Maladaptive Strategies

- Avoiding mathematical tasks;
- Procrastinating on assignments;
- Relying on peers' answers.

Adaptive Strategies

- Asking teachers or peers for assistance;
- Independently reviewing learning materials;
- Breaking problems into smaller, manageable steps;
- Using visualizations or concrete examples.

Participant 8 (P8) reflected: "*I used to avoid mathematics all the time, but gradually I tried little by little… and it turned out I could do it."* This narrative illustrates a behavioral transformation from avoidance to engagement, reflecting a gradual process of meaning negotiation and increasing self-efficacy.

The statement indicates a shift in how mathematics learning was interpreted. Initially, mathematics was perceived as a source of threat that should be avoided. However, through repeated learning experiences, participants gradually developed the belief that difficulties could be addressed step by step. This transformation did not occur instantaneously but emerged through reflection and small experiences of success that gradually reshaped participants' perceptions of themselves as mathematics learners.

These findings demonstrate that learning experiences are dynamic and open to renegotiation. They further suggest that interventions based on emotional regulation, particularly through the reinterpretation of learning experiences (emotional reappraisal), can reduce mathematics anxiety and enhance students' performance (Ramirez et al., 2018).

The transformation from avoidance to engagement indicates that mathematics learning experiences are dynamic and can be renegotiated through reflection, social support, and incremental successes. The adaptive coping strategies demonstrated by participants reveal a process of reconstructing the meaning of mathematics. Mathematics is no longer perceived as a threatening space but rather as a learning experience that can be understood gradually.

These adaptive coping strategies also reflect processes of emotional regulation in mathematics learning. Emotional regulation plays a significant role in reducing affective pressure and re-establishing students' engagement with mathematics learning (Ramirez et al., 2018).

(4) Reconstructing Understanding: The Transformation from Anxiety to Comprehension

The central theme of this study concerns the transformation of learning experiences marked by the emergence of conceptual understanding. This transformation occurred through:

- Incremental experiences of success;
- Supportive teacher interactions;
- Changes in perceptions of mistakes (from sources of pressure to opportunities for learning).

Participant 1 (P1) stated: *"Once I understood it, I felt relieved… it was not as difficult as I had imagined."* This expression of affective satisfaction indicates an existential shift in the student's relationship with mathematics, in which epistemic barriers were overcome through the reconstruction of learner identity. The transformation suggests that mathematics anxiety is not a permanent condition but can be reconstructed through positive and reflective learning experiences.

The sense of relief described by participants was not merely associated with successfully solving a problem; it also reflected a profound change in their relationship with mathematics. Achieving understanding generated a new realization that mathematics could be learned and mastered. This moment served as a turning point that enabled students to rebuild their self-confidence and mathematical identity, which had previously been dominated by feelings of fear and inadequacy.

The transformation toward understanding represents the phenomenological essence of this study. Mathematical understanding does not emerge instantaneously; rather, it develops through a complex emotional process. The "aha" moments experienced by students signify the reconstruction of the relationship among emotion, identity, and mathematical competence. These findings suggest that success in mathematics learning is strongly influenced by the quality of students' emotional and social learning experiences.

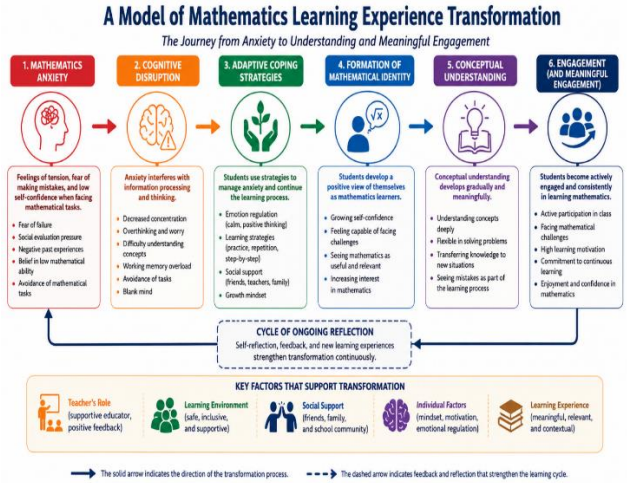


Figure 1. A Model of Mathematics Learning Experience Transformation

4. Discussion

(1) Mathematics Anxiety as a Lived Experience

The integration of subjective meaning dimensions into these findings provides a new perspective that complements previous parametric studies, thereby offering a more holistic and contextual understanding of mathematics anxiety. This finding suggests that mathematics anxiety develops through the interaction of learning experiences, prior performance, and cognitive as well as affective factors within the learning context (Carey et al., 2016).

From a phenomenological perspective, mathematics anxiety is not merely understood as an emotional response to academic tasks but as a conscious experience that is interpreted and given meaning by individuals. The findings indicate that anxiety emerges through the accumulation of previous learning experiences, which subsequently influence how students perceive themselves as mathematics learners. Consequently, anxiety becomes part of students' lifeworld, shaping how they understand, experience, and engage with mathematics. These findings are consistent with phenomenological perspectives that regard lived experience as the primary source for understanding a phenomenon. (Neubauer et al., 2019 ; Rodriguez & Smith, 2018)

(2) Cognitive–Affective Interactions in Mathematics Learning

A large-scale meta-analysis published in Psychological Bulletin revealed that mathematics anxiety has a significant and consistent negative relationship with mathematics performance. This relationship is partly explained by disruptions in cognitive processes, such as working memory, as well as interactions with students' affective factors (Connie Barroso et al., 2021).

Within the framework of transcendental phenomenology, the cognitive difficulties experienced by students cannot be separated from the emotional meanings attached to their mathematics learning experiences. Difficulties in understanding problems, uncertainty when answering questions, and tendencies to avoid mathematical tasks arise not solely from limitations in cognitive ability but because these experiences have been interpreted as threatening situations. Therefore, cognitive and affective dimensions coexist simultaneously within students' consciousness when they engage in mathematical activities.

(3) Transformation as a Pedagogical Process

A substantial body of research suggests that the difference between those who succeed and those who do not is not determined by innate intellectual capacity, but rather by how individuals perceive their potential, the messages they receive regarding their abilities, and the opportunities they are given to learn (Boaler et al., 2021).

This perspective emphasizes that mathematical ability is malleable and can be developed through a growth mindset. Accordingly, all students have the potential to achieve success when they believe that intelligence can be improved through effort and effective learning strategies.

The transformation experienced by participants can be understood as a process of reconstructing the meaning of mathematics learning experiences. From a phenomenological standpoint, the shift from anxiety toward understanding occurs when students begin to assign new meanings to the mistakes, challenges, and successes they encounter. Repeated experiences of small successes contribute to the formation of a new horizon of meaning, in which mathematics is no longer perceived as a source of threat but as something that can be understood through a gradual learning process.

(4) Mathematics Anxiety within the Socio-Cultural Context of Papua

The findings indicate that mathematics anxiety is shaped not only by individual cognitive and affective factors but also by the social and cultural contexts in which students develop. In Papua, mathematics learning takes place within a distinctive social environment characterized by diverse linguistic backgrounds, communal patterns of social interaction, and varying geographical and educational conditions. Papua is a highly multicultural and multilingual region, with more than 250 local languages spoken across different ethnic groups. Consequently, students' learning experiences are often influenced by the linguistic and cultural diversity they bring into the classroom (Mumu & Aninam, 2018 ; Yembise, 2011).

These findings further support the argument that mathematics learning in Papua is inseparable from students' cultural contexts and lived experiences. The local Papuan context serves as a significant foundation for shaping meaningful mathematical learning experiences, highlighting the need for instructional and assessment practices that are responsive to the cultural realities of students' everyday lives. From this perspective, mathematics anxiety should not be viewed solely as an individual psychological phenomenon; rather, it can be understood as a product of the interaction between academic demands, cultural contexts, and the meaning-making processes through which students engage with mathematics (Ismail et al., 2024).

Furthermore, studies examining the learning needs of Indigenous Papuan students have demonstrated that local socio-cultural characteristics shape how students understand learning environments, establish social relationships, and interpret educational experiences (Fiharsono et al., 2024). Therefore, the mathematics anxiety experienced by participants in this study should be understood not merely as an individual psychological phenomenon but also as an experience situated within the distinctive socio-cultural context of Papua.

Several participants reported that difficulties in understanding mathematical terminology or the language used in mathematical problems often served as an initial source of anxiety. This finding suggests that learning mathematics cannot be entirely separated from language comprehension. For students who primarily communicate using local languages or regional language varieties in their daily lives, exposure to formal mathematical terminology may increase cognitive load as they attempt to understand the concepts being taught.

Furthermore, the strong sense of collectivism embedded within Papuan society appears to influence how students cope with learning difficulties. Peer support and group interactions emerged as important sources of assistance in reducing anxiety when students encountered mathematical tasks. Participants reported that discussing problems, studying collaboratively, and receiving help from peers often provided a sense of emotional security that facilitated the development of mathematical understanding.

These findings suggest that the transformation from anxiety to understanding occurs not only as an individual process but also as a social process shaped by interpersonal relationships within the learning environment. Consequently, the experience of mathematics anxiety among Papuan students should be understood as a phenomenon rooted in the interaction between personal factors, learning experiences, and the broader socio-cultural context in which students are situated.

This perspective broadens existing understandings of mathematics anxiety, which have traditionally been explained

primarily through individual psychological approaches. In the Papuan context, social support, linguistic diversity, and the collective nature of local culture form part of the experiential horizon through which students interpret mathematics and respond to the learning challenges they encounter.

The findings of this study reveal characteristics that differ from those reported in much of the mathematics anxiety literature conducted in Western educational settings and urban regions of Indonesia. Previous studies have generally explained mathematics anxiety in terms of individual factors such as self-efficacy, numerical ability, experiences of academic failure, and evaluation pressure (Carey et al., 2016 & Connie Barroso et al., 2021)) In contrast, within the Papuan context, mathematics anxiety appears to be more closely connected to the social and cultural dimensions that shape students' everyday learning experiences.

One of the most significant findings concerns the role of linguistic diversity in shaping students' experiences of mathematics anxiety. Unlike educational settings where the language of instruction is relatively homogeneous, Papuan students frequently navigate transitions between local languages, everyday Indonesian, and the formal academic language of mathematics. This condition suggests that mathematics anxiety is not solely related to difficulties in understanding mathematical concepts but also to the challenge of translating mathematical meaning across different linguistic systems. Therefore, mathematics anxiety in the Papuan context can be understood as a phenomenon situated at the intersection of cognitive and linguistic demands.

In addition to language-related factors, this study demonstrates that social relationships play a particularly central role in overcoming mathematics anxiety. While many psychological models explain anxiety reduction through improvements in individual self-regulation, participants in this study described peer support, collaborative learning, and social interaction as the primary mechanisms through which they developed confidence and emotional security in learning mathematics. These findings indicate that the transformation from anxiety to understanding occurs not only intrapersonally but also interpersonally.

From the perspective of transcendental phenomenology, these findings extend current understandings of mathematics anxiety as a situated lived experience embedded within the context of individuals' everyday lives. Experiences of anxiety do not emerge universally in identical forms across all students; rather, they are constructed through distinct horizons of experience shaped by cultural backgrounds, language practices, and social relationships. In other words, while the essential structure of mathematics anxiety includes both emotional and cognitive dimensions, its manifestation is influenced by the socio-cultural context in which the experience occurs.

This study contributes to the mathematics anxiety literature by demonstrating that the phenomenon cannot be fully explained through individual psychological mechanisms alone. Instead, mathematics anxiety should be understood as a biopsychosocial-cultural phenomenon, particularly in culturally and linguistically diverse contexts such as Papua. This finding provides an important theoretical extension to existing models of mathematics anxiety and highlights the need for culturally responsive approaches in mathematics education.

This study also emphasizes the importance of the Papuan cultural context in mathematics education. While previous studies have focused on the use of local cultural contexts in developing mathematics instruction and assessment, this study expands that perspective by showing that students' emotional experiences, particularly mathematics anxiety, are also constructed through the cultural, linguistic, and social relations unique to Papua. Thus, local culture does not only function as a context for learning, but also as part of the horizon of experience that shapes how students interpret mathematics and respond to learning challenges (Ismail et al., 2024).

(5) Theoretical Implications

This study contributes significantly to the integration of phenomenological perspectives into mathematics anxiety research by demonstrating that anxiety is a complex and dynamic phenomenon shaped through the interaction of learning experiences, self-perceptions, and students' social contexts. The findings extend current understandings of the relationship between emotion, identity, and mathematical understanding, supporting phenomenological studies that emphasize how mathematics anxiety emerges from the interplay of experiential, affective, and social factors (Nolasco, 2025; Sutrisno et al., 2025)

More specifically, this study advances mathematics education research by introducing a phenomenological perspective on mathematics anxiety. The findings suggest that mathematics anxiety cannot be understood solely as a measurable psychological variable; rather, it should also be viewed as an affective experience that shapes students' learning identities and influences how they engage with mathematical knowledge.

A phenomenological approach enables researchers to understand mathematics learning as a lived experience constructed through the interaction of emotions, learning experiences, and students' subjective meanings (Hajar, 2025). Consequently, mathematics anxiety should be conceptualized not merely as an individual deficit or emotional barrier but as a meaningful experience that influences how students interpret themselves as mathematics learners and navigate mathematical challenges.

(6) Practical Implications

Based on the findings, several recommendations can be proposed, including the development of more humanistic and empathetic learning environments, the reduction of excessive evaluative pressure, the promotion of conceptually oriented instructional strategies, and the provision of reflective opportunities that enable students to recognize and regulate their emotions. These recommendations are consistent with previous studies demonstrating that emotionally supportive learning environments, conceptual understanding approaches, and emotional regulation strategies play important roles in reducing mathematics anxiety and enhancing learning outcomes (Luttenberger et al., 2018 ; Ramirez et al., 2018; Schukajlow et al., 2017)

Instruction that emphasizes conceptual understanding and gradual problem-solving processes has been shown to foster students' active engagement in mathematics learning. This finding aligns with research indicating that contextual approaches based on Polya's problem-solving framework support students' mathematical thinking in a more systematic manner (Zakiah et al., 2019).

Educational practitioners should consider creating affectively supportive learning ecosystems to mitigate cognitive disruptions associated with excessive anxiety. Humanistic and supportive instructional practices can help students reconstruct their relationships with mathematics in more positive and meaningful ways.

Although the findings indicate that emotional support, experiences of success, and understanding-oriented instruction play important roles in transforming mathematics anxiety into mathematical understanding, their implementation should be considered within the realities of the current educational curriculum. Indonesia's Merdeka Curriculum provides greater opportunities for differentiated, reflective, and student-centered learning. However, teachers continue to face various challenges, including limited instructional time, competency achievement requirements, heterogeneous student abilities, and relatively high teacher–student ratios. These conditions may restrict teachers' capacity to provide intensive emotional support to individual students experiencing mathematics anxiety.

Furthermore, the findings were derived from the subjective experiences of a small number of participants within a particular school context and are therefore not intended to be generalized across all educational settings in Indonesia. Accordingly, interpretations of the findings should take into account the specific characteristics of schools, learning cultures, and instructional practices within which these experiences occurred. Further research is needed to explore how the principles of the Merdeka Curriculum can be more effectively implemented to support students in managing mathematics anxiety across diverse educational contexts.

The practical implications of these findings are increasingly important in the context of education in Papua. Mathematics learning that integrates the local cultural context of Papua has the potential to enhance the relevance of students' learning experiences and help them connect mathematical concepts with their everyday realities. A contextual approach rooted in local culture can serve as a strategy to reduce the psychological distance between students and mathematics, thereby supporting the creation of more positive and meaningful learning experiences . Mathematics teachers do not only need to pay attention to students' cognitive aspects but also need to consider their diverse linguistic and cultural backgrounds. The use of contextual examples that are close to students' daily lives, collaborative learning, and communication that is sensitive to cultural diversity can help create a more inclusive learning environment and reduce mathematics anxiety. This approach is in line with the spirit of the Merdeka Curriculum, which places learners and local contexts as an essential part of the learning process (Ismail et al., 2024).

Synthesis

Mathematics learning can be understood as a transformative process involving the interaction of cognitive and emotional dimensions, in which anxiety does not necessarily function as an ultimate barrier but may instead serve as a starting point for the development of understanding, self-confidence, and meaningful learning when supported by appropriate educational environments.

The findings indicate that the transformation of mathematics learning experiences occurs through six major stages:

(1) Emotional pressure associated with mathematics;
(2) Cognitive disruption during problem solving;
(3) Emergence of coping strategies;
(4) Negotiation of meaning regarding learning experiences;
(5) Active engagement in learning; and
(6) Reconstruction of mathematical understanding and identity.

This model suggests that mathematics anxiety is not inherently destructive. Rather, it may become a catalyst for reconstructing understanding when students receive adequate emotional, pedagogical, and social support.

Within the Papuan context, this transformation is influenced not only by individual factors but also by social support, linguistic diversity, and the collective cultural values that characterize students' everyday lives. Therefore, efforts to reduce mathematics anxiety should incorporate local socio-cultural dimensions as integral components of the learning process.

The conceptual model emerging from this study extends existing mathematics anxiety literature by demonstrating that students' experiences are shaped through the interaction of cognitive, emotional, linguistic, social, and cultural factors. Consequently, mathematics anxiety should be understood as a biopsychosocial-cultural phenomenon rather than solely as an individual psychological condition. This perspective offers a more contextualized framework for understanding mathematics anxiety and provides a foundation for developing culturally responsive mathematics education in diverse educational settings.

5. Conlusion

This study demonstrates that mathematics anxiety is a complex and multidimensional learning experience involving cognitive, emotional, and social dimensions simultaneously. From a phenomenological perspective, mathematics anxiety emerges from previous learning experiences, evaluative pressures, and negative self-perceptions regarding mathematical ability. These conditions disrupt students' thinking processes, reduce self-confidence, and hinder problem-solving performance.

However, the findings reveal that mathematics anxiety is not a permanent condition. Through empathetic pedagogical support, meaningful experiences of success, and a shift in perspective that views mistakes as an integral part of the learning process, students can transform anxiety into deeper mathematical understanding. This transformation highlights that mathematics learning is a dynamic and meaningful process of personal growth and meaning-making.

Theoretically, this study enriches mathematics education research by conceptualizing mathematics anxiety as a lived experience constructed through the interaction between individuals and their learning environments. Practically, the findings underscore the importance of creating mathematics learning environments that are humanistic, emotionally supportive, and focused on conceptual understanding.

Based on the findings, mathematics teachers are encouraged to: (1) identify signs of mathematics anxiety at an early stage through classroom observation and student reflection activities; (2) provide progressively challenging tasks that enable students to experience sustained success; (3) facilitate collaborative discussions and peer-support opportunities to reduce individual pressure when solving mathematical problems; and (4) offer feedback that emphasizes learning processes and problem-solving strategies rather than focusing exclusively on correct or incorrect answers. Furthermore, schools can support emotionally safe learning environments by fostering a learning culture that recognizes mistakes as valuable opportunities for developing students' mathematical competence.

Future studies should broaden the scope of investigation by

examining diverse socio-economic and educational contexts in order to validate the proposed model of emotional transformation across a wider range of educational settings.

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