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(Research Article)

The impact of mathematics anxiety on technology career choices: A comprehensive study on the relationship between anxiety levels, misconceptions, and tech career selection

Adekunle, J.D [1,*], Oyeniran, M. I [1], Oyelakin, S. O [2] and Sule, H. S [3]

[1] *Department of Mathematics, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.*

[2] *Department of Statistic, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.*

[3] *Department of Mass Communication, Bayero University, Kano, Kano State, Nigeria.*

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Abstract

Quite number of researchers has looked into the level of anxiety perceived by different individuals, both in the educational environment and non-educational environment on Mathematics. However, none has looked at how this anxiety influenced technology skill/career selection which birth misconception. This research work aimed to address this issue by considering all forms of tech careers/skills and exploring the relationship between these factors and their career decisions, proving insights into fostering better perceptions among tech professionals. To achieve this, an online survey was conducted by creating and sharing a Google form to individuals on social media. A total of 250 responses were collected and analysed. The result shows that, mathematics anxiety does not influence willingness to pursue a tech career. Also, there is no significant difference in the perception of mathematics requirements among participants who are aware of tech career mathematics and those who are not. Specifically, participants with higher educational backgrounds, such as MSc or PhD, tend to report higher self-confidence in mathematical abilities compared to those with lower backgrounds, such as WAEC or OND. However, this study did not find evidence to suggest that gender influences how individuals rate their confidence in mathematical abilities.

Keywords: Mathematics Anxiety; Mathematics in Technology; Level of mathematics in tech; Impact of mathematics anxiety; Technology career choices; Application of mathematics

1. Introduction

The pivotal facet of everyday lives has been metamorphosed by the world of technology, pervading industries such as software development, data analysis and data science, machine learning(ML), robotics and more (Cascio & Montealegre, 2016; Hansson, 2020; Xu *et al*., 2021). The aptitude to explore the strength of technology depends heavily on a deep understanding of mathematical concepts and their applications (National Academies of Sciences, Engineering, and Medicine, 1991; Philip, 2018; Lin & Chang, 2023). One could argue that mathematics is an important component of science, technology and engineering (Rozgonjuk, *et al.,* 2020) , presenting a structure for innovation and advancement - from designing algorithms and developing efficient software to analysing vast datasets and enhancing complex systems (Xu *et al.,* 2021; Alexander *et al*., 2011; Sarker, 2022). Commonly, mathematics is perceive to be difficult (Fritz, Haase, & Räsänen, 2019). A study by Udousoro (Udousoro, 2011) claimed that 64% of the learning topics in mathematics were perceived to be difficult to achieve. In the sphere of computer science and programming, proficiency in discrete mathematics, including logic, set theory, and combinatorics, permit individuals to design efficient algorithms, optimize data structures, and ensure the security of information systems (Doberkat, 2015; Wing, 2002). However, understanding

* Corresponding author: Adekunle JD

probability and statistics is invaluable for data scientists and analysts, as they explore trends, extract insights, and build predictive models (Sarker, 2021).

1.1. Mathematics Field

Mathematics is a field of study that deals with the logical and abstract properties of numbers, quantities, shapes, and patterns (Ziegler & Loos, 2017). It involves the use of symbols, numbers, and formulas to describe and analyse relationships, structures, and patterns in various contexts (Yadav, 2017). Mathematics encompasses various branches such as algebra, geometry, calculus, statistics, and more, each with its own specialized areas of focus (Huang, 2022). Mathematical knowledge are often used to solve problems, forecast, and understand the fundamental principles underlying the natural and physical world (Yadav & M., 2020; Asia Society, n.d.). It provides tools and methods for precise reasoning, logical deduction, and quantitative analysis. Mathematics is both a field of study and a powerful tool that enables us to explore, understand, and describe the patterns and structures that exist in the world around us. It serves as a language of logic and precision, providing a framework for discovering and explaining relationships and phenomena. It helps cultivate precision, rigor, and abstraction in thinking, providing a foundation for understanding and navigating complex concepts and systems.

1.2. Application and Usefulness of Mathematics Knowledge in Technology

In technology, mathematics serves as a critical foundation for understanding and solving complex problems (Liljedahl, *et al.,* 2016; Jain & Rogers, 2019). While the level of mathematical expertise necessary for tech careers may vary, it is essential to recognize that mathematics acts as a universal language that bridges the gap between theoretical concepts and real-world applications. It equips professionals with the ability to think critically, solve problems logically, and make data-driven decisions. In today's rapidly advancing world of technology, mathematics plays a crucial role as a fundamental tool for understanding and solving complex problems. The integration of mathematical concepts across various tech careers highlights the importance of a solid mathematical foundation. Proficiency in mathematics acts as a catalyst for innovation, enabling professionals to push the boundaries of what is possible in the tech industry. As technology continues to evolve at a rapid pace, the demand for individuals with strong mathematical skills persist. Moreover, the interdisciplinary nature of many tech fields necessitates collaboration between mathematicians, computer scientists, engineers, and data analysts. The ability to communicate effectively and apply mathematical concepts in a team environment becomes crucial in tackling complex problems and driving technological advancements. Mathematics plays a fundamental role in various aspects of technology, including computer science, data analysis, programming, and engineering. While the level of mathematics required in tech careers may vary depending on the specific field and job role, a solid foundation in mathematics is essential for success. Table 1 shows the applications of all these topics.

Table 1 Application of mathematics topics in different tech professions'

Mathematics Topic	**Area of Understanding**	**Applications**	**Source**
Arithmetic and Algebra	Proficiency in basic arithmetic operations, solving equations, and manipulating algebraic	Algorithm development, coding, calculations	Carraher, *et al*., 2006.
Geometry	Familiarity with geometric concepts, such as lines, angles, triangles, and circles	Graphics programming, computer-aided design (CAD), spatial reasoning	Osta, *et al.,* (1998).
Trigonometry	Understanding trigonometric functions	Computer graphics, signal processing, robotics	Nguyen, *et al.,* (2021); Kusaka, and Tanaka (**2022**); Gupta, (2023).
Logic and Boolean Algebra	A solid understanding of logic, truth tables, and Boolean algebra	Logical circuit design, algorithm development, binary systems	Raval, K. (2014); Ikwunne & Okide, (2020).
Set Theory	Knowledge of set operations, including unions, intersections, and complements	Data analysis, database management, algorithm design	Bello, (2009).

Combinatorics and Probability	Understanding combinatorial principles, permutations, combinations, and probability theory	Data analysis, uncertainty modelling, algorithm design	English, (2005); Srihith Indla, (2023).
Differential and Integral Calculus	Proficiency in calculus enables the understanding of rates of change, optimization problems, and mathematical modelling	Machine learning, optimization algorithms, physics simulations	Bigotte de Almeida, *et al.*, (2021); Chen, *et al*., (2023).
Differential Equations	Knowledge of differential equations	Dynamic system modeling, signal processing, control systems, simulations	Patrascoiu, (2013); Dassios, (2020); Ali, (2020); Khan, (2020); Li, (2019); De la Sen, Manuel, and Asier Ibeas. (2019); Guo, (2019).
Vectors and Matrices	Understanding vectors, matrices, and operations like multiplication, addition, and inversion	Computer graphics, machine learning, data analysis, cryptography	Cano, Alberto. (2018); Cen Chen, *et al.,* (2017); Kiran, (2022).
Eigenvalues and Eigenvectors	Familiarity with eigenvalues and eigenvectors	Data analysis, dimensionality reduction, linear transformations	Saul Goldman, *et al.,* (2018); Wim van Drongelen, (2010); Bartholomew, (2010).
Probability Theory	Proficiency in probability theory	Data analysis, experiment design, machine learning	Tinungki & Nurwahyu, (2021); Unpingco, (2016).
Statistical Analysis	Knowledge of statistical concepts, hypothesis testing, regression analysis, and data visualization	Data analysis, decision-making, experiment design	Fotios Petropoulos, *et al*., (2022); Henshaw, (2019).

Source: Adopted from several sources

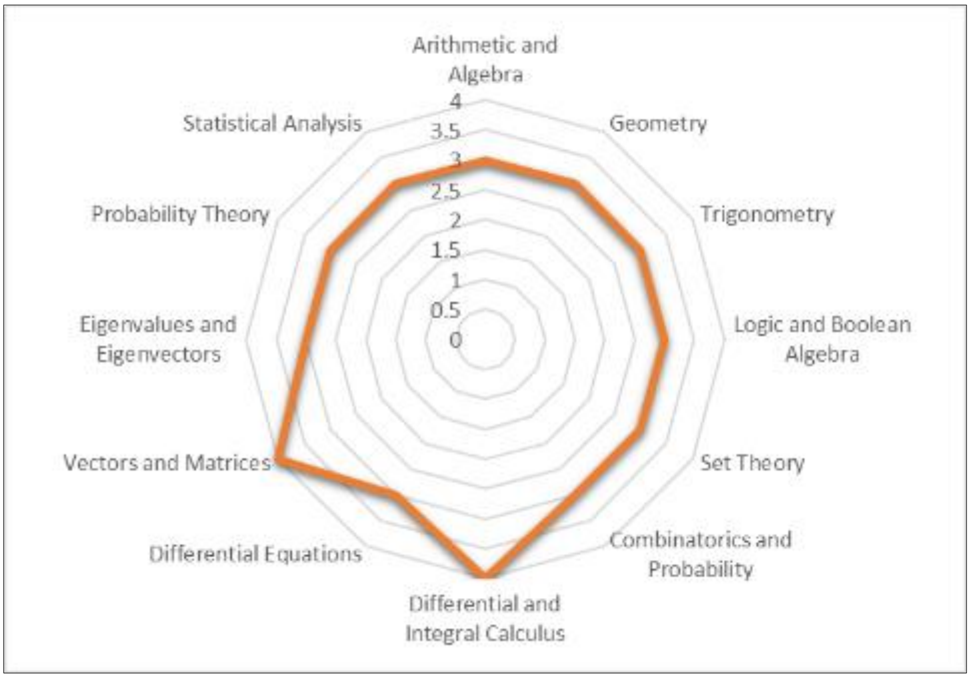


Figure 1 Mathematics topics by number of applications

1.3. Problem Statement

In the field of technology, there is a prevailing misconception regarding the level of mathematics required for various tech skills. This misconception has caused individuals to hesitate and be cautious when selecting a career path in technology, fearing the perceived high level of calculations involved. Consequently, this misconception and anxiety surrounding mathematics requirements have hindered many talented individuals from pursuing a tech career. The problem stems from the lack of clarity and accurate information regarding the actual level of mathematics proficiency necessary for different tech roles. As a result, potential candidates may either opt for alternative career paths or feel discouraged from pursuing their interests in technology. This problem is multifaceted, encompassing both the dissemination of accurate information and addressing the anxiety associated with mathematics in the tech industry. By addressing this issue, we can help individuals make informed decisions about their career paths, empower them to explore opportunities in technology without unnecessary hesitation, and promote diversity and inclusivity within the tech workforce (Rajendra, *et al.,* 2022).

1.4. Aims and Objectives

The research aims to investigate the specific mathematics requirements across various tech disciplines, dispel misconceptions, and develop resources that provide clear guidance on the necessary mathematical skills for different tech career paths. Additionally, the research will explore strategies to alleviate anxiety surrounding calculations, such as promoting problem-solving approaches and highlighting the availability of tools and resources that can aid in complex mathematical tasks. Ultimately, the goal of this research is to bridge the gap between misconceptions and reality, ensuring that individuals interested in pursuing technology careers have accurate information and are empowered to make informed decisions based on their skills, interests, and aspirations rather than unfounded fears of mathematics requirements. This discussion seeks to delve into the significance of mathematics in tech professions and provide insights into the diverse levels of mathematical proficiency required in different fields.

- To investigate and clarify the actual level of mathematics proficiency required for different tech disciplines.
- Identify and analyze the specific mathematical concepts and skills necessary for different tech career paths.
- Explore strategies and interventions to alleviate anxiety and promote problem-solving approaches in mathematical tasks.

1.5. Hypotheses

To achieve the project aim, the following hypotheses was formed**.**

1.5.1. Hypothesis 1: Calculations Anxiety and Career Aspirations

- **Null Hypothesis (H0):** There is no significant relationship between calculations anxiety and participants' willingness to pursue a tech career.
- **Alternative Hypothesis (H1):** Higher calculations anxiety is associated with decreased willingness to pursue a tech career.

1.5.2. Hypothesis 2: Misconceptions and Awareness

- **Null Hypothesis (H0):** There is no significant difference in the perception of mathematics requirements among participants who are aware of tech career mathematics and those who are not.
- **Alternative Hypothesis (H1):** Participants who are aware of specific mathematical skills needed for tech careers have different perceptions compared to those who are not aware.

1.5.3. Hypothesis 3: Mathematics Perception and Educational Background

- **Null Hypothesis (H0):** There is no significant difference in the self-rated confidence in mathematical abilities across different educational backgrounds.
- **Alternative Hypothesis (H1):** Participants with higher educational backgrounds (e.g., MSc, PhD) report higher self-confidence in mathematical abilities compared to those with lower backgrounds (e.g., WAEC, OND).

2. Literature review

Previous studies have demonstrated the impact of anxiety and misconception on educational outcomes (McCurdy, et al., 2022; Rajendra, *et al.,* 2022). Szczygieł(2020) discussed and analysed the likable reason for mathematics anxiety such as gender, nationality and environment.

2.1. Mathematics Anxiety and Misconceptions

Research has shown that mathematics anxiety is prevalent across different grades and can have a significant impact on students' performance in mathematics (Dowker, *et al.,* 2016). Several studies have established a relationship between mathematics anxiety and mathematics performance. For example, a study conducted by Ashcraft and Krause (2007) found that high levels of mathematics anxiety were associated with lower mathematics achievement scores. Similarly, Hembree (1990) conducted a meta-analysis and concluded that mathematics anxiety has a moderate negative correlation with mathematics performance. However, it is important to note that not all students who experience math anxiety will have negative experiences with mathematics. Some students may be able to perform well despite their anxiety, while others may struggle extensively. This suggests that individual factors such as self-efficacy, motivation, and coping mechanisms may also play a role in mitigating the impact of mathematics anxiety on performance. Research also suggests that mathematics anxiety can have broader effects on students beyond their academic performance. For instance, studies have found that mathematics anxiety is associated with negative emotions, decreased self-esteem, and avoidance of math-related activities (Ma and Xu, 2004; Wu *et al.,* 2012). These emotional and behavioral consequences can further perpetuate the cycle of anxiety in mathematics.

2.2. Mathematics Anxiety and its Environmental Factors

A relationship has been found between learning environment and mathematics anxiety, The findings of Yildirim and Simsek's study revealed that the most frequently used rating scale to measure mathematics anxiety was the Mathematics Anxiety Rating Scale (MARS)(Yildirim, 2005). Factors influencing mathematics anxiety in senior high school students include individual factors such as gender differences, learning style, and personal motivation (Liu, 2023). Family factors such as parent-child relationship and parenting style can also contribute to mathematics anxiety (Siti, *et al.,* 2022). Additionally, the school environment, including the internal school atmosphere and teachers' teaching strategies, can impact mathematics anxiety in students (Nasruliyah, *et al.,* 2021). The availability of educational infrastructure is another factor that influences mathematics anxiety (Nurul, *et al.,* 2022). Furthermore, the beliefs of students about their own ability to solve math problems, known as self-efficacy, can also contribute to mathematics anxiety (Boj, *et al.,* 2022). Verbal behavior from older people, including discouragement, abuse, fear, and dilemma, can induce mathematics anxiety in students and affect their interest and choice in studying mathematics.

2.3. Mathematics in tech career

Mathematics provides the necessary framework for technology development, enabling engineers and scientists to build innovative solutions across various domains (Pierce, *et al.,* 2007). Mathematics is frequently seen as favouring closed solutions (Winkelman, 2009). However, mathematics is known to be the foundation of computer science, which is the bedrock of technology (BYJU'S Future School Blog, 2023), the basic principles of mathematical logic laid the groundwork for the development of digital circuits and computers. Moreover, many of the algorithms and data structures that are essential to computer programming are based on mathematical concepts (EdX , 2021).. For an average programmer, the world consists of binary numbers. Thus he tends to see everything around him like a matrix made of numbers and math functions (Codemonkey, 2021). Moreover, simple mathematical functions are vital for low-level hardware programming. Therefore, knowing 'hexadecimal number system' assists with multiple programming operations such as setting/changing the colors of items (Lan, 2021). Basic arithmetic is also utilized in computer science. For example, division, multiplication, subtraction, and addition are used in almost all written programs. Even the process of coding itself relies heavily on mathematical notation and symbols. Consequently, those who wish to study computer science should have a basic foundation in math.

2.4. Career Decision-Making

Career decision-making is a complex and personal process that individuals navigate throughout their lives. It involves a series of considerations and reflections to make informed choices about one's professional path. Robert and Steven says that career choice interventions typically rely on methods for matching people to work environments based on a century-old three-step prescriptive formula (Robert and Steven, 2020). At its core, career decision-making begins with self-assessment. It involves introspection to understand one's strengths, weaknesses, interests, and values. By recognizing what you are naturally good at and what truly motivates you, you can align your career choices with your personal attributes and passions. In a research done by Wang, it was hypothesized that CDMSE can significantly influence career decision making. The results showed that both career values and career decision self-efficacy had significant positive effects on career decisions (Wang, *et al.,* 2023).

The results of the study conducted by Storme indicate several key findings regarding the relationship between career exploration, career decision-making difficulties (CDMD), and various psychological factors. The study found that individuals who were active in career exploration did not perceive limited mobility as a hindrance to making career decisions. This suggests that those who actively explore career options may feel less constrained by perceived limitations in their mobility. However, participants who engaged in career self-exploration reported higher levels of general indecisiveness, indicating that despite being motivated to make decisions, they still experienced indecision. Interestingly, this effect was moderated by CSE, with individuals with low CSE levels exhibiting a stronger association between career self-exploration and general indecisiveness. Also, among active career explorers, individuals with lower levels of CSE reported higher levels of dysfunctional career beliefs and general indecisiveness. This suggests that confidence in one's abilities to make career decisions can mitigate the negative effects of career exploration on indecisiveness and dysfunctional beliefs. The study also highlights the importance of understanding the nuanced relationship between career exploration and decision-making difficulties. Depending on individual characteristics such as ambiguity tolerance and CSE beliefs, career exploration can either facilitate or hinder the decision-making process. This underscores the need for career counselors to tailor interventions based on clients' specific characteristics. The analysis of this study shows that career counselors should pay attention to the associations between career exploration, GI, and DB among individuals with low levels of CSE. Interventions could focus on addressing clients' fears regarding career decisions and assisting them in organizing and integrating information gathered during exploration into viable career options (Storme and Celik, 2018).

2.5. Calculations Anxiety in Tech Fields

Calculations anxiety, often known as math anxiety, is a psychological condition that affects many individuals working in technology-related professions. It is characterized by feelings of stress, fear, or discomfort when confronted with mathematical calculations or quantitative tasks. This phenomenon is notably prevalent in the tech industry, where mathematical and problem-solving skills are crucial for roles such as coding, data analysis, and algorithm development. Several factors contribute to calculations anxiety in tech fields. It can result from past negative experiences with mathematics, societal pressure to excel in STEM (Science, Technology, Engineering, and Mathematics) fields, and the fear of making mistakes in coding or other calculations. Additionally, the fast-paced and often competitive nature of the tech industry can intensify these feelings. The impact of calculation anxiety on performance can have a profound impact on job performance. In tech roles, even minor errors in code or calculations can lead to significant setbacks, including project delays and decreased productivity. In severe cases, it can hinder career advancement and professional development. Prolonged calculations anxiety can lead to mental health issues, including burnout and stress-related disorders. It's essential to recognize the mental health implications of calculations anxiety and take steps to mitigate them.

2.6. Educational Interventions

Researchers have found that the way mathematics is taught contributes to mathematics anxiety, particularly when there is an emphasis on rote learning of rules and procedures (Newstead, 1998). To tackle this issue effectively, educational interventions should commence with the early identification of students who may be at risk (Ramirez, *et al.,* 2018). Identifying these students at the elementary level allows for timely support, preventing the exacerbation of anxiety over time. Also, an integral part of addressing mathematics anxiety involves incorporating interactive and engaging teaching methods, such as games, puzzles, and hands-on activities, which help demystify mathematical concepts and make them more accessible (Gallenstein, 2005). Furthermore, demonstrating the practical applications of mathematics in real-life situations showcases its relevance and alleviates anxiety associated with abstract theory. Educator and parent should recognize that each student possesses unique learning styles and paces, educational interventions aim to provide personalized instruction. This tailored approach allows students to grasp mathematical concepts at their own rate, promoting understanding and reducing anxiety associated with trying to keep up with the class. A significant component of educational interventions is the cultivation of a growth mindset, emphasizing that intelligence and mathematical skills are not fixed attributes but can be developed through effort and persistence. This shift in mindset encourages students to approach mathematics with a positive attitude and a willingness to learn from mistakes. Teaching students relaxation techniques and mindfulness practices that can be applied when tackling math-related challenges. Techniques such as deep breathing exercises and meditation can help manage anxiety and stress, particularly during exams or complex problem-solving. In the modern educational landscape, integrating technology and educational software that offer adaptive learning can be invaluable. These tools allow students to progress at their own pace and receive tailored support, reducing math anxiety by accommodating individual needs. Students working together on problems, discussing their difficulties, and providing mutual encouragement create a supportive learning community where math-related stress is reduced. To mitigate anxiety related to traditional testing, educational interventions explore alternative assessment methods. Project-based assessments, for instance, allow students to demonstrate their understanding of math concepts in ways that may be less anxiety-inducing, focusing on real-world application and problem-solving skills.

2.7. Tech Career Diversity and Inclusion

Tech career diversity and inclusion are critical topics in the tech industry and beyond. They refer to the efforts made to ensure that individuals from all backgrounds, regardless of their race, gender, age, sexual orientation, disability, or socioeconomic status, have equal opportunities and representation in technology-related careers. The Importance of Diversity and Inclusion in innovation involves diverse teams bringing together a wide range of perspectives, experiences, and ideas, leading to more innovative and creative solutions. It relevance in market helps tech companies to serve diverse customer bases - having a diverse workforce to help in understanding and addressing the needs of different demographics ensuring that opportunities are available to everyone, not just a select few. Although, there are some recognised challenges pertaining to these, such as: underrepresentation, unconscious Bias, and hostile work environments. The strategies for diversity and inclusion are known to be: diverse hiring practices whereby companies actively recruit from underrepresented groups, implement blind recruitment processes, and ensure diverse hiring panels. Another known strategy is inclusive company culture which has to do with diversity training, employee resource groups, and mentorship programs where every employee feels valued and heard. Others are: Equitable Policies to ensure that policies and practices related to pay, promotion, and work-life balance are fair and unbiased; representation to encourage diverse representation at all levels of the organization, from entry-level positions to leadership roles and measuring and reporting on diversity metrics to hold the organization accountable. According to___ some benefits of diversity and inclusion are: innovation and problem-Solving, enhancing reputation, and attracting top talent.

3. Methodology

3.1. Research Design

We employed a qualitative research design, distributing an online survey to 500 individuals from diverse disciplines. The survey contained questions about their perceptions of mathematics in tech careers, levels of calculations anxiety, and career aspirations.

3.2. Research Instruments

For this research, we used some research instruments, which are procedures put up or research tools used to collect data. The following instruments were used to collect data:

3.2.1. Questionnaires

A Google form was created to gather information from different people. This method was adopted for easy accessibility and to avoid location limitation. The Google form was restricted to receive a response from individual once to avoid one person giving response multiple times.

3.2.2. Administration of Questionnaires

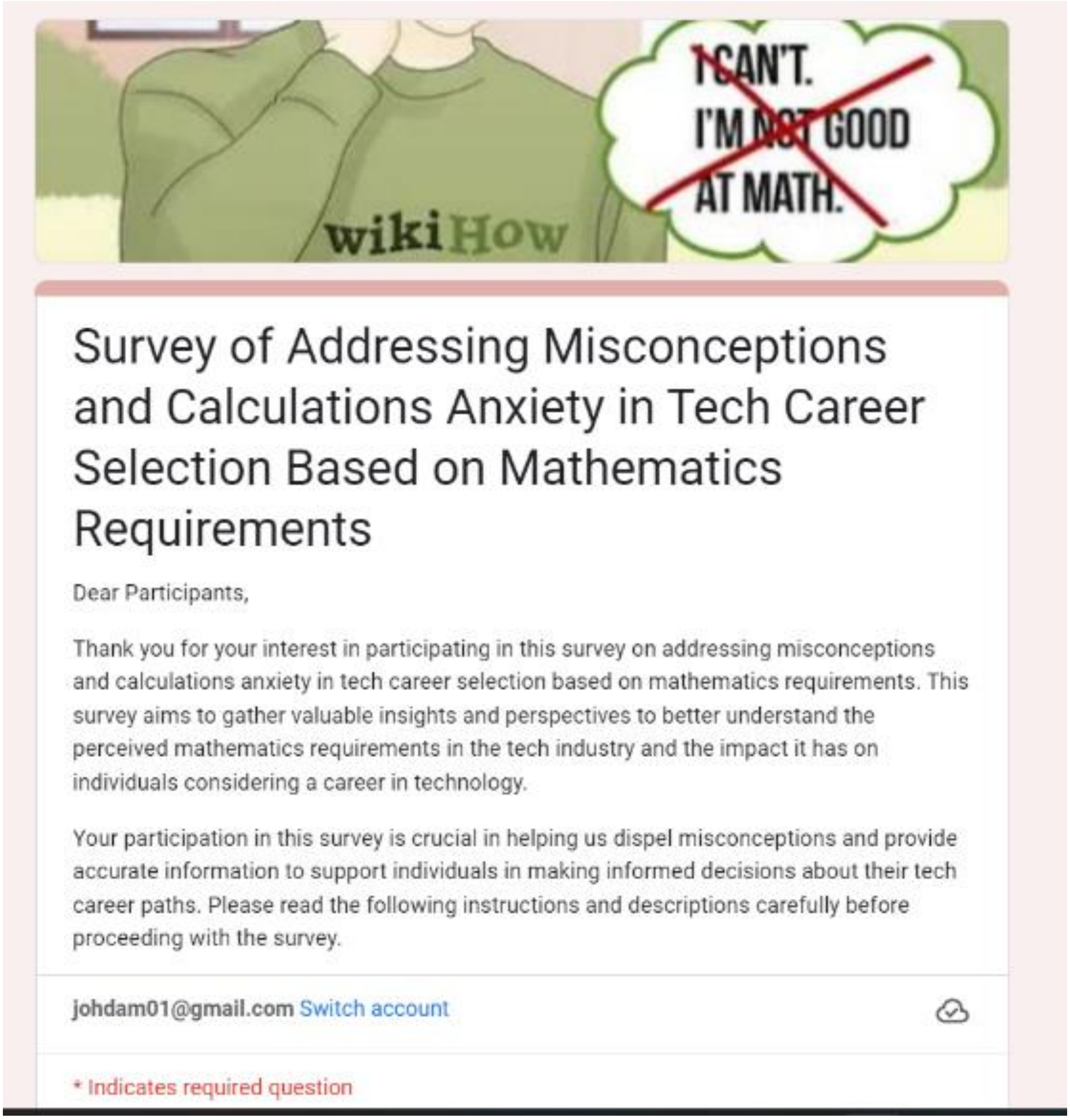
For this research we target individuals with a pre-existing technological skills and those without such skills. The created Google form was shared across whatsApp groups aimed at maximizing accessibility and convenience for participants. By utilizing WhatsApp groups, we ensure that the form reaches a diverse range of individuals who may possess varying levels of technological proficiency. WhatsApp's widespread usage makes it an ideal platform for reaching a broad demographic, allowing participants to engage with the form at their convenience. Moreover, distributing the form digitally enables participants to respond from any location, eliminating barriers associated with physical attendance or mailing of surveys. This approach not only increases the reach of our research but also accommodates participants' busy schedules, enhancing overall participation rates.

3.2.3. Collection of Questionnaires

After the completion and designing of the Google form questionnaires, a Google sheet is connected to it before publishing it out. The purpose of this connection is to direct all the response collected to a spreadsheet and make it a structured data, which can be analyse without any advance cleaning. This process were followed to maintain reliability and validity of the information or data given.

3.3. Data Analysis

The collected data were analysed with SPSS version 27. A descriptive statistic was adopted for analysis due to the nature of the data collected – qualitative data. According to Canales and Rakowski (2006) and Beatty *et al.* (2004), the development of therapy tools, research evaluations, and surveys can all benefit from corresponding statistical analysis when using purposeful sampling as a guide. A frequency table which is a measure of central tendency showing the counts of each categories, the percentage which is proportion of each count by total, the mean, median and mode. Measures of Dispersion to provide information about the spread of the responses. Finally, a Chi-square test will be used to test the significant association between two categorical variables in the questionnaire to assess whether the observed differences between groups are statistically significant or due to chance.



Survey of Addressing Misconceptions and Calculations Anxiety in Tech Career Selection Based on Mathematics Requirements

Dear Participants,

Thank you for your interest in participating in this survey on addressing misconceptions and calculations anxiety in tech career selection based on mathematics requirements. This survey aims to gather valuable insights and perspectives to better understand the perceived mathematics requirements in the tech industry and the impact it has on individuals considering a career in technology.

Your participation in this survey is crucial in helping us dispel misconceptions and provide accurate information to support individuals in making informed decisions about their tech career paths. Please read the following instructions and descriptions carefully before proceeding with the survey.

johdam01@gmail.com Switch account

* Indicates required question

Figure 2 Google Form for this study. (Adapted)

4. Result

The results section of this study presents a comprehensive analysis of math anxiety perceived by those in tech and those who are considering going into technology. As outlined in the literature, mathematics anxiety is a multifaceted construct influenced by various factors, including individual perceptions of math skills, attitudes towards mathematics, academic achievement, and socio-environmental factors such as school expectations and peer comparisons. The documentation of this research result was split into two sections for simplicity. The first part address mathematics anxiety issue, misconception around mathematics especially in technology and level of mathematics required in tech while the second part address the percentage of mathematics required in some common tech field.

4.1. Addressing perception and misconception of mathematics requirement from the respondent perspective

Table 2 Descriptive Analysis of the Questionnaire responses

		Male	Female
Gender	N	145	60
	Percent	70.7%	29.3%

Table 3 Descriptive Analysis of the Questionnaire responses

Variable	Statistic	No	Yes
Do you perceived mathematics as a challenging subject?	N	110	95
	Percent	53.7%	46.3%
Have you ever felt anxious or intimidate by mathematics	N	100	105
	Percent	48.8%	51.2%
Do you believe a high level of mathematics is required for a tech career?	N	115	90
	Percent	56.1%	43.9%
Are you currently in Tech?	N	35	170
	Percent	17.1%	82.9%
Do you wish to pursue a Tech Career?	N	1	204
	Percent	0.5%	99.5%
Have you ever been discouraged from pursuing a tech career due to concerns about mathematics requirements?	N	160	45
	Percent	78.0%	22.0%
Are you aware of the specific mathematical skills and knowledge required for different tech disciplines?	N	90	115
	Percent	43.9%	56.1%
Do you believe there are misconceptions about the level of mathematics needed in the tech industry	N	30	175
	Percent	14.6%	85.4%
Have you come across any information or resources that clarify the mathematics requirement for tech careers?	N	115	90
	Percent	56.1%	43.9%
Have you ever experienced anxiety or stress related to mathematical tasks or calculations?	N	95	110
	Percent	46.3%	53.7%
Would access to tools or technologies that assist with mathematical calculations positively impact your perception of pursuing a tech career?	N	25	180
	Percent	13.2%	87.8%

The table 3 above shows the relationship between calculations anxiety and willingness to pursue a tech career, finding no significant association between the variables based on Chi-Square Tests (Pearson Chi-Square: $\chi^2(4) = 6.034$, $p = 0.197$; Likelihood Ratio: $\chi^2(4) = 9.271$, $p = 0.055$), with symmetric measures indicating a weak association (Phi coefficient: $\Phi = -0.068$; Cramer's V: $V = 0.068$). Therefore, the null hypothesis, suggesting no significant relationship, was retained, indicating that factors other than calculations anxiety may influence individuals' career aspirations in the technology industry.

Table 4 Chi-square test showing the relationship between calculations anxiety and participants' willingness to pursue a tech career

	Value	df	Significance
Pearson Chi-Square	6.034a	4	0.197
Likelihood Ratio	9.271	4	0.055
Phi	-0.068		0.328
Cramer's V	0.068		0.328

a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is 1.71.

Table 5 Chi-square test showing the relationship between misconceptions and awareness

	Value	df	Significance
Pearson Chi-Square	0.957a	1	0.328
Likelihood Ratio	1.343	1	0.247
Phi	0.172		0.197
Cramer's V	0.172		0.197

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 0.49.

The table 4 above indicate that there is no significant association between participants' awareness of specific mathematical skills needed for tech careers and their perceptions of mathematics requirements ($\chi^2 = 0.957$, df = 1, p = 0.328). Similarly, the likelihood ratio test also does not show a significant difference in perceptions between the two groups (LR = 1.343, p = 0.247). Furthermore, the symmetric measures (Phi and Cramer's V) suggest a weak association between the variables, with Phi = 0.172 and Cramer's V = 0.172. Based on these results, we fail to reject the null hypothesis (H0) and conclude that there is no significant difference in the perception of mathematics requirements among participants who are aware of tech career mathematics and those who are not.

Table 6 Mathematics Perception and Educational Background

	Value	df	Significance
Pearson Chi-Square	66.892a	15	0.000
Likelihood Ratio	1.343	15	0.000
Phi	0.571		0.000
Cramer's V	0.330		0.000

a. 16 cells (66.7%) have expected count less than 5. The minimum expected count is 0.37.

The table 5 above reveal a significant association between participants' educational backgrounds and their self-rated confidence in mathematical abilities ($\chi^2 = 66.892$, df = 15, p < 0.001). Similarly, the likelihood ratio test also indicates a significant difference across educational backgrounds (LR = 67.570, p < 0.001). Furthermore, the symmetric measures (Phi and Cramer's V) demonstrate a moderate association between the variables, with Phi = 0.571 and Cramer's V = 0.330. Given these results, we reject the null hypothesis (H0) and conclude that there is a significant difference in the self-rated confidence in mathematical abilities across different educational backgrounds. Specifically, participants with higher educational backgrounds, such as MSc or PhD, tend to report higher self-confidence in mathematical abilities compared to those with lower backgrounds, such as WAEC or OND.

Table 7 Influence of gender on confidence in mathematic

	Value	df	Significance
Pearson Chi-Square	0.605a	3	0.895
Likelihood Ratio	0.601	3	0.896
Phi	0.054		0.895
Cramer's V	0.054		0.895

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.39.

Table 6 presents the analysis of the relationship between gender and confidence levels. Both Pearson Chi-Square (χ^2 = 0.605, df = 3, p = 0.895) and Likelihood Ratio (χ^2 = 0.601, df = 3, p = 0.896) tests suggest no significant association between gender and confidence. Similarly, the symmetric measures Phi (Φ = 0.054, p = 0.895) and Cramer's V (V = 0.054, p = 0.895) indicate a negligible association between the variables. Therefore, this suggests that there is no substantial relationship between gender and self-rated confidence levels. This result indicates that there is no statistically significant relationship between gender and self-rated confidence levels. In other words, the analysis did not find evidence to suggest that gender influences how individuals rate their confidence in mathematical abilities.

Table 8 Relationship between Confidence and career aspiration in technology

	Value	df	Significance
Pearson Chi-Square	189.481a	30	0.000
Likelihood Ratio	163.869	30	0.000
Phi	0.961		0.000
Cramer's V	0.555		0.000

a. 38 cells (86.4%) have expected count less than 5. The minimum expected count is 0.37.

The table 7 above indicate a highly significant relationship between participants' self-rated confidence in mathematical abilities and the tech careers they have considered (χ^2 = 189.481, df = 30, p < .001). Symmetric measures further support this association, with a Phi value of .961 and a Cramer's V value of .555, both indicating a strong relationship (p < .001). These findings reject the null hypothesis (H0) and support the alternative hypothesis (H1) that participants with higher confidence in their mathematical abilities are more inclined to consider tech careers that require strong mathematical skills, such as Data Scientist, Software Developer/Engineer, System Analyst, and Cybersecurity Analyst, compared to those with lower confidence.

Table 9 Relationship between knowing the important of mathematics in tech and self-rated confidence

	Value	df	Significance
Pearson Chi-Square	66.783a	12	0.000
Likelihood Ratio	64.631	12	0.000
Phi	0.571		0.000
Cramer's V	0.330		0.000

a. 11 cells (55.0%) have expected count less than 5. The minimum expected count is 0.73.

Table 8 illustrates a significant relationship between understanding the importance of mathematics in technology and self-rated confidence, as indicated by Pearson Chi-Square (χ^2 = 66.783, df = 12, p < 0.001) and Likelihood Ratio (χ^2 = 64.631, df = 12, p < 0.001) tests. Moreover, symmetric measures Phi (Φ = 0.571, p < 0.001) and Cramer's V (V = 0.330, p < 0.001) demonstrate a moderate association between the variables. This result indicates that there is a statistically significant relationship between two variables. In simpler terms, individuals who recognize the significance of mathematics in the tech industry tend to have higher levels of confidence in their mathematical abilities.

4.1.1. Percentage of Mathematics required in some common tech field

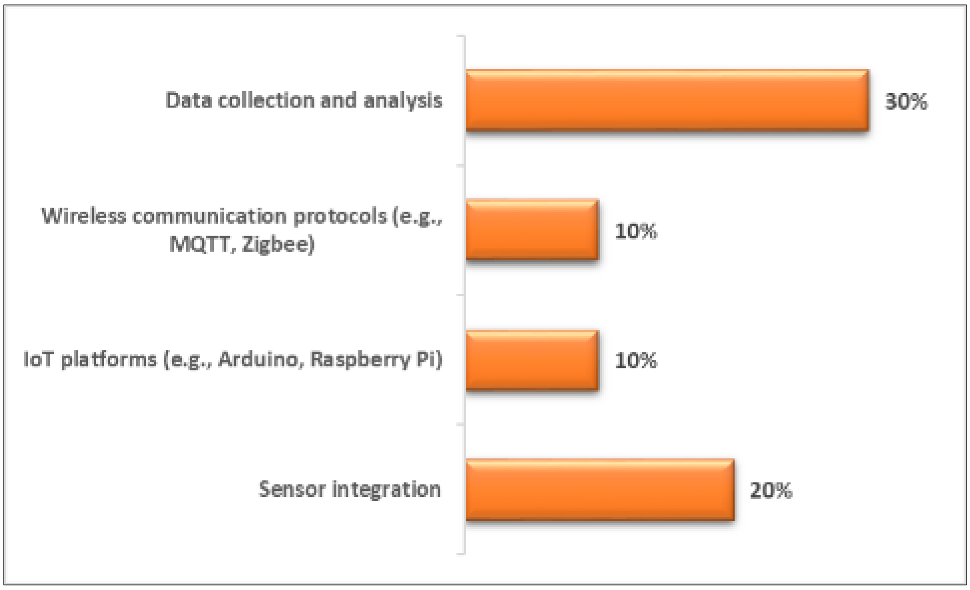


Figure 3 Mathematics percentage in internet of a thing (IoT)

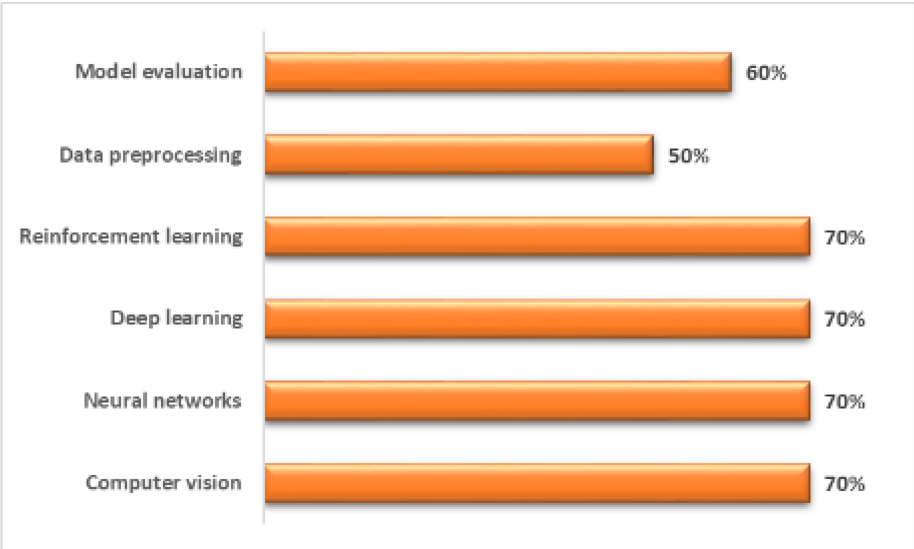


Figure 4 Mathematics percentage in Data Science

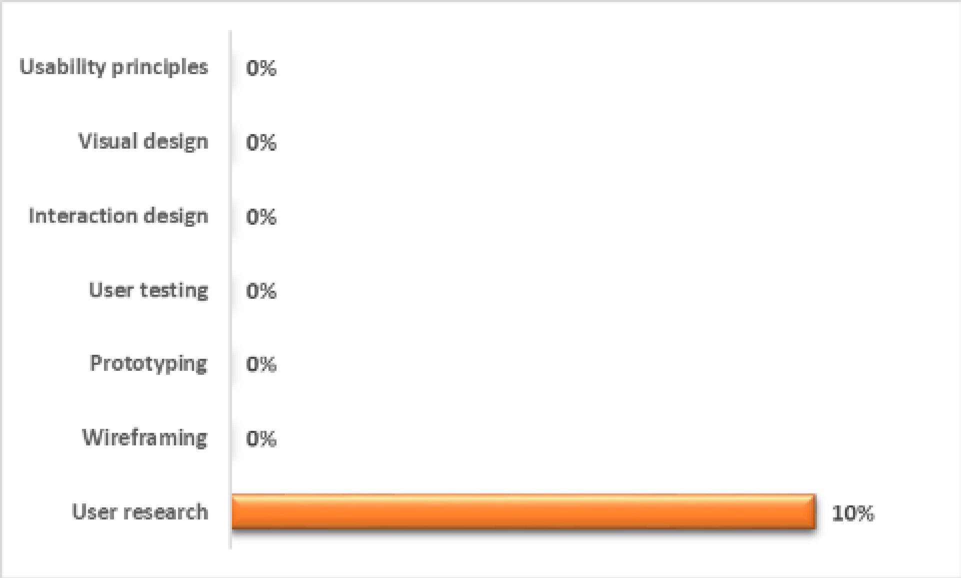


Figure 5 Mathematics percentage in User Interphase and User Experience (UI/UX)

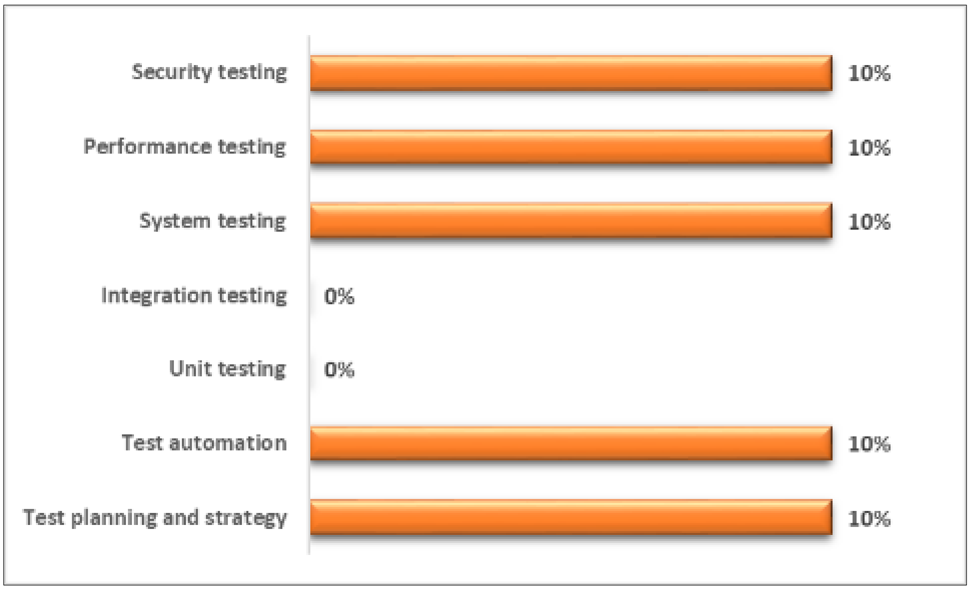


Figure 6 Mathematics percentage in Software Testing

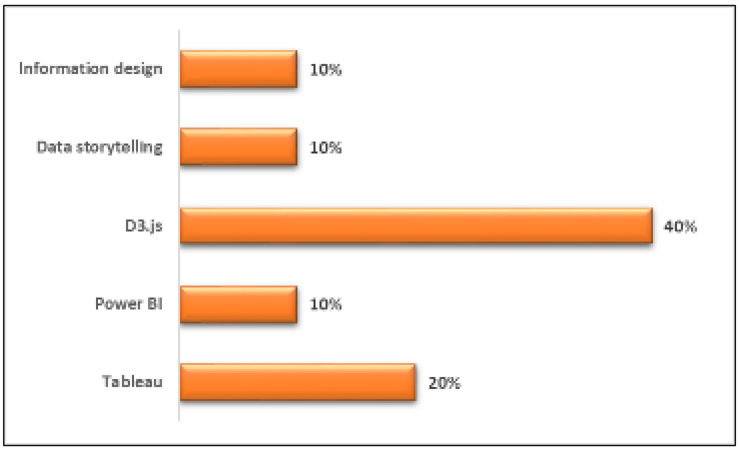


Figure 7 Mathematics percentage in Visualization

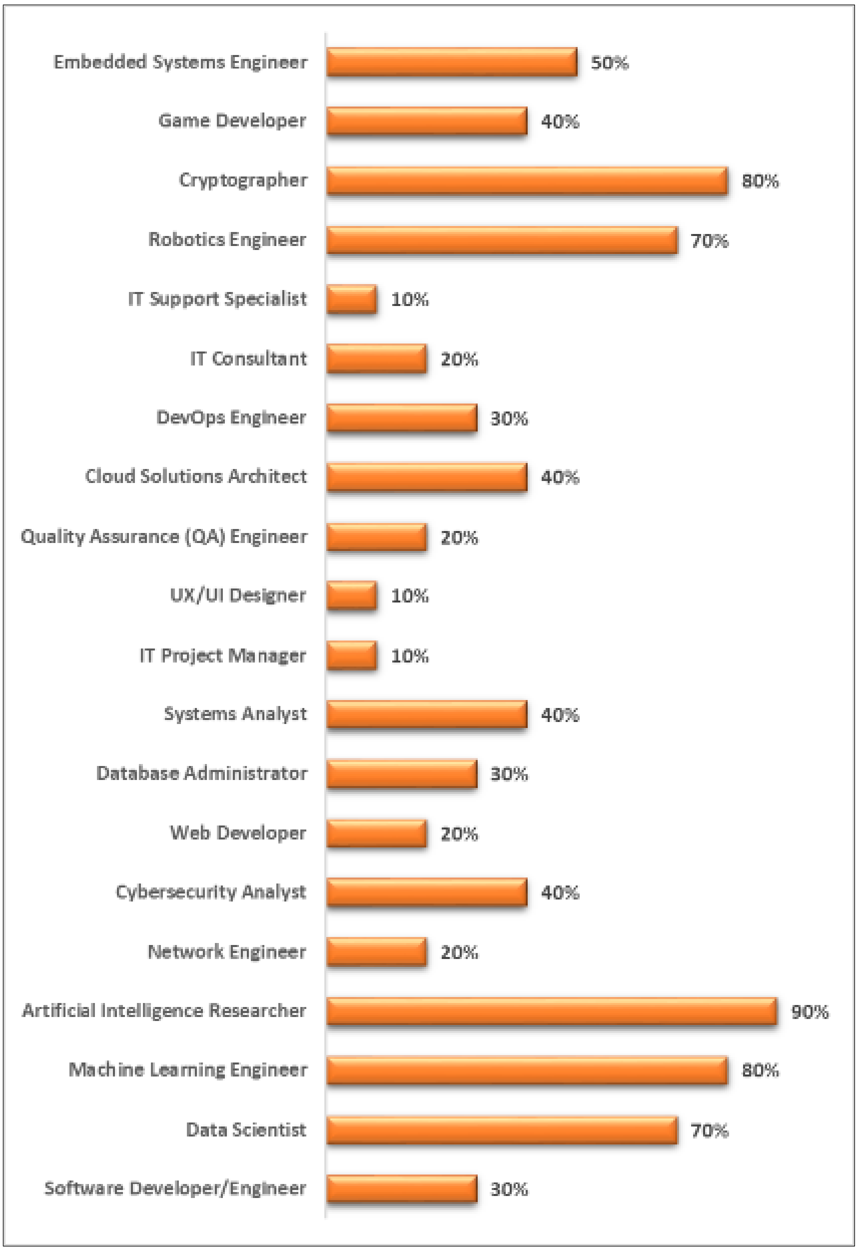


Figure 8 Mathematics percentage in Technology Careers

5. Discussion

The results of this study shed light on several key aspects related to the perception and significance of mathematics in the field of technology, addressing the problem statement and objectives outlined in the project. According to Khasawneh, many factors may contribute the maths anxiety, such as parents, impact of teaching methods, etc. (Khasawneh, *et al.,* 2021). A study by Zakaria & Nordin shows that mathematics anxiety is associated with compromised working memory (Zakaria & Nordin, 2008). But the result of this findings reveal that there is no significant association between calculations anxiety and the willingness to pursue tech careers. This suggests that fears regarding the perceived high level of calculations involved in some technology skills or career may not be a significant deterrent for individuals considering a career in this field. Additionally, the analysis indicates that awareness of specific mathematical skills needed for tech careers does not significantly impact individuals' perceptions of mathematics requirements. Significantly, the study highlights a strong association between participants' educational backgrounds and their self-rated confidence in mathematical abilities. Individuals with higher educational backgrounds, such as MSc or PhD, tend to report higher levels of confidence in mathematics compared to those with lower educational backgrounds. This underscores the role of education in shaping individuals' confidence levels and suggests that providing access to quality education and training opportunities may help alleviate confidence issues in mathematics among aspiring tech professionals (Orbach, *et al.,* 2019; Field, *et al.,* 2019). Contrary to expectations, the analysis found no substantial relationship between gender and self-rated confidence levels in mathematical abilities. This suggests that gender does not play a significant role in determining individuals' confidence in mathematics within the context of this study. However, further research may be warranted to explore potential gender disparities in other aspects of technology education and career pathways. However, individuals with higher confidence levels are more inclined to consider tech careers that require strong mathematical skills, such as Data Scientist, Software Developer/Engineer, System Analyst, and Cybersecurity Analyst. Also, individuals who recognize the significance of mathematics in the tech industry tend to have higher levels of confidence in their mathematical abilities. This highlights the importance of promoting awareness about the role of mathematics in technology and its relevance to various tech career paths.

6. Conclusion

In conclusion, this study highlights the complex interplay of various factors, including educational background, awareness of mathematics requirements, and understanding of the importance of mathematics in technology, in shaping individuals' confidence levels and career aspirations within the technology sector. Further research could explore additional factors influencing these dynamics and their implications for educational and professional interventions aimed at promoting diversity and inclusivity in the tech industry. Also, valuable insights into the perception and significance of mathematics in the field of technology were provided. By addressing misconceptions, promoting awareness, and providing accurate information about mathematics requirements, individuals were empowered to make informed decisions about pursuing careers in technology without unnecessary hesitation. Additionally, efforts to promote confidence-building strategies and educational opportunities may help bridge the gap between perceived barriers and actual requirements in the tech industry, thereby promoting diversity and inclusivity within the workforce.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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