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A Study of Students' Mathematical Concept Understanding Ability: Learning Anxiety and Independence in Learning Mathematics

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ABSTRACT

Purpose of the Study: This study aims to explore fourth-grade students' understanding of mathematical concepts by examining two psychological and behavioral variables: mathematics anxiety and learning independence. Specifically, the study investigates how these two factors influence students' abilities to comprehend and apply mathematical concepts in classroom learning. Addressing this issue is essential, as early mathematical understanding serves as a foundation for more complex problem-solving in later education.

Methodology: This research employs a qualitative case study approach, with data collected through classroom observations, structured interviews with students and teachers, and analysis of related documents, including student worksheets, math test scores, and teacher reflections. The study utilizes a customized analytical framework based on a modified version of Bloom's Taxonomy, allowing for a detailed exploration of cognitive understanding, emotional responses, and metacognitive strategies in relation to mathematical learning.

Main Findings: Findings indicate that many fourth-grade students experience moderate to high levels of math anxiety, often rooted in negative prior experiences. This anxiety correlates with lower conceptual understanding and reduced classroom performance. Conversely, students who demonstrate high learning independence characterized by initiative, persistence, and self-regulation tend to show greater comprehension and confidence in learning mathematics, even in the face of challenging tasks.

Novelty/Originality of this study: The novelty of this study lies in its integrative framework that connects emotional (anxiety), behavioral (independence), and cognitive (conceptual understanding) domains in elementary mathematics education. It also introduces a structured interview instrument designed specifically to uncover students' internal learning experiences, providing deeper insight into early mathematical development.

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1. INTRODUCTION

Education is a continuous process of transforming knowledge, skills, and values that are essential for students' personal and intellectual development. Its primary objective is to equip learners with the competencies necessary to face future challenges and fulfill their societal roles. Within this context, teachers play a vital role in shaping student learning through effective classroom management, instructional strategies, and meaningful interactions. The quality of teaching and learning significantly influences the quality of graduates, while diverse

teaching methods can be applied to meet the unique needs of students [1]-[5]. Moreover, education contributes to shaping students' attitudes and behaviors, fostering the development of well-rounded and high-quality individuals.

In the learning process, particularly in mathematics, students are expected to achieve a level of competence that allows them to understand and apply basic concepts to solve problems. This aligns with the principles of behaviorism, a learning theory that emphasizes changes in behavior resulting from stimulus-response interactions. Positive reinforcement is often employed in mathematics classrooms to motivate students and shape their learning behavior [6]-[11]. Mathematics, however, remains one of the most challenging subjects for elementary students, as it involves abstract symbols, unfamiliar notations, and logical structures that require strong conceptual understanding. Mathematics is not merely a subject to be memorized but a discipline that develops critical thinking and problem-solving skills [12]-[16].

Understanding mathematical concepts involves more than rote memorization; it requires a deep comprehension of ideas and their applications. Teachers must be cautious in delivering concepts accurately because any misunderstanding at the beginning can hinder students' grasp of subsequent material [17]-[20]. Therefore, learning activities should be contextualized and connected to students' prior knowledge to facilitate comprehension. Mathematics, when taught effectively, prepares students to navigate real-world problems logically and efficiently. This aligns with the philosophy of John Dewey, who emphasized experiential learning, critical thinking, and reflective inquiry in education.

Previous research in mathematics education has employed experimental methods to measure students' conceptual understanding through pretest-posttest designs, such as those described by Şenyiğit using the Campbell and Stanley model [21]. These studies emphasize the importance of active and engaging learning strategies to improve student outcomes [22]. However, a significant gap remains in the literature regarding the psychological and emotional factors that influence students' understanding of mathematical concepts particularly the roles of learning anxiety and learning independence. Students who struggle with understanding mathematical concepts often experience anxiety, which hinders their participation and willingness to ask questions. This anxiety can lead to passive learning behavior, where students simply observe rather than engage. Conversely, students who are independent and confident are more likely to actively participate and respond to teachers' questions [23]-[25]. Observations at Elementary school Sukoharjo 03 Pati indicate a significant discrepancy in students' performance, where mathematics scores, as reflected in ATS data, are considerably lower than in other subjects suggesting that both cognitive and non-cognitive factors may be at play.

While prior studies have focused on improving conceptual understanding through pedagogical strategies, there is limited research that explores how emotional factors like anxiety and autonomy in learning affect students' ability to understand mathematical concepts, especially at the elementary level. Most existing literature has not sufficiently examined the interplay between student affect (e.g., anxiety) and self-directed learning behaviors (e.g., independence) in influencing conceptual learning outcomes in mathematics. This gap is critical to address because students' emotional states can either support or hinder their cognitive engagement with mathematical material.

This study aims to investigate the ability of fourth-grade students to understand mathematical concepts in relation to their learning anxiety and learning independence. By exploring how these two non-cognitive factors interact with conceptual understanding, this research seeks to offer a more holistic view of student learning in mathematics. Providing effective learning strategies that reduce anxiety, foster autonomy, and offer emotional support can significantly improve students' understanding of mathematical concepts. Furthermore, the findings of this study are expected to offer valuable insights for educators, parents, and policymakers in creating supportive and emotionally safe learning environments that nurture both cognitive growth and emotional resilience in students.

2. RESEARCH METHOD

This study adopts a qualitative descriptive approach to explore Grade IV students' understanding of mathematical concepts, particularly focusing on decimals and fractions, through the lens of students' learning independence and anxiety. A qualitative descriptive design is suitable for capturing detailed insights into the real-life experiences of participants without relying on statistical analysis. This method allows researchers to describe social phenomena holistically and contextually. According to Bogdan and Taylor, qualitative research is a research procedure that yields descriptive data in the form of written or spoken words and observable behavior, focusing on the meaning participants attach to their experiences [26]. The aim is to provide an in-depth depiction of students' comprehension, thought processes, and emotional responses in a natural classroom setting. The study was conducted in three main phases: the pre-research stage, the field research stage, and the post-research stage. Each phase was carefully planned and implemented to ensure the depth and quality of data collected.

In the pre-research stage, the researcher carried out initial preparations that included selecting the research location, Elemetary school Sukoharjo 03 Pati, and conducting preliminary observations to identify

existing learning challenges and opportunities for improvement. The researcher also formulated the research proposal, prepared ethical clearance, and developed research instruments. These instruments included interview guides and concept test questions designed to assess students' understanding of decimals and fractions. At this stage, informants were selected based on relevance to the research objectives, and tools such as notebooks, recording devices, and consent forms were also prepared to ensure ethical and effective data collection.

The field research stage, conducted from August to November 2024, involved the actual collection of data from primary sources, which included students, teachers, and educational documents. Various qualitative techniques were employed to gather data. Firstly, observations were conducted directly in the classroom to capture the teaching-learning process and student behavior, particularly in mathematics lessons. The researcher took detailed field notes during these sessions to document real-time occurrences and patterns of student interaction and engagement. Secondly, semi-structured interviews were conducted with selected students and teachers to gain insights into their perceptions, feelings of anxiety or independence, and interpretations of mathematical concepts. Interviews were conducted face-to-face to allow for a more personal and in-depth exploration of individual experiences.

In addition to observation and interviews, the researcher employed document analysis. This involved collecting and reviewing school records such as lesson plans, teaching materials, curriculum documents, student work samples, and academic performance records. These documents provided valuable context and corroborated the findings from direct interactions. Another important component of data collection was the administration of mathematical concept tests. These tests were specifically designed to evaluate students' understanding of decimals and fractions. The test items included a combination of multiple-choice, short-answer, and essay questions. For example, one question asked students to convert the fraction 1/4 into decimal form, another required simplifying the fraction 24/36, and an essay question asked students to explain a comparison involving equivalent fractions in daily life contexts. The test results were used to identify common errors and patterns in students' understanding. All test sessions were observed, and the researcher documented how students approached the questions, which further enriched the qualitative data.

The final phase, the post-research stage, took place between December 2024 and January 2025. During this phase, the data collected were analyzed using the Miles and Huberman model of qualitative data analysis, which includes three major steps: data reduction, data display, and conclusion drawing or verification. Data reduction was carried out by selecting, simplifying, and transforming raw data into meaningful units. The data were then displayed in the form of thematic summaries, narrative descriptions, and categorized matrices to facilitate interpretation. Finally, conclusions were drawn based on recurring patterns, themes, and relationships observed in the data. Triangulation across various data sources interviews, observations, tests, and documents was applied to ensure the validity and reliability of the findings.

Through this methodical and rigorous qualitative approach, the study seeks to provide a comprehensive and nuanced understanding of the factors that influence how Grade IV students grasp mathematical concepts, particularly in the areas of decimals and fractions, within the broader context of their emotional and behavioral responses during the learning process.

3. RESULTS AND DICUSSION

Students' understanding of mathematical concepts is relatively low in mathematics learning activities, there are several students who experience difficulties in learning mathematics where students tend to be active when learning using interesting media such as concrete objects.

3.1. Analyze

This research was carried out as students as researchers in classroom learning. The research implementation technique is by interview, observation and discussion with the class teacher. In this process, researchers can find out the obstacles that occur in learning in class IV to find out how strategies are used to solve problems in understanding students' mathematical concepts in terms of anxiety and student learning independence.

The results of the study showed that the results of data from interviews, observations, questions about fractions of students and class teachers and documentation of students' mathematics learning outcomes. In this case, the researcher conducted observations in mathematics learning activities in understanding mathematical concepts in terms of anxiety and independence of mathematics learning. The researcher conducted observations by participating in mathematics learning in learning activities directly in class IV. After conducting observations, the author interviewed the class IV teacher to find out the development of understanding mathematical concepts in teachers and class IV students. Questions are used to measure how much students understand the concept of mathematics. The questions are arranged according to the material being studied in class on the fraction and decimal number material. Questions with this material are used to measure the level of students' understanding

of mathematical concepts, and observations and documentation are made on how to work on the questions and how they work on the questions in terms of students' anxiety and learning independence.

3.2. Data on Results of Understanding Mathematical Concepts

Research data shows that students' understanding of mathematical concepts is relatively low in mathematics learning activities, there are some students who experience difficulties in learning mathematics where students tend to be active when learning using interesting media such as concrete objects. The school provides adequate facilities in the learning process, some students can work with formulas When given assessment questions which are not allowed to open books, students cannot answer.

The school has a program which is implemented to support reasoning in student learning, When the teacher explains the mathematical concept, students pay close attention and there are some students who are responsive when the teacher asks questions [27]-[31]. The class teacher has several methods used to help students understand mathematical concepts by giving homework (PR) in the form of assignments regarding mathematical concepts with this method can increase students' interest in learning. The mathematics learning process when the teacher explains there are some students who tend to be silent and unresponsive when they do not understand the material explained by the teacher [32]-[39]. The provision of repeated material is carried out by the class teacher for students to understand mathematical concepts, the teacher also provides a special way so that students who do not understand mathematical concepts can know the mathematical concepts of the level of completion of Mathematical Concept Understanding in understanding mathematical concepts can be seen in the following Table 1.

Table 1. Data on Student Learning Outcomes in Understanding Mathematics Concepts at Elementary School Sukoharjo 03

Indicator Description	Number of Students	Persentage (%)
Not finished yet	15	80
finished	9	40

Students are less aware of the mathematical concept that should be one of the keys in the mathematical process of students. Students are able to provide examples of examples of materials that have been given but forget when researchers ask for an explanation of what is meant by the material. This is supported by researchers conducting interviews with grade IV students, the following interview data on students.

PN: "Mention some things you learned in class about mathematics?"
PD: "Learning addition, subtraction, multiplication, fractions, etc."
PN: "Can you explain what addition and subtraction are? Give an example!"
PD: "addition is addition and subtraction in sequence, subtraction is 2 objects into 1 object, an example of subtraction is 3-1 = 2 an example of addition is 4 = 1 = 5"
PN: "multiplication is multiplying one object into 2 objects, an example is 1x2 = 2"

Understanding of mathematical concepts in students where they have a way or method by reading and working. Some students think they understand the concept of mathematics well enough, out of 10 students interviewed, students stated that they found it quite difficult to understand the concept of mathematics. Some students said that they prefer to study in groups, because when working on questions they can help each other and discuss materials that are considered difficult.

3.3 Student Anxiety Data in Mathematical Concepts

Anxiety in the process of learning mathematics often occurs in students, most students feel anxious when learning mathematics. Out of 10 students, 6 of them admitted to being anxious when learning mathematics and experienced high anxiety when exams or tests required them to answer questions in front of the class. Many students relate their bad experiences, such as difficulty in understanding the material given by the teacher. S1 students stated "I feel that mathematics is very difficult, especially in the material on fractions and multiplication, I can't answer the questions correctly". The anxiety factors of students' learning can be seen in the following table.

Table 2. Student Learning Anxiety Factors

Causative factor	Description
Negative Perception	Students Find Mathematics Difficult and Scary
Bad Experience	A bad experience when working on problems in front of the class.
Academic Pressure	High Expectations from teachers and parents of students

Students feel pressured to appear in front of the class in mathematics learning with the fear of answering questions that do not match the answers given, which makes students increasingly anxious and stressed. Student S2 said, "I am afraid that if my answer is wrong, my friends will laugh at me and I will be scolded by the teacher when my answer is wrong."

3.5 Mathematical Concept Understanding Test Result Data

The data obtained from the mathematical concept understanding test results show several results that students have. The test consists of 15 questions divided into 10 multiple choice questions and 5 essays with questions arranged to measure students' understanding of mathematical concepts with the calculation of each value obtained with multiple choice questions has a value weight of 5 for each question for essay questions has a value weight of 10 for each question. The data that can be described as Table 3.

Table 3. Data on the Results of the Mathematics Concept Understanding Test of Sukoharjo 03 Elementary School

Test Score	Category	Many Students	Persentage (%)
81-100	Very high	0	81-100
61-80	Tall	2	61-80
41-60	Currently	20	41-60
21-40	low	0	21-40
0-20	Very low	0	0-20

The results in this range of values can indicate that a group of students have difficulty in understanding mathematical concepts which in this case students should understand the basic concepts of mathematics that have been tested. So it is necessary to pay further attention to students to help students understand mathematical concepts by adding more effective learning methods.

3.6 Mathematical Concept Understanding Test in Fraction Material

Students' understanding of mathematical concepts in fractional metrics is a challenge that students often face in learning at the elementary school level. Many students have difficulty in understanding mathematical concepts in fractional material. The application of understanding mathematical concepts in fractional material can use a contextual approach in this case the teacher can relate the material to the lives of students. The use of concrete media such as fractional blocks is one effective way in contextual application in learning can improve understanding of mathematical concepts.

The use of media that has a very significant influence can improve students' understanding where a test of understanding mathematical concepts in fractional material has been carried out, before using a contextual approach using learning media as a supporting medium, a test was carried out with test results less than the minimum completeness criteria (KKM), namely as follows.

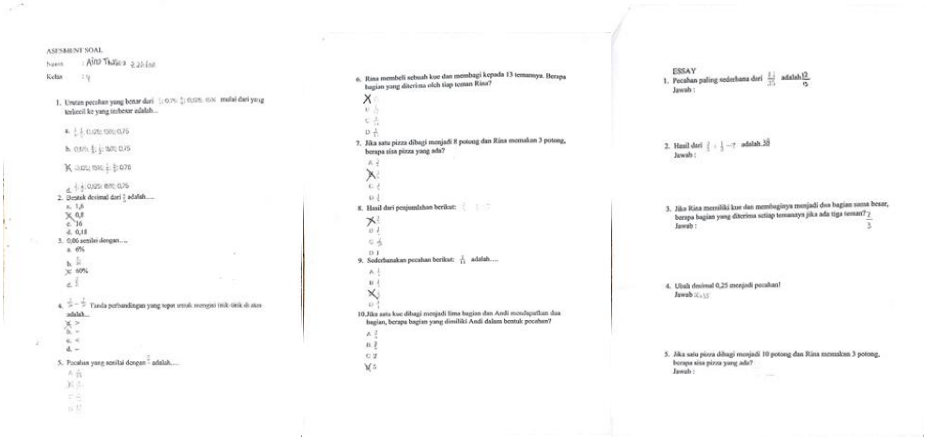

Figure 3. Test Question Answers Before Using Contextual Approach

The test was conducted with the second cycle with the same questions and after using contextual application with concrete media, 15 out of a total of 24 students had scores that reached the minimum completion criteria (KKM) with the following results.

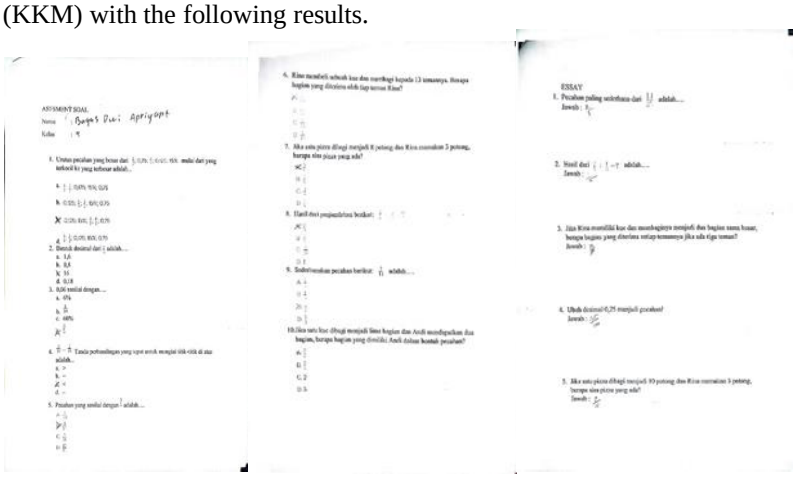

Figure 4. Test Question Answers After Using Contextual Approach

Students who have difficulty in the mathematical concept of fractions have difficulty in understanding comparison and simplification of numbers and problems in the form of HOTS or stories. Around 40% of students have difficulty in fractions. Understanding the mathematical concept of fractions in grade IV of SD Negeri Sukoharjo 03 requires the use of a variety of approaches and appropriate media for students that can improve students' understanding of mathematical concepts.

3.7 Learning Anxiety in Grade IV Students of Sukoharjo 03 Elementary School

Learning Anxiety is often felt by elementary school students, especially in mathematics learning. Anxiety can affect motivation in learning. Students in grade IV of Elementary School Sukoharjo 03 tend to be silent when asked by the teacher, students often experience anxiety when facing learning situations such as exams, assignments and when the teacher asks students to answer questions in front of the class. Based on the results of interviews with fourth grade students, most students stated that they were anxious when facing exams, especially in mathematics. Around 70% of the fourth grade students of Elementary School Sukoharjo 03 Pati felt anxious when they did not get exam scores above (KKM), some students said they often felt unable to do the questions given by the teacher. Students often feel unprepared for exams because of the lack of time they spend studying with a lack of understanding of the material.

Learning methods that are sometimes less liked by students are one of the obstacles for students in learning. Students have an emphasis on learning, especially on learning mathematics where students have to achieve high achievements, which causes pressure for students [40]-[44]. Difficulty understanding the material given by the teacher and a lack of study time can increase students' learning anxiety. Students often compare the grades they get with the grades obtained by friends who are considered smarter and achiever in class so that it can help reduce students' sense of self-confidence. The experience of fourth grade students of Elementary School Sukoharjo 03 in getting scores below the Minimum Completion Criteria (KKM) in mathematics learning makes students feel afraid in mathematics learning. The less conducive classroom atmosphere is one of the factors causing anxiety in mathematics learning, during the exam, friends have finished working first, making students answer exam questions with a lack of concentration, making students get low scores on the mathematics exam. Fourth grade students of Elementary School Sukoharjo 03 often avoid interactions with their friends which can hinder their social skills. Encouraging students to prepare themselves before the exam and asking students to study regularly by understanding the material makes students understand the concept of mathematics by using more varied methods so that students do not get bored easily in understanding the concept of mathematics.

Learning planning carried out by teachers using several methods, namely lecture, discussion, and demonstration methods, demonstrations carried out by teachers in supporting learning such as concrete teaching aids such as cubes, triangles, and other teaching aids. Teachers have planning in learning to understand mathematical concepts in a special way by sharing experiences with fellow teachers in the problems of students who do not understand mathematical concepts where teachers plan learning in grade IV to be carried out once a week. The indicators used to assess students' understanding of basic mathematical concepts are in the form of concept maps and work results and evaluations.

3.8 Learning Independence in Grade IV Students of Sukoharjo 03 State Elementary School

Learning Independence in students has the ability in their learning process independently, including in setting goals and choosing strategies in learning and evaluating learning outcomes according to learning objectives. In mathematics learning, learning independence is very important because it can influence a better understanding of mathematical concepts in solving student problems. Students in grade IV of Elementary School Sukoharjo 03 have a method in learning independence and are also supported by class teachers by providing enthusiasm for learning to students. Class IV teachers have challenges in implementing student learning independence in understanding mathematical concepts, students tend to be withdrawn and do not want to socialize with friends. Teachers always provide full support to students in learning independence, the results of interviews with class IV teachers where there are factors that encourage or inhibit student learning independence, namely learning environment factors, and support from students' parents. Students who have independent learning are 40% of the total number of students in Class IV of Elementary School Sukoharjo 03 by showing high initiative and creativity in learning mathematical concepts by looking for additional sources, and setting goals for the material being studied. The method used by the teacher in explaining mathematical concepts has an effect, an interactive method supported by the experience gained by the teacher which is effective in improving student understanding. The readiness of students to receive new material is knowledge that must be possessed and can affect students' understanding of mathematical concepts. Teachers have the biggest challenge in teaching understanding of mathematical concepts to class IV students with many students who pay less attention to the delivery of material about mathematical concepts.

Student learning independence must have support from parents can increase student self-confidence by contributing to students' understanding of mathematical concepts. The results of interviews with Grade IV teachers of Elementary School Sukoharjo 03 teachers always provide opportunities for students to explore and discover mathematical concepts creatively and independently. Utilization of technology, with video applications with tutorials explaining mathematical concepts and providing students with access to learning resources with their own exploration [45]-[48]. Teaching students in independent learning in an effective way, by making notes, planning study time and using strategies in solving problems regarding mathematical concepts. The use of formative assessment is often used by teachers to evaluate each learning. The use of summative assessment is usually done once a month and is very helpful in learning. Students with high learning motivation tend to be more independent and active when mathematics learning takes place with a strong interest in mathematics material [49]-[53]. Students who have positive experiences in understanding mathematical concepts have higher independence compared to other students with the application of concepts that have been learned in new situations. Conversely, students with low independence often have difficulty in understanding mathematical concepts and practical applications.

This research offers a novelty contribution to the field of elementary mathematics education by integrating three key domains emotional (learning anxiety), behavioral (learning independence), and cognitive (conceptual understanding) within a single qualitative framework. Unlike many previous studies that isolate one variable or rely on quantitative methods, this research employs an in-depth qualitative case study approach, allowing for a nuanced exploration of students' internal learning experiences. Another significant innovation is the structured interview and observation method designed specifically to capture the emotional states and self-directed learning behaviors of young students during actual classroom interactions. By focusing on fourth-grade students in a public school setting, the study contributes to the limited but growing body of research on how non-cognitive factors influence foundational mathematical thinking in early education.

The findings indicate a clear negative correlation between mathematics anxiety and students' understanding of mathematical concepts. Students who reported high levels of anxiety often due to prior negative experiences, fear of making mistakes, or pressure from teachers and parents demonstrated lower engagement and comprehension in learning activities. These students frequently showed signs of withdrawal, lack of confidence, and avoidance behavior, particularly during assessments or teacher questioning. On the other hand, students who exhibited high learning independence demonstrated by behaviors such as self-motivation, persistence, and proactive engagement tended to perform better in understanding decimals and fractions. They were more willing to seek help, explore alternate strategies, and take ownership of their learning process. This finding aligns with existing literature on self-regulated learning, suggesting that autonomous learning behaviors contribute significantly to improved academic performance in mathematics. Another critical insight from the study is the effectiveness of contextual learning media, such as concrete objects and visual aids, in helping students overcome conceptual barriers, particularly in fraction material. The dramatic improvement in student scores after the implementation of media-supported learning demonstrates that hands-on, contextual approaches can bridge abstract mathematical ideas and real-life understanding.

This study holds several important implications for educators, school administrators, and policymakers. Classrooms must be designed as emotionally supportive environments where students are encouraged to make mistakes, ask questions, and express confusion without fear of ridicule or reprimand. Integrating activities that develop self-regulated learning—such as goal-setting, journaling, peer collaboration, and self-assessment—can

significantly improve students' autonomy and mathematical competence. Teachers should also incorporate more contextual and visual teaching tools, especially when introducing abstract concepts like fractions and decimals. Media that relate to students' everyday lives are not only more engaging but also more cognitively accessible. Additionally, teacher training should include strategies to recognize and mitigate mathematics anxiety and promote student independence, focusing on socio-emotional learning (SEL), differentiated instruction, and formative assessment techniques.

Despite its valuable contributions, this study has several limitations. As a qualitative case study conducted in one elementary school, the findings may not be generalizable across different regions, school types, or student populations. The number of participants, particularly those interviewed and observed in-depth, was relatively small, which may limit the representativeness of the data. Furthermore, qualitative data rely heavily on the researcher's interpretation, which, despite triangulation, could introduce bias. The study was also conducted within a limited timeframe and may not reflect long-term changes or trends in student learning behavior or anxiety levels. Future research could replicate this model in urban, suburban, and rural schools to examine contextual differences and enhance generalizability. A mixed-methods approach combining qualitative insights with statistical validation could also strengthen the findings. Longitudinal studies exploring how mathematics anxiety and learning independence evolve over time would provide deeper insight into the long-term effects of early emotional experiences on cognitive development. Experimental studies testing specific interventions (e.g., anxiety-reduction workshops, self-regulated learning training, or media-based learning modules) would offer practical guidance for improving classroom outcomes. Finally, future research could explore how family dynamics contribute to or mitigate student anxiety and autonomy, given the significant role of the home environment and parental expectations.

4. CONCLUSION

This study qualitatively concludes that mathematics anxiety poses a substantial barrier to students' understanding and mastery of mathematical concepts, which directly influences their performance in science learning. In scientific disciplines such as physics, chemistry, and biology, mathematical reasoning and computational skills are fundamental for conceptual understanding and problem-solving. Students who experience high levels of anxiety toward mathematics often encounter difficulty when required to apply mathematical operations in scientific contexts, leading to a weakened grasp of scientific principles and lower learning outcomes. The findings demonstrate a clear negative correlation between mathematics anxiety and conceptual understanding. Students with heightened anxiety are less likely to engage deeply with learning tasks, avoid mathematical challenges, and often rely on rote memorization rather than genuine comprehension. This behavior significantly impairs their ability to interpret data, understand formulas, or make logical inferences core competencies in science education. On the other hand, learning independence emerges as a strong positive contributor to students' success in understanding mathematical concepts. Students who exhibit higher levels of self-directed learning marked by goal setting, resourcefulness, and persistence are better able to manage the challenges of mathematical content embedded within science curricula. These students tend to seek clarification independently, explore multiple strategies for problem-solving, and take ownership of their learning process, which enhances both their mathematical and scientific competence.

The implications of these findings are significant for science educators, curriculum developers, and educational policymakers. First, it is crucial to design learning environments that reduce mathematics-related anxiety. This includes creating a classroom culture where mistakes are seen as part of the learning process, where emotional safety is prioritized, and where students feel supported in expressing difficulties without fear of judgment. Encouraging a growth mindset and providing consistent positive reinforcement can help reshape students' perceptions of mathematics from threatening to manageable and even enjoyable. Second, science learning must be supported by pedagogical strategies that foster learning independence. Inquiry-based learning, problem-based learning, and project-based approaches that integrate math and science can be especially effective. These methods place students in active roles, encouraging them to explore, hypothesize, and test ideas skills that require both cognitive engagement and self-regulation. When students are given autonomy and responsibility in their learning, their confidence grows, anxiety diminishes, and deeper understanding is achieved. Third, teacher professional development should include training on recognizing signs of mathematics anxiety and strategies to address it. Teachers should be equipped not only with instructional methods but also with emotional and psychological support strategies to assist anxious learners. Integrating social-emotional learning (SEL) principles into science instruction can help students build resilience, manage stress, and maintain motivation in the face of academic challenges. Furthermore, schools and educators should provide structured opportunities for students to develop independent learning habits. This can be facilitated through metacognitive activities, guided self-assessment, peer teaching, and the use of digital tools that support personalized learning paths. The cultivation of such habits not only improves academic performance but also prepares students to be lifelong learners capable of adapting to various learning environments.

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