

Real-Life Valuation And Re-Configuring Instructional Approach Of Learning Mathematics Among College Non-Math-Oriented Students

Lorena G. Tan

lorena_tan@zscmst.edu.ph

Zamboanga State College of Marine Sciences and Technology.

Abstract

Incorporating a diverse range of instructional strategies is essential to address the multifaceted nature of students' attitudes and motivations towards mathematics. Students' positive outlook and recognition of mathematics' practical utility in real-world scenarios are reflected in their ability to see the relevance of the subject to their future careers, which in turn reflects positively on their perception of mathematics. The purpose of this study was to explore the perceptions of students on the value of mathematics in their life and identify the components of mathematics learning that represents this perceived value. The non-mathematic-oriented college students (n=20) were purposively sampled. The one-on-one interview was conducted to extract the personal experiences of students and describe how they value mathematics. The findings indicated that the perceived value of mathematics involves its general use, personal use, and applications to human-essential processes or resources. Perceived value governs the practical relevance of mathematics in everyday life and signifies an opportunity to leverage this awareness for improved learning experiences. Educators should thus focus on nurturing this subjective valuing, tailoring instruction to align with students' individual preferences and highlighting how mathematical concepts align with their personal and career aspirations. This study underscored the need for a multidimensional approach to mathematics education – one that capitalizes on perceived value, addresses attitudes and difficulty perceptions, fosters intrinsic motivation, and promotes personalized and engaging learning experiences.

Keywords: instructional approach, mathematics learning, non-mathematics oriented course, perceived value, realistic mathematics education.

Introduction

Learning involves individuals actively participating in a range of activities that ultimately lead to observable changes in behavior (Arenillo & Cruzado, 2014). The acquisition of mathematical knowledge is a multifaceted and evolving process that necessitates careful planning and a state of preparedness (Moussa & Saali, 2022). However, students see mathematics as a demanding and exhausting subject to learn which elicits fear and anxiety (Abina, 2021; Langoban & Langoba, 2020).

This paper investigates on how students value mathematics in their daily life and use this perspective to reconfigure the instructional approaches of teachers. The narratives from non-mathematics-oriented students shed light on how to develop a curriculum that focuses on the applications of mathematics to the life of students which also influences their perception and interest to the subject.

The complex nature of student engagement in mathematics covers various affective, cognitive, and behavioral concepts, directly impacts the quality of their learning outcomes (Al-Mutawah & Fateel, 2018; Fredricks et al., 2004; Lawson & Lawson, 2013; Kartowagiran & Manaf, 2021; Kong et al., 2003). When students possess a positive belief in their ability to achieve success in the field of mathematics, they would actively participate in and gain enjoyment (Hannula, 2012; Middleton & Spanias, 1999; Putwain et al., 2018; Ryan et al., 2022).

The use of mathematical practices in real-life scenarios and professional environments is depends on the contextual factors and is employed to address practical difficulties (Julie, 2002; Robitaille & Dirks, 1982; Spooner et al., 2023). The cultivation of such knowledge and perspective is crucial for students to start learning at an early stage in their lives (Maaß, 2005; Stillman, 2010). However, students exhibited low and very low perceptions with regards to their education as implemented by the teacher (Fitriana et al., 2016).

Siregar (2017) observed that 45% of the student population, perceive mathematics as a challenging subject, 80% thinks mathematics is an important academic discipline, and 85%

believes that use of innovative and interactive teaching could improve students' learning engagements. The mathematics classroom fosters a sense of community, wherein students are encouraged to engage in open discussions, cultivate ideas, engage in debates, and ultimately attain a comprehensive understanding of mathematical concepts (Bruce, 2007; Sinay & Nahornick, 2016). The potential for enhanced learning experiences arises when the content and context of educational materials are closely aligned with the daily activities of students (Laurens et al., 2017).

RME is an instructional approach that aims to tackle the challenges associated with traditional and abstract methods of teaching mathematics (Bray & Tangney, 2016; Laurens et al., 2017). Along with the concept of RME, this study explored the experiences of students, and how they use and value mathematics in their everyday life. As Freudenthal (1971) argued, it is imperative that students are afforded the opportunity to engage in the rediscovery of mathematics through the management and processing of real-world situations or mathematical relationships. The implementation of reforms in mathematics education has necessitated the restructuring and advancement of syllabi, educational resources, and classroom practices. Professional development plays a role in facilitating the implementation of effective classroom practices, thereby serving as a key component of policy changes (Kaufmann & Ryve, 2022).

This study could provide an understanding of the concept of RME in learning mathematics. This study sought to determine how non-mathematics-oriented students value the use of mathematics in their life and potentially reflect these narratives into the development of a curriculum. The study highlighted the use of real-life applications of mathematics to encourage students and engage them in doing complex and meaningful mathematical pursuits.

Research Objectives

This study explored how students perceived the value of mathematics based on their personal experiences. Narratives from students highlighted important concepts that were relevant in reconfiguring the instructional approaches in education. Specifically, this study sought to assess their narratives based on the objectives below.

1. Determine real-life valuation of mathematics among non-Mathematics-oriented college students.

2. Determine instructional approach to learning Mathematics among non-Mathematics-oriented college students.

Literature Review

The concept of this study mainly revolves around the idea of valuation and the perceived value of mathematics. Students' subjective task values (STV) encompass various dimensions, including attainment value, intrinsic value, utility value, and cost (Eccles & Wigfield, 2020; Hagen et al., 2022). Importance value is the subjective significance attributed to person's involvement in a specific task. Intrinsic value relates to the subjective experience of pleasure or enjoyment derived from engaging in said task. Utility value encompasses the perceived usefulness or practicality associated with the task. Perceived cost could be the negative consequences, such as stress, exertion, or missed opportunities for alternative activities, that are anticipated as a result of engaging in the task or domain (Brown & Putwain, 2022; Gorges, 2016; Hagen et al., 2022). In this study, the researchers focused on the utility value as this is the most simplified concept of STV in general.

This study assumes that valuing mathematics in the context of its real-life applications could encourage students to be engaged in mathematics learning. Recent empirical findings indicate that there exists a positive correlation between students' perception of the value of mathematics relative to the verbal domain and their preference to pursue a professional trajectory in the field of mathematics (Gaspard et al., 2019; Oppermann et al., 2021). Hence, understanding why non-mathematics oriented students value math in their daily life could provide knowledge on that aspects the school administration implement RME.

If children are exposed to mathematical concepts that do not align with their everyday experiences, it is likely that they will struggle to retain this knowledge and may find it challenging to apply mathematical principles to other scientific disciplines or their daily routines (Bakker, 2004; Gravemeijer, 1994; Julie, 2002; Wijaya, 2012). In Netherlands, RME facilitates the construction of mathematical knowledge by children through the use of their existing mathematical understanding. This approach is achieved by imbuing real-world contextual issues with meaning fostering a deeper comprehension of mathematical concepts (Treffers, 2012).

One illustrative instance of a mathematical problem that exhibits RME involves the tracking of changes in the count of individuals boarding buses at a designated bus stop (Gravemeijer,

1994; Wahyudi et al., 2017). In the context of passenger dynamics within a bus system, the situation gives rise to a naturally occurring process of addition and subtraction (Wahyudi et al., 2017).

This study employed the concept of perceived value towards mathematics to capture more about which aspects of students' life they use mathematics. Certainly, this is a form of mathematical belief. The central concept in the implementation of mathematical pedagogical strategies (Chavez & Lamorinas, 2023) is the assumption of mathematical belief (Goldin, 2002). The formation of a student's mathematical belief is influenced by their attitude towards their own mathematical knowledge, thus leading to the augmentation of their mathematical value (Yanita et al., 2018). The enhancement of students' mathematical beliefs can be facilitated through the implementation of effective teaching methods by teachers (Greer et al., 2002).

The formation of an individual's perspective on mathematics is influenced by their knowledge of mathematical procedures, proficiency in formulating mathematical concepts, and adeptness in applying diverse problem-solving techniques (Tariq et al., 2013). The term "realistic" serves to highlight the comprehensive range of concepts and ideas that can be conjured within the minds of students. It refers to a problem or scenario that originates from the real-life, it is based on formal mathematics, and it alludes to an imaginary context that exists outside the bounds of reality yet can still be imagined (Fauzana et al., 2020; Panhuizen et al., 2014).

Understanding the concept of valuation holds the potential for encouraging engagement in mathematics learning, especially among non-mathematics-oriented students who may find relevance in the subject's real-life applications. This alignment could guide educational institutions in implementing strategies like RME, which emphasizes the construction of mathematical knowledge through contextual, real-world scenarios. RME's incorporation of meaningful, everyday issues resonates with students' existing understanding and facilitates a deeper grasp of mathematical concepts.

Methods

Research Design

This study used qualitative research design to analyze the narratives of students. Qualitative analysis is a form of textual pattern analysis that delves into the intricate relationships in how

people respond and perceive something. Qualitative research is a systematic methodological approach that seeks to understand and interpret complex phenomena through an in-depth exploration of individuals' experiences, perspectives, and narratives. In this study, exploratory design, a form of qualitative design, was used to explore more about the experiences and ideas of students on how to improve the instructional approach in mathematics while reflecting their perceptions of the value of mathematics in general.

An exploratory design is an effective approach because researchers can probe into the participants' experiences and understand how real-world scenarios (Chavez, 2022). Exploring narratives can uncover the practical significance of mathematics beyond academic contexts, revealing the ways in which students perceive its relevance and applications in their daily lives.

Participants and Sampling Technique

The participants of the study were college students ($n=20$) who are enrolled in non-mathematics-oriented courses. The participants were purposively sampled based on some characteristics i.e., enrolled in non-math courses (<50 math-based units), enrolled in college. These characteristics narrowed down the scope of the study among those people in a specific demographic.

Purposive sampling is particularly well-suited when the research aims to explore a specific phenomenon or understand the experiences of a distinct group (Etikan et al., 2016; Tongco, 2007). By purposively selecting participants who fall within this specific category, researchers can ensure that the collected data directly aligns with the research questions. This focused approach enables a comprehensive exploration of the experiences and perspectives of the target population.

Research Instrument

The interview guide for the study was structured to address the research objectives by facilitating discussions on the real-life valuation of mathematics, preferences for instructional approaches, and strategies for enhancing the learning experience. The guide was designed to encourage participants to share their perspectives, experiences, and suggestions in a coherent and comprehensive manner, thereby contributing to the study's endeavor to shed light on the thematic interplay between mathematics education and student perceptions. In Table 1.0 below, 15 participants were interviewed in each set of questions

per objectives. They were randomly selected on which set/s they will be interviewed.

Table 1.0 Interview Guide Questions

Objectives	Interview Questions
Determine real-life valuation of mathematics among non-Mathematics-oriented college students.	a. For someone who is a non-math course taker, how do you value mathematics as part of completing a degree? b. Do you believe learning mathematics subjects in school is important in real-life situations? Elaborate in specific situations.
Determine instructional approach to learning Mathematics among non-Mathematics-oriented college students.	a. How should mathematics be taught in schools so that learners (who believe they are weak or who have developed hate for the subject) will appreciate it? Elaborate in terms of approach or strategies.

Data Gathering Procedure

Initially, formal permission was sought from the school administration to conduct the study within the educational institution. A formal request was submitted outlining the purpose, scope, and objectives of the research. This request emphasized the academic contribution of the study and its potential to take part in the improvement of instructional approaches. The administration was informed about the interview-based data gathering method and assured that all necessary ethical considerations will be adhered to.

Subsequently, prospective participants are identified, and their informed consent is diligently sought. A formal letter detailing the research's aims, the interview process, and the significance of their contribution is sent to potential participants. This letter outlined the voluntary participation, emphasized the confidentiality measures protecting their responses, and explained how the collected data to be utilized solely for research purposes.

The systematic process ensures ethical integrity, transparency, and respectful engagement with both the educational institution and the participants, thereby contributing to the validity and reliability of the study's findings.

Data Analysis

This study employed thematic analysis to analyze and extract themes from the narratives. Thematic analysis starts in data familiarization, where researchers immerse themselves in the interview transcripts to gain a deep understanding of the content. This step allowed the researchers to become acquainted with the participants' narratives, experiences, and perspectives related to the valuation of mathematics and instructional approaches. As the analysis progresses, codes were generated to identify meaningful units within the data. These codes served as initial labels for significant concepts, allowing researchers to organize and categorize the data in a systematic manner.

Themes are patterns of meaning that encapsulate recurring concepts, ideas, and sentiments expressed by participants (Chavez, 2020). These themes provided a holistic view of participants' experiences and insights, shedding light on their perceptions of mathematics and their preferences for instructional methods. Through careful consideration and comparison of themes, the researchers gained a comprehensive understanding of the diverse perspectives within the non-mathematics-oriented student population.

Results

Objective 1. Determine real-life valuation of mathematics among non-Mathematics-oriented college students.

Theme 1: General Utilitarian Concept

Majority of non-mathematics-oriented students (n=20) believe that mathematics is an essential skill to learn that has real-life applications. Some of them use mathematics in their daily life. Students (n=14) pointed out computing skills, which includes addition, subtraction, and converting numbers, as the most applicable and useful skill from math. Some also give instances where they used mathematics in stores, purchasing in supermarkets, and transportation.

"I hate math, actually. That is why I choose a course that has less math. It is a valuable skill to learn like adding, and subtraction, but in most other topics, it is difficult." [Participant 8]

"For me, math has a daily life application. We can use math when we have a business. For professionals, math is also important to them. They should have knowledge about it. Even if a person is a student or a graduate of non-math courses, they also use math."

“We really need something like pure math like when you measure things...when you have a formula. For example, in ratio. Mathematics also has that topic on unit conversion and converting metric system.”

“Even if I’m not math-oriented, the math still has value to me. I feel I really need math in my life because it can help me go to certain places and use them whenever I need to.” [Participant 2]

“Just like in transportation, sir, we still need mathematics. We need to count our money to actually pay the exact amount that we need when we are riding jeepney or other transportation. And then, if I’m in school, I still need mathematics to buy food. I need to count money.”

Theme 2: Use for Self-management and regulation

Some students (n=11) also believed that mathematics improves the overall skills, not only in computing. They explained that exposure to mathematics improves the problem-solving skills and critical thinking. It can help improve students’ well-being and allows them to manage their time effectively.

“Math is not only about solving numbers and problems. You can use it in your everyday life. For example, time loss where you are not able to manage your time effectively. With math, you are able to tell time, how ahead or late you are.”

“For me, math is very tricky subject because it tests your mental skills. Even simple math activities like adding and subtracting within limited time improves your mental skills and hence, boosts your intellectual self.”

Theme 3: Life-essentials with Math

Appreciation to the subject was also emergent concept. Students (n=5) believed that learning mathematics makes them appreciate math around them. They learned that most of the essential aspects of human existence like electricity and housing rely widely on the concept of math.

“Math is anywhere around us. When you learn math, you also appreciate that even your life-essentials like electricity and housing rely on math.”

“Learning math, especially on its real-life applications, makes you more positive on how we could use simple additions to make something useful in humans.” [Participant 16]

Objective 2. Determine instructional approach to learning Mathematics among non-mathematics oriented college students.

Theme 1: Instructional Factor

Most of non-mathematics oriented students (n=17) find it difficult to learn mathematics because of its complex applications of concepts and formulas. One student highlighted it is less focused on its application in real-life. In some instances, teachers would delve right into difficult topics without thoroughly explaining its pre-requisites and foundations. Students prefer a gradual and meaningful discussion on the mathematical concepts they might encounter in daily basis.

“During our time, before the instructor will teach, he/she will say okay, there would be 99 formulas that you have to look forward. This makes students less engaged in the math because it mainly focusses on formulas and math concepts, and less focus on its real-life applications.” [Participant 1]

“About instruction, what are the problems and what we need to do to solve these problems? In my opinion, I’m not really good at math. I think, the best way to teach math is by not making it look like difficult. I mean, not to use strategies that leave students confused and difficult to understand. Teachers could make the lesson gradual and not to expose to students in challenging math problems right away.” [Participant 20]

Theme 2: Student’s Intrinsic Factor

Some students (n=6) believed that it might be from students that causes problems in learning mathematics. Some teachers are good in teaching the concepts of math but students still unable to catch up and learn. In this sense, there could be a relationship on how to build the interest of students by integrating into the concepts of mathematics and its applications in real-life. Nevertheless, there is an underlying intrinsic factor that causes students to be less interested in learning mathematics in general.

“It depends on the person how they feel about the subject. For me, it depends. Based on my experience, it is very difficult for me even it is repeatedly explained to me, I find it very difficult. Honestly, teachers are very well in explaining but sometimes the problem is in their students.” [Participant 14]

Discussion

Objective 1. Determine real-life valuation of mathematics among non-Mathematics-oriented college students.

Non-mathematics oriented students valued the use of mathematics in their daily life. They observed using mathematics in basic transaction in a store, adding numbers, and for transportation. Some of them valued the use of mathematics in self-regulation and management assisting them to understand and develop more on their skills. Others grow appreciation in mathematics because of its huge application in complex life essentials.

Several studies had been conducted on the students' perception on the use of mathematics in their life (Daud et al., 2020; Olasehinde & Olatoye, 2014). Students perceived mathematics as an important core subject and everybody needs mathematical knowledge (Hagan et al., 2020). This perception is evident even in early times because people naturally perceive mathematics as the basis for scientific knowledge (Anthony & Walshaw, 2009). The problem is that, even students perceived it has value on their everyday life, they still choose to opt out whenever possible and choose other courses that has less math units (Brown et al., 2008). This explains why students "hate math...[and] choose a course that has less math" [Participant 8]. Attitude and perceptions on the difficulty of math could influence a student not to pursue career in mathematics. Mathematics is generally not a subject that garners widespread popularity among students (Khan, 2012). In fact, some mathematics-oriented students believed that mathematical concepts like proving, is not relevant to their career in the future (Göller, 2020). It is a discipline that presents numerous challenges, leading many students to disengage and ultimately choose to opt out of this subject (Akhter & Akhter, 2018).

Initially, this study observed a divergence between perceived value and pursuing math. Although students think it has value in their daily life, some of them choose to opt-out of learning the subject. The concept of perceived value defines the value "as the consumer's evaluation of a product or service, based on his perception of the result of the exchange between what he gives and what he receives" (Amado-Mateus et al., 2023; Zeithaml, 1988). This study used perceived value in marketing (Alves, 2011) and took it into the general application of perceived value in learning a skill. It turns out, students give value to mathematics because of its application in real life. This is similar to the concept of perceived value in marketing (Lai et al., 2012; Sheth et al., 1991),

students see mathematics as an important skill to learn even though some perceived learning it is difficult.

Essentially, perceived value governs the perceptions, attitude, and acceptance of students toward mathematics and mathematics learning. Students' subjective evaluation of relevance is not only based on utilitarian concepts, but rather encompasses a broader range of factors, including personal interest and curiosity (Büdenbender-Kuklinski et al., 2022). As a student explained, “even if I’m not math-oriented, math still has value to me” [Participant 2]. Further investigation into this phenomenon may shed light on the complex interplay between intrinsic motivation, cognitive engagement, and the perception of relevance in educational settings.

The student’s ability to recognize the importance of mathematics is indicative of their capacity to establish a connection between their interest in the subject and their prospective career, thereby reflecting a positive perception and acknowledging the practical utility of mathematics in real-world scenarios (Moussa & Saali, 2022). In this study, perceived value of mathematics shows the interest of students in mathematics. One student believed that “learning math, especially on its real-life applications, makes you more positive on how we could use simple additions to make something useful in humans” [Participant 16].

Perceived value is not enough to engage students in learning mathematics. Related to expectancy-value theory, learning should focus on the subjective valuing of mathematics to engage students. Importance value is strongly associated with the other components of remaining value concepts within the expectancy-value framework. This association plays a crucial role in the overall subjective evaluation of a specific task (Gaspard et al., 2019; Lauermann, 2015). When students perceive something to be valuable, it does not automatically impact how they engage in certain tasks e.g., learning mathematics.

Non-mathematics-oriented students recognize the practical applications of mathematics in daily life, such as basic transactions, calculations, and transportation. While these students acknowledge the value of mathematics, this study revealed a paradoxical trend where some individuals opt out of math-related courses despite perceiving its value. This underscores the complexity of the interplay between perceived value and actual engagement, suggesting that external factors like

attitudes, difficulty perceptions, and personal interests influence students' choices.

Objective 2. Determine instructional approach to learning Mathematics among non-mathematics-oriented college students.

Understanding how students valued mathematics in several instances provided important foundation on how to reconfigure the education system with this concept. The findings of the study also indicated that learning mathematics has two major mechanisms—instructional and intrinsic factors. Students also highlighted the need for integrating into the realistic applications of mathematics to make students less threatened about learning math in general.

The interrelation of mathematical structures and concepts is a fundamental aspect of the subject. In order to facilitate meaningful learning experiences, it is often imperative to delve into the intricate relationships that exist within a subject (Bustanika, 2019; Indriani & Julie, 2017; Laurens et al., 2017; Mulbar & Zaki, 2018; Wahyudi et al., 2017). Perceived value can be the initial step to engage students in learning mathematics because it stimulates them to do something meaningful. For instance, students find it difficult to learn statistics (Andriani & Fauzan, 2019) because of mathematical concepts with formulas such as mean, median, and mode (Andriani & Fauzan, 2019; Sudarmilah et al., 2013) and their practical applications (Uyeon et al., 2021). Realistic applications of mathematical concepts are necessary when teaching students, especially those that are not in mathematics-oriented courses.

When students said, “The best way to teach math is by not making it look like difficult” [Participant 20], it highlighted the concept of teaching math in relation to how students perceived its difficulty. Students believed that learning math is easy when teachers know how to explain the concepts well. A teacher possessing a comprehensive understanding of the mathematics curriculum and adept pedagogical skills will contribute to the cultivation of positive attitudes and perspectives of students toward the subject (Hagan et al., 2020; Salifu & Bakar, 2022). Students prefer teachers who could use math applications in discussions rather than mere abstract and solving aspects of it. One student reflected on this idea as “[formulas and math concepts] make students less engaged in the math, and less focus on its real-life applications” [Participant 1].

Students also take part in mathematics learning. As one student discussed, “it depends on the person how they feel about the subject... teachers are very well in explaining but sometimes the problem is in their students” [Participant 14]. Several factors can be the reason for this perception in learning mathematics like boredom and no enjoyment (Matthews & Pepper, 2005; Nardi & Steward, 2003). However, teachers have a role to improve the perceptions of students in learning mathematics (Arthur et al., 2014; Arthur et al., 2017) and they may focus on realistic mathematics education approaches (Supriyanto et al., 2020).

In a broader context, empirical evidence consistently demonstrates that learners possess a natural perception in making sense of what they are being taught. In essence, students prefer learning when there are real-life applications on abstract topics. The principle gave rise to the concept of applications-led instruction, wherein the selection of concepts to be studied is based on an evaluation of the learners' needs within the framework of their cultural background, age, and habits (Reid, 2009). The worksheets utilized in the implementation of the RME approach exhibit several key characteristics (Supriyanto et al., 2020). These characteristics include the incorporation of real-world contexts, the emphasis on the construction of mathematical knowledge, the utilization of various mathematical processes, the integration of interactive elements, and the promotion of integrated learning experiences (Chavez, 2020b; Basuki & Wijaya, 2018; Deniz & Uygur-Kabael, 2017; Treffers, 1993).

By linking abstract mathematical principles to tangible real-life scenarios, educators can alleviate students' perceived difficulties and enhance their motivation to learn. This approach aligns with the concept of applications-led instruction, which prioritizes selecting concepts based on learners' needs, cultural backgrounds, and everyday experiences. Implementing such an approach could potentially bridge the gap between perceived difficulty and actual engagement in mathematics. By incorporating interactive elements, real-world contexts, and various mathematical processes, educators can promote integrated learning experiences that enhance students' intrinsic motivation and facilitate deeper comprehension.

Conclusion

Despite recognizing the practical utility of mathematics in everyday life, a substantial number of these students still exhibit

reluctance to engage fully with the subject. Educators should capitalize on students' acknowledgment of mathematics' real-life applications by designing curricula that emphasize the practical relevance of mathematical concepts. By integrating tangible, everyday scenarios into mathematics instruction, educators can bridge the gap between perceived value and active participation, thus potentially increasing students' motivation and engagement.

This study underscored the potential of realistic mathematics education (RME) approaches that contextualize mathematical concepts within students' daily lives. Implementing such approaches can create a more supportive and engaging learning environment, accommodating different learning preferences and aiding in the reduction of negative perceptions associated with the subject. This study emphasized the importance of aligning instructional strategies with students' perceived value, leveraging real-life applications, and fostering intrinsic motivation to reshape the mathematics learning experience for non-mathematics-oriented college students.

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