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RESEARCH ARTICLE

Increasing the interest of students in problem-solving through authentic learning experiences: Lens from non-math enthusiast learners

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ABSTRACT

Authentic learning is an educational approach that emphasizes real-world relevance and active engagement, allowing students to apply their knowledge and skills to meaningful, practical situations. It involves tasks that mirror real-life challenges, collaborative problem-solving, and critical thinking, enabling learners to connect theoretical concepts with practical applications. This qualitative study explored the experiences of non-mathematics major college students in problem-solving and how authentic learning experiences develop their interest in the subject. Non-mathematics major college students (n=16) were purposively sampled to be interviewed in this study. The findings indicated that contextualized approaches, such as integrating real-life applications like budgeting or life management, could develop students' intrinsic motivation by demonstrating the practical relevance of mathematical concepts. Student engagement and sustained effort depend on their perceived likelihood of success and the value they assign to the task. Collaborative problem-solving activities also developed engagement by encouraging peer interaction, building confidence, and developing critical thinking skills. Active and hands-on learning experiences bridge the gap between academic concepts and their real-world applications. With participatory methods, such as financial literacy tasks or structural engineering challenges, students develop higher-order thinking and systematic problem-solving abilities. They also confirmed the positive impact of dynamic teaching strategies, such as group discussions and collaborative tasks, in reducing disengagement and promoting sustained interest in mathematics. Essentially, integrating these approaches into mathematics curricula not only improves academic performance but also equips students with critical life skills and encourage positive attitude toward the subject.

Keywords: authentic learning; engagement; learning interest; problem-solving; real-life application

1. Introduction

The role of schools in shaping the academic futures of students cannot be overstated. As the foundation of formal education, schools are instrumental in fostering not only intellectual growth but also the holistic development of learners who will ultimately contribute to a nation's progress[1]. However, the traditional methods of teaching problem-solving skills, especially in mathematics, often fail to engage students, particularly those who do not see themselves as "math enthusiasts." This disconnect highlights the urgent

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need for more innovative approaches to teaching problem-solving, approaches that move beyond theory and engage students in meaningful, real-world applications.

Education is a multifaceted process that equips students with essential knowledge, skills, beliefs, habits, and values[2]. While schools aim to provide the knowledge students need to succeed[3], traditional learning approaches can fall short when addressing the specific needs of students who struggle with mathematics. Teachers play a critical role in this context, as their methods of instruction can either inspire or inhibit students' ability to think creatively and master problem-solving techniques[4]. For non-math enthusiasts, the way problem-solving is taught often determines their level of engagement and interest.

To make learning more meaningful, teacher-student interaction must go beyond passive instruction. Wilkins[5] argues that active interaction is key to helping students form personal connections with the material, leading to more meaningful learning experiences. Through tailored teaching strategies, teachers can help students reflect on their learning processes and develop critical thinking skills. This is especially important in mathematics, where abstract concepts can be difficult to grasp without practical, real-world connections. For non-math enthusiasts, this personalized approach can be the difference between disengagement and newfound interest in the subject.

Even with dedicated efforts, many students continue to struggle with mathematics. Roche et al.[6] highlight that certain students persistently face challenges in mastering mathematical concepts, particularly those who do not naturally gravitate toward the subject. These students often find it difficult to see the relevance of mathematics to their everyday lives, which further diminishes their interest in problem-solving. A shift in teaching methods, particularly toward authentic learning experiences, may be necessary to help these students connect mathematical problem-solving to real-world applications, reigniting their interest and motivation.

Authentic learning experiences, as noted by Abramovich[7], offer a promising solution by enabling students to apply problem-solving skills in realistic scenarios. This approach bridges the gap between theoretical knowledge and practical application, making mathematics more accessible to non-math enthusiasts. Shimizu[8] further emphasizes that when students can relate their classroom learning to real-world problems, their problem-solving abilities improve. For non-math enthusiasts, authentic experiences offer a pathway to engagement by demonstrating the practical value of mathematics in everyday life.

Nancy[9] underscores the importance of empowering students through problem-solving learning, as it fosters critical and creative thinking. By involving students in solving real-world problems, they not only become more engaged but also gain a deeper understanding of mathematical concepts. This is particularly beneficial for students who are typically disengaged from traditional math instruction, as authentic experiences can transform their attitudes toward the subject. By providing opportunities for students to apply their knowledge in meaningful ways, problem-solving learning may significantly increase the interest of non-math enthusiasts in mathematics.

This study, therefore, aims to explore how authentic experiences can increase the interest of non-math enthusiast learners in problem-solving. By determining the impact of real-world applications in mathematical problem-solving, this research seeks to provide insights into improving student engagement and interest, particularly among those who do not traditionally excel in mathematics. The participants of this study consist of 40 students currently enrolled in higher education across various universities in the Zamboanga Peninsula, Philippines. These students, representing a diverse range of academic disciplines, have been identified as non-math enthusiasts and will provide valuable perspectives on how authentic learning experiences can reshape their attitudes and interest in problem-solving.

2. Literature review

Education is fundamental for enhancing students' competencies, shaping cognitive abilities, and fostering a lifelong interest in learning. Among the various factors influencing educational outcomes, students' willingness and motivation to engage with the complexities of real-life situations are paramount. Rahmah et al.[10] emphasize that a student's internal willingness to learn is crucial in determining academic outcomes. They argue that motivation and mindset toward learning are foundational for achieving better results, highlighting the necessity of balancing interest in learning with practical efforts to drive engagement. Furthermore, communication between teachers and students serves as an essential enabler of educational quality, reinforcing the importance of recognizing the individual learning characteristics of students[11]. This perspective underscores that education transcends mere subject content; it also encompasses fostering strong motivational dynamics within learners to help them excel academically.

Interest, as articulated by Ijeoma and Rita[12], significantly influences both high and low academic achievement. They define interest as an active state that stimulates attention and directs it toward a task or subject, thereby functioning as a motivational factor that ignites the desire for purposeful action. In the realm of problem-solving, interest can be a decisive factor in a student's persistence when tackling complex challenges. When students cultivate a heightened interest in a subject—particularly one they may have previously found daunting—they are more likely to engage meaningfully and invest the effort necessary to enhance their understanding and performance.

Ebrahim and Lisa[13] recommend that introductory courses, especially in mathematics, place greater emphasis on problem-solving. This focus is critical for providing students with a solid foundation upon which more advanced skills can be developed. Without mastering basic problem-solving techniques, students risk disengagement when faced with more challenging material. Gokbulut and Kus[14] echo this sentiment, advocating for the integration of real-life applications into mathematical learning activities. By grounding learning in real-world contexts, students become better prepared for practical challenges, thereby rendering their educational experience both relevant and applicable.

Problem-solving is not merely a skill; it is a central goal of education, particularly in mathematics[15]. Over time, it has evolved into the primary objective of mathematical learning within schools[16]. The significance of problem-solving is further emphasized by Li et al.[17] and Peng et al.[18], who highlight its critical role in shaping students' cognitive abilities. By equipping students with robust problem-solving skills, educators empower them to navigate complex scenarios in both academic and real-world contexts, reinforcing the indispensable role of problem-solving in the overall educational framework.

Wokoma[19] defines problem-solving learning as an approach that merges knowledge, skills, and attitudes in addressing various challenges. This method facilitates the development of students' abilities to identify, analyze, and solve problems effectively, a point further supported by Tóthová and Rusek[20]. They argue that by employing appropriate strategies within problem-solving, students cultivate essential cognitive tools for navigating unfamiliar and complex tasks. Thus, problem-solving becomes not just an academic exercise but a critical life skill that students carry beyond the classroom.

Authentic learning provides a vital link between classroom instruction and the real world. Aynas and Aslan[21] assert that this teaching approach allows students to apply their knowledge in practical contexts, thereby making learning more permanent and meaningful. Authentic experiences engage students on a deeper level, enabling them to recognize the relevance of their studies. This connection between classroom learning and real-life application enhances knowledge accessibility and empowers students to develop skills directly applicable to their everyday lives.

The role of authentic learning in problem-solving is further elucidated by Gürgül[22], who posits that authentic learning prepares students for real-life challenges by involving them in real-world problems and tasks. The primary objective is not merely to learn academic subjects but to develop the ability to address real-life issues. This method encourages students to tackle complex, open-ended problems, thereby cultivating critical thinking and practical problem-solving skills. As such, authentic learning becomes integral to teaching, ensuring that students acquire not only theoretical knowledge but also the capability to apply that knowledge meaningfully.

3.Theoretical framework

3.1. Experiential learning theory

Historically, the concept of experiential education in the United States gained prominence in the 1970s, particularly with the advent of adventure education movements like Outward Bound[23]. Since then, its scope has expanded significantly, now encompassing a wide range of educational settings, including alternative education, therapy, and corporate training, and it has become a mainstay in formal university curricula[24,25]. This broad application of experiential learning highlights its value in both personal and professional development. While some critics argue that the field is "experience-rich and theory-poor"[23], the growing body of literature and ongoing discourse aim to address these concerns and refine the theoretical underpinnings of experiential education.

As early as 1975, the World Congress on Educating Engineers for World Development recognized the importance of experiential learning for shaping future engineers, emphasizing its value not only in developed countries but also in developing regions[26]. Since then, experiential learning has become integral to engineering curricula worldwide, with its focus on "learning by doing"[27]. The shift towards experiential learning in engineering has been accompanied by significant investments in new curricula designed to engage students more deeply and equip them with the skills needed to succeed in a complex, interdisciplinary world[28,29]. In recent years, the expansion of virtual learning, especially accelerated by the COVID-19 pandemic, has further emphasized the need for innovative forms of experiential learning, even in remote settings[30]. These developments indicate a growing recognition of experiential learning's value in fostering critical thinking, problem-solving, and collaboration—skills essential for students in fields such as engineering.

3.2. Expectancy value

Interest in learning has been a focal point of educational research, particularly in understanding why some learners exhibit greater engagement than others and how these variations influence academic behaviors[31]. Teachers and educators have long grappled with this challenge, which remains persistent despite advancements in pedagogical strategies. Motivation theories, such as Expectancy-Value Theory (EVT), provide insights into the interplay between learners' perceived abilities, anticipated achievements, and the subjective value they assign to tasks[32]. EVT suggests that learners' task selection, persistence, and performance are closely tied to their beliefs about their likelihood of success (expectancy) and the value they associate with the task[33]. These beliefs are shaped by a combination of personal and social factors, which evolve over time, influencing learners' academic decisions and outcomes[34].

The core components of EVT—expectancy and value—serve as a comprehensive framework for examining motivation and sustained effort in learning contexts. Expectancy refers to learners' confidence in their ability to succeed in a task, while value denotes the importance they attach to the task itself[35,36]. According to the theory, a positive expectancy without a corresponding value diminishes motivation, as

learners may lack the rationale to engage in the task. Similarly, a task perceived as valuable but unattainable may prompt learners to redirect their efforts toward more achievable goals[37]. Thus, EVT underscores the importance of aligning tasks with learners' expectations and values to foster sustained interest and academic engagement[38,31].

4. Methods

4.1. Research design

This paper explored the interests of non-mathematics major students in problem solving through authentic classroom experiences. Exploratory studies provide flexibility, allowing researchers to investigate complex topics without strict hypotheses or predefined variables, which is particularly useful in areas with limited prior knowledge. Through qualitative methods like interviews, open-ended surveys, and observations, these studies capture real-life experiences and reveal underlying structures within social or psychological contexts[39-41]. Although sometimes criticized for lacking scientific rigor, exploratory research is valuable for generating initial insights and contextual data, which can form the foundation for future hypothesis-driven studies[42,43]. In the social sciences, exploratory research adheres to systematic and structured methodologies designed to identify fundamental patterns in human behavior, social structures, or psychological phenomena[44,45]. These studies contribute to a broader understanding by providing valuable insights into the context and dynamics of a given phenomenon, without imposing preconceived notions or theoretical frameworks on the participants' experiences[46]. As such, exploratory research is often used to investigate emerging phenomena by uncovering its potential implications, challenges, and opportunities for future study[47]. This paper answered one critical question: what processes could encourage non-mathematics majors to learn mathematics? Through qualitative exploration, the study highlighted the need for innovative teaching strategies that make mathematics more accessible and engaging for non-mathematics majors.

4.2. Participants and sampling

In exploratory research, the focus of participant sampling tends to be on depth rather than breadth, often involving smaller sample sizes to gain detailed insights rather than aiming for broad generalization[48,42,49]. Understanding sampling methods in research design is crucial for analyzing and drawing conclusions from data[50]. One common approach to sampling in exploratory studies is purposive sampling, a non-random technique where participants are selected intentionally based on characteristics relevant to the research[51,52]. This ensures that the individuals chosen have experience or knowledge critical to the research questions, enriching the data and increasing its relevance[53,54]. In sampling the participants, an online purposive sampling[55] through initial online survey that gathered preliminary data from potential participants. Open-ended surveys allow for a deeper exploration of respondents' thoughts, feelings, and experiences by providing them with the freedom to express their views in their own words. Participants were sampled (n=16) based on three major characteristics: (1) a college student enrolled in a non-mathematics course, (2) currently enrolled in Academic Year 2024-2025, and (3) classroom experiences in authentic learning. **Table 1** summarizes the demographics of the participants who were interviewed in the study.

Table 1. Primary information of the participants.

Name	Age	Sex	Course	GPA* (Gen-Math)	Experience in Authentic Learning about Learning Mathematics
John	21	Male	Communication Arts	2.5	John has experienced hands-on math-related projects in media production, like budgeting for event planning.
Sarah	22	Female	Psychology	2.25	Sarah participated in group projects that applied statistical analysis in psychology research.
Michael	20	Male	Criminology	2.25	Michael used basic math concepts for crime data analysis and statistical trends in criminology research.

Name	Age	Sex	Course	GPA* (Gen-Math)	Experience in Authentic Learning about Learning Mathematics
Anna	23	Female	English Literature	2.0	Anna explored patterns in literature through the use of statistical analysis in text studies.
Karen	22	Female	Journalism	2.5	Karen applied basic math for editorial planning, managing column spaces, and estimating publication costs.
Daniel	21	Male	Sociology	2.75	Daniel encountered real-world data analysis, utilizing basic statistics to analyze sociological trends.
Jessica	24	Female	Nursing	2.0	Jessica has used basic math in dosage calculations and managing patient care schedules.
Kevin	20	Male	Film Studies	3.0	Kevin applied mathematical concepts in film production budgeting and scheduling.
Isabella	22	Female	History	3.0	Isabella utilized math concepts in analyzing historical data and timelines in research projects.
David	23	Male	Political Science	2.5	David applied statistical methods to analyze voting patterns in his political science coursework.
Maria	21	Female	Tourism Management	2.5	Maria used math in creating travel packages, calculating costs, and analyzing market trends.
Angela	20	Female	Marketing	2.25	Angela encountered data analysis for market research and trend predictions, applying basic statistics.
Gabriel	23	Male	Public Relations	2.75	Gabriel used math to manage budgets for PR campaigns and analyze media outreach performance.
Monica	24	Female	Social Work	2.75	Monica employed statistics in case studies and social service assessments to determine impact outcomes.
Elizabeth	21	Female	Fine Arts	2.5	Elizabeth integrated math concepts in art history and digital design projects, working with proportions and scale.

Table 1. (*Continued*)

**Passing GPA is 3.0*

4.3. Instrumentation

In qualitative research, the development of an interview guide is a critical step that shapes the data collection process, ensuring it is both systematic and adaptable. A semi-structured interview guide, in particular, serves as a vital tool in this regard, allowing researchers to explore topics in-depth while maintaining flexibility to adjust to the responses. The creation of this guide begins with a clear understanding of the study's objectives, ensuring that the questions align with the research aims and the specific context of the study[56], which also involves gathering relevant background information that informs the construction of the interview questions, which are designed to encourage open and reflective responses from participants[57,58]. An effective semi-structured interview guide includes carefully crafted preliminary questions that address the core themes of the study, with the intention of prompting detailed and narrative responses[59,60]. The semi-structured format allows interviewers the flexibility to adapt their approach, asking follow-up questions based on participants' answers and exploring new, unanticipated topics as they emerge[61]. This adaptability is crucial for uncovering deeper insights and ensuring that the data collection remains dynamic and responsive to the flow of conversation. Before finalizing the guide, pilot testing is a common practice to assess the clarity and relevance of the questions. Pilot testing typically involves a small sample of participants, such as college students, to provide feedback on the guide's usability and effectiveness[59,62]. Based on this feedback, researchers make necessary adjustments to the interview questions, refining them to ensure they align with the study's objectives and are comprehensible to the target audience. Feedback from education professionals and researchers helps enhance the clarity, relevance, and focus of the questions, ensuring they are well-aligned with the study's research goals[56]. Through this iterative process, researchers develop an interview guide that not only facilitates a rich, comprehensive exploration of participants' perspectives but also supports the systematic and flexible approach necessary for

qualitative data collection[63]. **Table 2** below presents the final version of the interview guide used in this study, which embodies this rigorous and adaptive process.

Table 2. Instrument of the study.

Objectives	Interview questions
Determine how authentic, real-life experiences can increase the interest of non-math enthusiast learners in problem-solving.	1. Can you describe a real-life experience where you became more interested in problem-solving than usual? 2. What aspects of that experience caught your interest and made you more engaged? 3. When solving real-world problems using math, have you noticed an increase in your interest to engage in problem-solving? Can you give an example of when this happened?
Identify specific authentic activities that spark interest and engagement in problem-solving among non-math learners.	1. What specific activity in math problem-solving sparked your interest and kept you engaged throughout the process? 2. Can you explain how a particular activity made problem-solving in math more appealing to you? What was different about this activity compared to others? 3. Are there any hands-on activities you've participated in that increased your interest in math problem-solving? How did these activities make you feel more connected to the subject?

5. Data gathering

Conducting interviews as a primary data collection method requires a structured yet adaptable approach to ensure that rich and reliable data is gathered. One-on-one interviews are particularly effective for capturing in-depth insights, as they enable researchers to listen actively and interpret the meaning participants attribute to their experiences[64,65]. To achieve this, a systematic process must be followed, beginning with clearly defining the research objectives and selecting participants who meet specific criteria relevant to the study's aims[66,67]. Transparent communication of the study's purpose, confidentiality protocols, and data usage is essential to build trust and ensure ethical considerations are met. Keeping the setting informal yet focused, with a conversational tone, encourages participants to share their experiences freely[68]. Thematic interview questions are designed to guide the conversation around core topics, with follow-up prompts to allow for elaboration and reflection. This approach ensures participants provide narrative, in-depth responses[69]. Additionally, cultural and linguistic considerations are essential to facilitate engagement and expression. By allowing participants to respond in their preferred language or dialect, language barriers are minimized, and participants can articulate their thoughts more comfortably[56]. Flexibility in the interview process is also vital for ensuring that the conversation stays relevant and participant-driven, which enhances the reliability and depth of the data collected[70]. With participants' consent, interviews are typically audio-recorded to ensure accuracy, while preliminary notes are taken during the session to capture key points for subsequent analysis[71].

5.1. Data analysis

Thematic analysis serves as an effective method for analyzing qualitative narratives. Thematic analysis allows researchers to systematically identify themes within narrative data, such as one-on-one interviews, and interpret these patterns to gain insights into participants' experiences[72]. Flexibility makes it ideal for exploring shared experiences, particularly in studies where the aim is to understand a social phenomenon[44]. Reflexive thematic analysis, as applied in this study, emphasizes the importance of researcher subjectivity in interpreting the data. It calls for a reflexive approach where researchers acknowledge and engage with their own perspectives, ensuring that their influence on the data analysis is considered throughout the process[73-75]. The analysis begins with descriptive codes and gradually progresses toward more interpretive and abstract codes[76,77]. An inductive approach is crucial to this method, as it ensures that themes are grounded directly in the data rather than imposed by pre-existing theoretical frameworks or hypotheses. This bottom-up strategy enhances the alignment of the analysis with the participants' lived experiences, reducing the risk of bias and

improving the authenticity of the findings[72,77]. Braun and Clarke[78] six-phase model of reflexive thematic analysis provide a comprehensive roadmap for this process, which includes familiarizing oneself with the data, generating initial codes, searching for themes, reviewing and defining themes, and producing the final report. The iterative nature of this process allows for continual refinement of the analysis, ensuring that each phase builds upon the last to deepen the understanding of the data[72]. **Figure 1** presents the six phases of reflexive thematic analysis.

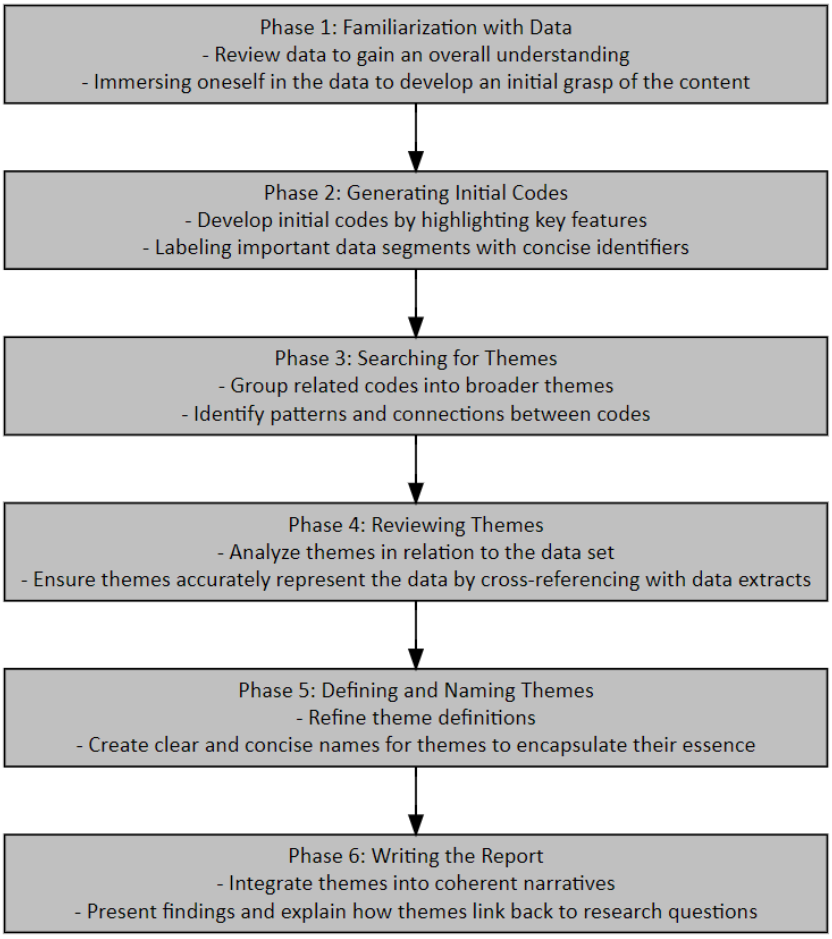

Figure 1. Six phases of reflexive thematic analysis.

6. Results

Objective 1: Determine how authentic, real-life experiences can increase the interest of non-math enthusiast learners in problem-solving.

This paper analyzed how authentic, real-life experiences helped non-math major students to be interested in mathematics. Three key themes emerged from the responses: *Personal*, *Application*, and *Solving Problems*.

In *Personal* theme, participants shared how real-life situations, such as budgeting for family expenses or managing their personal finances, made them realize the practical value of math in everyday life. This connection to personal needs increased their interest in problem-solving, as it became something directly relevant to their experiences.

The *Application* theme emphasized how learners became more engaged when they saw the direct impact of math on their daily decisions. Participants noted how math helped them with tasks like budgeting for

gasoline or calculating expenses, making math not just theoretical but essential for managing real-world challenges.

Finally, the *Solving Problems* theme highlighted the importance of tackling real-world scenarios that required critical thinking. Learners reported feeling more engaged when they could apply mathematical concepts to solve practical problems, whether in accounting or everyday decision-making, with the problem-solving process being both personal and meaningful.

Theme 1: Personal

Participants revealed that real-life experiences, particularly related to finances, played a pivotal role in enhancing their interest in problem-solving and mathematics. The connection between personal financial management and mathematics made the learning process more relevant and engaging.

> "Finances made me realize how useful problem-solving and math could be in everyday life, especially when it affected something important like our family business."

> "It made me more interested in problem-solving than usual because it was something I needed to do for myself."

Several participants noted that when problem-solving became a necessity in their daily lives, such as *budgeting for their allowance* or managing family business finances, it sparked a greater interest in the subject. The personal impact of solving financial problems was emphasized, with participants reflecting on how *real-life applications*, like *calculating discounts* or *allocating resources* for events, made the experience more meaningful. One participant highlighted how breaking problems down into *smaller, more manageable parts* helped alleviate feelings of overwhelm, reinforcing the practical utility of math in personal contexts.

> "Life experience, I think when I budget my allowance as a student."

> "When I budget my allowance as a student who is struggling financially."

> "I noticed I cared more about solving the problem when it related to real life. For example, calculating discounts when buying new clothes or budgeting for the rides."

> "Breaking down the problem into smaller, more manageable parts made it less daunting."

For many, the process of applying math to *time, money, and expenses* became an integral part of their decision-making, further strengthening their engagement with the subject. This shift from abstract concepts to tangible applications created a more engaging and purposeful learning experience.

> "Allocating ingredients, materials, and decorations and adding their prices helped us to be more prepared. It became part of my life."

> "It made more interested in a way that I can apply it in my every decision when it comes to time, money, and expenses."

Theme 2: Application

Participants highlights the practical significance of mathematics in daily life, where participants noted that using mathematical skills in real-world contexts enhanced their engagement with the subject.

For many, the act of applying math to everyday responsibilities, such as *budgeting money for gasoline* or managing finances, was a central aspect of their learning. One participant specifically mentioned

the challenge of *figuring out how much to spend each day* to avoid running out of funds, demonstrating how the application of math became crucial for maintaining financial control. The direct *impact of solving real problems* was another key factor that sparked interest, as participants realized that the consequences of their decisions extended beyond the classroom, with real-world outcomes, such as *avoiding wasteful spending on supplies* or *preventing stock shortages*.

> "I acknowledge that learning and being interested in math would help me each day."
>
> "Even though I hate math, I am the one in charge of budgeting money for gasoline."
>
> "I am the one in charge of budgeting money for gasoline."
>
> "I had to figure out how much I could spend each day without running out of money."
>
> "What caught my interest was seeing the direct impact of the problem I was solving."
>
> "It wasn't just numbers on a worksheet, but real consequences. I had to use math to avoid wasting money on too many supplies or running out of stock."

Furthermore, participants expressed a sense of engagement when applying basic mathematical operations—*addition, subtraction, and division*—to simplify and solve practical problems. This connection between learning and application reinforced the relevance of math, transforming it from abstract concepts into tools for managing everyday tasks effectively.

> "I consider myself engaged in mathematics whenever I am applying what I learned in real life situation…using additions, subtraction, and divisions from what I learned helped me to make my situation easy."

Theme 3: Solving Problems

Participants underscores the personal and practical nature of math, emphasizing how real-life scenarios enhance engagement and critical thinking. Participants reflected on how they were more motivated to solve problems when the scenarios felt relevant and *connected to their own lives*, such as in situations requiring thoughtful decision-making or problem resolution.

> "My real-life scenario is connected to some mathematical problem scenarios which made me interested and looking forward to more realistic problem solving."

One participant emphasized the importance of looking for the *bigger picture* rather than focusing on small, isolated solutions, which encouraged a deeper level of engagement. The process of solving problems became particularly compelling when participants recognized the impact their solutions had on their daily lives, highlighting the *personal* and *practical* nature of their experiences.

> "I always think and look for a bigger picture directly than to look for a small solution."
>
> "This felt different because it was something I needed to care about."
>
> "What made me more engaged is when I allow myself to see the bigger picture and was able to answer math problems correctly, also when it makes me think critically."

> "It was personal and practical. I felt like I was solving a real problem that had an impact on my daily life."

Further, the *challenge* of finding solutions that fit specific constraints, such as weight, size, and functionality, was described as both stimulating and rewarding. This engagement was further reinforced in subjects like *Fundamentals of Accounting*, where real-world examples, such as *balance sheets and company financials*, captured their interest and demonstrated the direct applicability of mathematical concepts in professional and personal contexts.

> "The challenge of finding a solution that fit all the constraints, weight, size, functionality was what really caught my interest."

> "One caught my attention is the subject Fundamentals of Accounting wherein the examples used in balance sheets or journals are companies or enterprises."

Objective 2: Identify specific authentic activities that spark interest and engagement in problem-solving among non-math learners.

The findings revealed that authentic activities significantly enhance non-math learners' engagement and interest in problem-solving by making math relevant to real-life contexts. One key area is *expenses*, where participants expressed greater investment in tasks such as budgeting for trips or managing limited resources. These activities transformed math from abstract concepts to tangible challenges, sparking deeper involvement in decision-making.

In addition, *collaboration* played a critical role, with learners noting that working in groups encouraged shared responsibility and the exchange of ideas, which enriched their problem-solving processes. Participants highlighted projects such as designing a model bridge, where *mathematical operations* like geometry and weight distribution were applied in practical, hands-on scenarios. The theme of *management* also emerged, with learners expressing interest in using math to organize their study schedules and optimize time, reinforcing the *creativity* involved in problem-solving.

Finally, the theme of *business* revealed that learners engaged more deeply with mathematical concepts when they were tied to real-world entrepreneurial activities, such as calculating profits, pricing, and financial planning, making math feel *practical* and aligned with future goals.

Theme 1: Budgeting

It becomes evident that authentic, real-life activities involving financial decision-making significantly increase interest in problem-solving for non-math learners. Participants expressed that engaging in activities such as *calculating costs*, *deciding on prices*, and determining how to *cut expenses* provided a sense of challenge that was both motivating and personally relevant.

> "Calculating costs, deciding on prices, and figuring out how to cut expenses without lowering product quality made the math feel more like a challenge I wanted to solve."

> "Using math to make sure we didn't go over budget while also making the trip fun was a challenge, but it made me more invested in solving the problem."

The application of math to ensure that a trip stayed within budget while maintaining enjoyment further enhanced their investment in solving the problem, as it tied directly to their lived experiences. The emphasis on managing a *limited budget* for various aspects of a trip—such as *food*, *decorations*, and *activities*—highlighted how math could be used to make practical, real-world decisions.

> "For example, when I was planning a road trip, I used math to calculate gas consumption, estimate travel time, and figure out the cost of parking."
>
> "We had a limited budget and had to balance costs for food, decorations, and activities. Using math to figure out how to stretch the budget while ensuring everyone had a good time made me much more invested."
>
> "This activity was different because it was related to something fun—planning a trip. It wasn't just solving equations on paper, it felt like solving something I could actually experience."

The learners noted that *budgeting* not only made math more relevant but also gave them a sense of agency, as they actively decided how to spend and save. This personal involvement with math, particularly in contexts like trip planning, made the activity feel more like an experience to be *lived* rather than just an academic exercise. Consequently, these real-life applications of math helped transform abstract mathematical concepts into practical tools for everyday problem-solving, demonstrating the potential of *authentic activities* to increase engagement.

> "Budgeting made me see how useful math could be in real life, not just in school. I was actively deciding how to spend and save, and math helped me figure out how much I could afford."
>
> "Math helped me stretch the budget while ensuring everyone had a good time."

Theme 2: Collaboration

Collaboration highlights how working together in group settings encourages greater engagement and enhances interest in mathematical problem-solving. Many participants emphasized the value of interacting with *classmates*, describing how learning from peers and listening to their different problem-solving approaches facilitated deeper understanding. The act of *brainstorming* and exchanging ideas during group discussions was noted as a key component of engaging with the problem-solving process, as it cultivated a sense of *shared ownership* and *responsibility*. This collaborative approach was particularly effective in real-life scenarios, such as *budgeting* for a group trip, where participants had to apply *mathematical operations* to allocate and manage expenses across various categories. The group dynamic encouraged critical thinking, as participants were required to work together to find practical solutions.

> "Classmates are also a big factor for me in being engaged because with them you can learn by just listening on how they got the solution."
>
> "Working with a team to brainstorm ideas and tackle challenges fosters a sense of shared ownership and responsibility."
>
> "We brainstorm by discussing each problem and exchanging of thoughts."
>
> "One example was when I was budgeting for a group trip with my friends. We had a set amount of money and had to figure out how to split costs for transportation, food, and accommodations."
>
> "We need to allocate our expenses and possible expenses which made me think critically and apply mathematical operations."

Collaborative activities like *building a model bridge* further exemplified the impact of teamwork on engagement. By applying mathematical concepts such as *geometry*, *structural integrity*, and *weight distribution*, students felt like they were solving real-world problems, not just abstract exercises. This hands-

on experience made the learning process more tangible and relevant, as participants actively worked together to understand and apply mathematical formulas. Overall, the theme of collaboration demonstrates that when learners are able to interact and solve problems in a team setting, their engagement and interest in mathematics are significantly enhanced, turning abstract problems into practical, shared challenges.

> "One activity that really sparked my interest in math problem-solving was a group project where we had to design and build a model bridge using only specific materials."

> "We had to apply concepts like geometry, structural integrity, and weight distribution to create a bridge that could withstand a certain amount of weight."

> "When we had a project where me and my group mates had to build model bridge and figure out its strength using math formulas kept me really engaged. It was hands-on and felt like we were engineers solving real problems."

Theme 3: Management

Management highlights the role of mathematical thinking in organizing and optimizing personal tasks, particularly in academic settings. Many participants reported that their interest in mathematics grew when they had to *calculate* essential factors such as study hours for exams, emphasizing the importance of *time management* and the strategic use of math in balancing multiple tasks. This practical application made the learning process more relevant and engaging, as it directly influenced their ability to effectively allocate time and effort across subjects. The use of math to *simplify tasks* was another key factor that increased engagement, as participants appreciated the real-life utility of finding mathematical solutions to improve efficiency and outcomes.

> "Became more interested when I had to calculate how many hours I needed to study to pass my exams."

> "I was figuring out how to balance my time effectively between subjects and made some of my school tasks bearable."

Furthermore, participants noted that rather than merely solving equations, they were applying math to make *informed decisions* that would influence future events, such as planning study schedules or allocating resources. This creative and flexible approach to problem-solving transformed math from a rigid, abstract concept into a dynamic tool for personal and academic growth.

> "Whenever I solved it I become interested and finding those formulas to simplify tasks or answer accurately. It is because in real life a person can't solve problems without thinking."

> "Instead of just solving equations, I was figuring out how to use math to make choices that would affect the outcome of the event. It made the process more creative and less abstract, which kept me engaged."

The idea of *looking for a bigger picture* was also emphasized, as it encouraged participants to consider alternative solutions and think critically about the most effective approaches. This ability to strategically approach problems with calmness and creativity reinforced the practical value of mathematics in managing various life situations, keeping learners engaged by demonstrating its immediate relevance and impact.

> "The look for a bigger picture and look for alternatives. So, I should be calm at first and think another way and solve your problems."

Theme 4: Business

Participants highlighted how math serves as a tool to fulfill their *dreams* of becoming successful business owners. They found that math became significantly more engaging when applied to practical scenarios such as *pricing*, *profits*, and *break-even analysis*, as these are essential elements in running a business. Rather than viewing math as a mere academic exercise, they began to see it as a necessary skill for making critical decisions that directly impact a business's success. This shift made mathematical concepts feel less abstract and more tied to real-world applications.

> "It really exercises my brain and is connected to my dream—to be a future businessman."

> "I cared about—starting a business. It wasn't just solving math problems for the sake of it. I had to think about pricing, profits, and how much we'd need to sell to break even. This made math feel more practical and less like an abstract concept. It was about making the business work, not just passing a test."

> "The capital, profit, and dealing with people by using mathematics in that case it increased my interest because I can do more and have more."

7. Discussion

Rocha et al.[79] emphasize the centrality of problem-solving in developing students' understanding of mathematical concepts, enabling them to relate these concepts to real-world situations. This aligns with the study's focus on promoting contextualized problem-solving to enhance relevance and motivation among learners. Similarly, Saini et al.[80] highlight the integration of financial literacy within mathematics curricula as an effective means to engage students, demonstrating the practical applications of mathematical concepts in managing personal finances. These findings resonate with the research's emphasis on contextual learning to address disengagement in mathematics education.

For example, college students noted that they develop interest in mathematics when they engage in math problems about budgeting. For example, one student said that *"Using math to make sure we didn't go over budget while also making the trip fun was a challenge, but it made me more invested in solving the problem."* Contextual problem-solving experiences allow students to recognize the practical applications of mathematics, so enhancing their engagement and drive to learn. These observations emphasize the necessity for a mathematics curriculum that not only imparts fundamental concepts but also contextualizes them within scenarios relevant to students' personal and prospective professional experiences.

Figure 2. Word cloud for thematic codes.

The thematic codes illustrated in **Figure 2** highlight critical keywords derived from the analysis. These codes encapsulate the essential elements of the narrative analysis, which emphasizes the authentic learning experiences of college students. The identified keywords serve as indicators of the themes that define and reflect the authenticity of the students' academic and personal growth, offering valuable insights into their educational journeys. Through these thematic codes, the analysis provides a structured understanding of how students engage with and perceive their learning experiences in a meaningful context. Effective problem-solving transcends mere solution-finding, involving a structured and analytical approach to challenges. Prabawa et al.[81] assert that this approach cultivates higher-order thinking, critical for students who face difficulties in grasping mathematical concepts. This reinforces the importance of equipping students with systematic problem-solving methodologies, a key objective of the study. Furthermore, Kaya et al.[82] argue for the contextualization of mathematical education to make learning more applicable to daily life, a strategy that directly addresses the practical relevance emphasized in this research.

Contextualized and collaborative learning strategies emerge as transformative in mathematics education. Ainhoa[83] highlights that engaging student with real-world scenarios promotes critical thinking and enhances motivation, particularly for those less inclined toward mathematics. Kusumawati et al.[84] and Hobri et al.[85] underline the role of collaborative problem-solving in facilitating knowledge construction through peer interaction, encouraging enthusiasm for mathematics. This paper observed that with this approach, non-mathematics major students were interested in solving mathematics problems with their group members. For example, students revealed that having group projects like building a bridge using simple accessible things enabled them *"to apply concepts like geometry, structural integrity, and weight distribution to create a bridge that could withstand a certain amount of weight."* They noted how discussing and debating ideas with peers fostered a sense of community and confidence in tackling mathematical challenges. These experiences highlight how peer interaction is pivotal in fostering critical and creative thinking, as students often benefit from diverse perspectives within their groups. Thus, contextualized and collaborative strategies not only improve academic outcomes but also cultivate essential interpersonal and analytical skills, making mathematics more accessible and engaging for learners across disciplines.

Interactive and engaging instructional methods are essential for encouraging a positive attitude toward mathematics because they make learning more enjoyable, relatable, and effective. Madrasah et al.[86] emphasize the impact of participatory lessons on reducing disengagement. Similarly, Samuelsson[87] highlight the importance of contextualized and hands-on learning experiences in sustaining interest and developing accountability among students. These findings substantiate the study's exploration of task-oriented and real-life-integrated approaches to learning.

The relevance of active learning methodos in mathematics education is further supported by Rogers et al.[88], who argue that dynamic teaching methods, such as discussions and collaborative tasks, enhance students' understanding of mathematical principles. Sherwood[89] adds that practical applications, such as financial management, significantly increase students' interest by demonstrating the subject's utility in everyday contexts. Finally, Kiheele & Mkomwa[90] establish a strong correlation between student interest and academic performance, reinforcing the necessity of engaging and relevant learning experiences to develop both enthusiasm and achievement in mathematics. This study supported these findings that students exposed to experiential learning experiences are more likely to be competent in the subject. One student explained that *"Whenever I solve it, I become interested and find those formulas to simplify tasks or answer accurately. It is because in real life a person can't solve problems without thinking."* When making mathematics relatable and actionable, this approach transforms students' perceptions of the subject, helping them move from apprehension or disinterest to confidence and engagement. As such, the integration of active and

experiential learning in mathematics education is not just a strategy to improve test scores but a means to develop well-rounded, critical thinkers prepared for the demands of modern society.

Experiential learning emphasizes the acquisition of knowledge and skills through active engagement rather than passive reception of information. As Halada and Wozniak[91] suggest, the learning process fundamentally alters an individual's way of thinking, feeling, perceiving, and behaving. In its application, experiential learning can be seen in various methods, such as laboratory experiments, field trips, or problem-solving activities in both engineering and language classrooms, aimed at achieving specific learning outcomes[92]. Dewey[27] is often cited as a foundational figure in this field, advocating for "learning by doing" and the integration of real-world experiences into the educational process. However, it is important to note that experiential learning is not merely about engaging in activities, but also involves thoughtful reflection that leads to deeper understanding and personal development[27]. In this paper, non-math majors were interested in mathematics when teachers exposed them to real-life applications of mathematics, mostly personal aspects like budgeting and life managements. This approach encourages them to learn mathematics as it has direct connections to their life. The findings in this study can be effectively related to the expectancy-value theory, which posits that students' motivation to engage in a task is influenced by their expectation of success and the perceived value of the task[93,31]. When teachers connect mathematics to real-life applications, such as budgeting or life management, they increase the perceived utility value of the subject. Students begin to see mathematics not merely as abstract concepts but as a practical tool that directly impacts their daily lives, making it more relevant and meaningful.

This study highlighted the importance of integrating contextualized and experiential learning approaches into mathematics education to engage non-math majors and students who struggle with the subject. Real-life applications, such as budgeting or life management, enhance the perceived relevance of mathematics, encouraging intrinsic motivation and engagement. Collaborative problem-solving activities, like group projects, encourage peer interaction, build confidence, and develop critical thinking skills, aligning with the expectancy-value theory by increasing both success expectations and task value. Task-oriented and hands-on learning experiences address barriers to engagement by connecting mathematics to everyday life and promoting systematic problem-solving. To maximize these benefits, educators should design active, participatory lessons that incorporate themes like financial literacy and practical challenges while encouraging reflective practices to deepen understanding and personal growth. This approach not only improves academic outcomes but also cultivates essential life skills and confidence in problem-solving.

8. Limitations

The study has several limitations that warrant consideration. First, the sample size was limited, which may restrict the scope of the findings and their applicability to broader populations. With a relatively small number of participants, the data may not fully capture the diversity of experiences and perspectives among college students. Second, the reliance on narrative data, while rich and insightful, is inherently subjective and may introduce potential biases in interpretation. Participants' accounts are shaped by personal contexts, which could limit the objectivity of the analysis. Third, the findings lack generalizability due to the specific demographic and institutional contexts in which the study was conducted. These results may not fully apply to other educational settings or student populations with different cultural, social, or academic environments. Finally, the qualitative methods employed, while effective in exploring in-depth experiences, may not provide the level of precision and replicability offered by quantitative approaches. Future research could address these limitations by incorporating a larger and more diverse sample, triangulating narrative

data with quantitative measures, and employing mixed-method approaches to enhance the reliability and generalizability of the findings.

9. Conclusion

This study examined the role of authentic, real-life experiences in enhancing the interest of non-math learners in problem-solving. The findings suggested that engaging students with practical applications of mathematics—especially in personal, financial, and real-world contexts—can significantly increase their interest in the subject. The key themes that emerged from the analysis—Personal, Application, and Solving Problems—demonstrate that when learners see the direct impact of math on their lives, they are more likely to engage with the subject. In addition, authentic activities, such as budgeting, collaboration, and project-based tasks, further reinforced the relevance of mathematics in real-life scenarios, encouraging deeper involvement and critical thinking. These findings underscored the importance of making mathematics not just a theoretical subject but a valuable tool for addressing everyday challenges.

The results of this study highlight several important implications for educators and curriculum designers. First, incorporating real-life scenarios into mathematics instruction can help demystify the subject for non-math learners, making it more relaf and engaging. By emphasizing the practical applications of mathematical concepts—such as budgeting, time management, and business planning—teachers can encourage a greater appreciation for the subject's relevance in daily life. The study also revealed that collaborative learning environments, where students work together on real-world tasks, can further enhance engagement and encourage a sense of shared responsibility. This suggested that teachers should integrate group-based projects and problem-solving tasks into their curricula, as they provide opportunities for students to apply mathematical knowledge in meaningful ways. Moreover, activities that involve real-world problem solving, such as budgeting for a trip or designing a model bridge, can stimulate students' interest and motivate them to actively participate in the learning process.

Future studies should explore the long-term effects of incorporating authentic activities into math instruction to determine whether the increased engagement observed in this study leads to sustained improvements in students' mathematical competence. Additionally, research could investigate how the integration of different types of real-life activities—such as business simulations, financial planning exercises, and entrepreneurial projects—affects students' problem-solving skills and overall mathematical understanding. Further, exploring the role of technology in facilitating authentic learning experiences in mathematics could provide insights into how digital tools and platforms can enhance problem-solving engagement for non-math learners. Finally, future studies could assess the effectiveness of specific teaching strategies—such as flipped classrooms or inquiry-based learning—when combined with authentic activities in developing student engagement in mathematics, to provide a more comprehensive understanding of best practices in math education for non-majors.

Conflict of interest

The authors declare no conflict of interest.

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