WISAARKHU

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MATHEMATICS FOR EVERYONE

YOGA

MATHEMATICS FOR EVERYONE WISAARKHU VOLUME

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YOGA

THE PROJECT

Wisaarkhu is a vibrant global community united by a mission to transform the perception of mathematics and academia. We firmly believe that mathematics is a powerful tool for success, accessible to all, and our project is dedicated to unveiling its hidden beauty and potential. Join us on this journey of discovery and help make mathematics more accessible.

Wisaarkhu aims to make advanced mathematics and related research accessible to a broader community of students, emphasizing inclusivity, diversity, and support. Our global community transcends boundaries, connecting individuals from various disciplines, statuses, and generations.

Mathematics is often seen as daunting and exclusive, fostering negative perceptions like "maths anxiety." At Wisaarkhu, we challenge these stereotypes, promoting a positive attitude toward math and fostering personal and professional growth.

Mathematics is integral to our lives, influencing art, technology, culture, and problem-solving. It empowers individuals of all backgrounds to develop essential skills and think critically.

Mathematics drives innovation, economic growth, and addresses global challenges like poverty and climate change. By embracing mathematics, we create a brighter future.

We transform negative perceptions through emotional connections, showcasing how math intersects with art, music, and literature. By blending math with creativity, we inspire enthusiasm for learning.

Math equips individuals with problem-solving skills and fosters communication. However, it's often taught in a way that leaves students disengaged. We seek to understand these challenges and bridge the gap between disciplines.

We acknowledge the emotional and human aspects of learning math, enhancing emotional intelligence for future generations. Our Goal: A Positive Change. Our project aims to revolutionize math education, nurturing empathetic individuals who drive positive change in society. We integrate math with psychology to make it more accessible.

Our project includes interdisciplinary discussions and this magazine. Explore the purpose of mathematics, its connection to humanity, and its role in emotional and intellectual growth. Let's redefine mathematics for a brighter future.

PROF SOPHIE MARQOUES
Managing-Director
Department of Mathematical Sciences,
Stellenbosch University, South Africa

Illustration by Sophie Marques

OUR PHILOSOPHY

WISAARKHU is not your typical magazine. It's a meticulously reviewed publication that dares to explore the intricate world of abstract mathematics through a psychological lens. But, it's equally important to venture beyond the boundaries of this discipline to gain a holistic understanding of our chosen themes. So, don't be surprised when you come across articles that touch on history, language, neurobiology, philosophy, physics, economics, and more. These diverse fields are interconnected and offer valuable insights that complement one another. Our goal is to share knowledge in a way that breaks down barriers and fosters a deeper understanding.

Every article in this magazine undergoes a rigorous review process, involving at least four sets of discerning eyes. Our aim is not to accept or reject contributions, but rather to embark on a collaborative journey with our contributors. We strive to enhance the value and quality of each piece, ensuring that the message resonates with readers on a human level, leaving a positive impact. Our team of editors, each with their unique expertise, plays a crucial role in this process. It's important to remember that many of our contributors are not professional writers or academics, and for some, writing a column may push them beyond their comfort zone, especially if English isn't their first language.

At WISAARKHU, we believe in giving every perspective a voice, maintaining authenticity throughout. Our mission is to paint a comprehensive and genuine picture of each theme we explore.

Of course, it's understood that no picture will ever be truly complete, but that won't stop us from striving for excellence.

EDITOR'S NOTE

Dear Readers,

Welcome to the latest volume of Wisaarkhu, where we continue our mission to make the wonders of science and mathematics accessible, engaging, and inspiring for high-school students, educators, and the general public alike. This edition proudly embraces the theme "Mathematics for Everyone," a timely reminder that mathematics is not an elite pursuit reserved for the few but a universal language that empowers us all to understand, innovate, and thrive in an ever-changing world.

In South Africa, we face a profound challenge in mathematics education. Despite our nation's rich history of resilience and creativity, too many young minds are deterred by barriers such as inadequate resources, outdated curricula, and a pervasive myth that math is "too hard" or irrelevant to everyday life. The consequences are stark: low pass rates in matric exams, a shortage of skilled professionals in STEM fields, and missed opportunities for economic growth and social progress. Yet, amid these difficulties, there is immense hope. Mathematics is the foundation of problem-solving, critical thinking, and discovery – skills that can transform lives and communities. It underpins everything from budgeting a household to designing sustainable infrastructure, from decoding the patterns of nature to advancing technology that connects us globally.

This volume is our collective response to these challenges, curated to demystify mathematics and showcase its beauty and practicality. The volume explores the critical question of how and why mathematics should be accessible to all. We delve into strategies for breaking down barriers to success, emphasising the inherent universality of mathematics and its integral role in everyday life. Furthermore, this volume encourages readers to explore the creativity embedded within mathematical concepts. It highlights its broad relevance across various fields, ultimately seeking to illuminate how we can collectively make mathematics truly for everyone.

Whether you're a high-school learner grappling with algebra or a curious adult rediscovering geometry, the volume is designed to spark joy

and curiosity. Our contributors – educators, researchers, and enthusiasts from across South Africa – share stories of triumph over mathematical hurdles, practical tips for mastering concepts, and interactive challenges to try at home or in the classroom.

At Wisaarkhu and NITheCS, we believe that everyone has the potential to excel in mathematics when given the right tools and encouragement. NITheCS reminds us that investing in mathematics is investing in South Africa's future – a future where every child can dream big, armed with the confidence that comes from understanding the world through numbers.

As you turn these pages, we invite you to engage actively: solve a problem, share an insight with a friend, or even submit your own math-inspired story for future issues. Mathematics is for everyone – it's in the rhythm of our hearts, the symmetry of our landscapes, and the solutions to our most significant challenges. Let's embrace it together and build a brighter, more equitable South Africa.

PROF FRANCESCO PETRUCCIONE
EDITOR IN CHIEF
School of Data Science and Computational
Thinking and NITheCS

OUR NAME

WI

In most languages, the word 'mathematics' is a direct derivative of the Latin term 'Matematica.' However, in Dutch, a fascinating linguistic shift occurred, thanks to the influence of the Flemish mathematician Simon Stevin (1548-1620). Stevin introduced the term 'Wiskunde,' which translates to "the knowledge of what is certain." The origins of this word can be traced back to the earlier Dutch term 'Wisconst,' signifying "the art of what is known."

SAAR
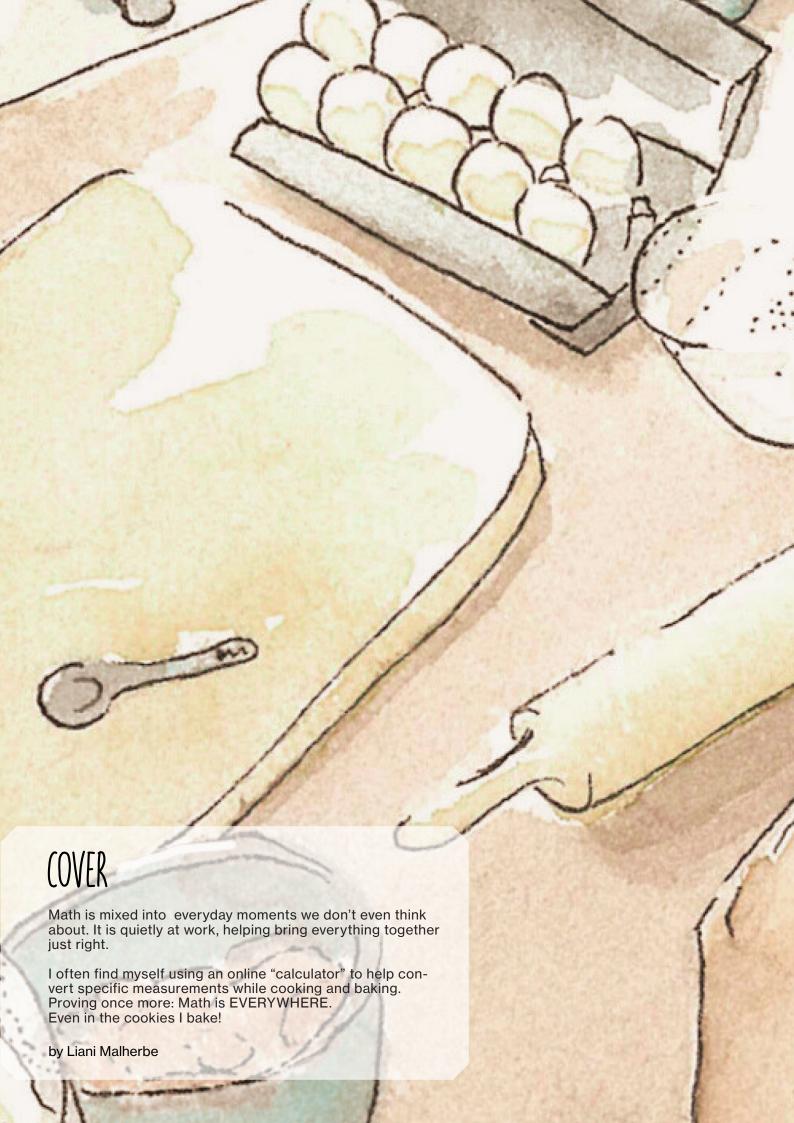
The Hindi word for 'abstract,' 'Saar,' carries a profound connotation that goes beyond its English counterpart. In Hindi, 'Saar' also encompasses essence, summary, and gist, adding depth to its meaning.

KHU

The Ancient Greek term 'Psūkhē' holds a rich history, signifying "life's breath, spirit, and soul." This word serves as the root for the English term 'psyche,' from which 'psychology' originates. Interestingly, the word 'psyche' also draws inspiration from Egyptian roots, where 'su' represents 'she' and 'khe' stands for 'soul.' This connection underscores the feminine nature of the Greek 'psu-khe.' When the initial 'p' is omitted, 'Sakhu' emerges, meaning "the understanding, the illuminator, enlightener, the eye, and the soul of being; that which inspires."

Wisaarkhu: That which inspires the essence of the art of what is known.

COVER

Math is mixed into everyday moments we don't even think about. It is quietly at work, helping bring everything together just right.

I often find myself using an online "calculator" to help convert specific measurements while cooking and baking. Proving once more: Math is EVERYWHERE.
Even in the cookies I bake!

by Liani Malherbe

TOPIC 1

HOW AND WHY SHOULD MATHEMATICS BE ACCESSIBLE TO EVERYONE?

Why should and How Can mathematics be for everyone?

In this article, Mr Damas and Mr David commemorate the International Day of Mathematics by highlighting the importance of Mathematics. They emphasise the importance of mathematical literacy and why math education should become more accessible.

Illustration by Neve Buckmastert

Mathematics is often seen as a subject reserved for a select few, with its complex formulas and equations that can intimidate even the most studious students. However, the truth is that mathematics is for everyone, and it is much more than just a subject we study in school. It is a language that helps us understand the world around us, from the smallest atoms to the largest galaxies.

On March 14th, we celebrate the International Day of Mathematics (IDM), also known as Pi Day, to recognize the importance of mathematics in our lives. Pi is a mathematical constant that represents the ratio of a circle's circumference to its diameter, and the first three digits of pi are 3.14. It is an irrational number with infinite decimal places, and it has fascinated mathematicians for centuries.

Why should Mathematics be for Everyone?

Mathematics is not just about numbers and equations; it is about problem-solving, logical thinking, and creativity. Mathematics is the foundation of science and technology, and it is through the power of mathematics that we can develop solutions to some of the world's most pressing problems. It plays a role in solving global challenges such as climate change, poverty, and disease. Mathematics can also be a source of creativity and inspiration. The beauty of mathematical patterns, symmetries, and structures can be seen in art, architecture, and music. Mathematical models and simulations can be used to explore complex phenomena and develop new technologies.

"-Mathematics is not just for mathematicians but is a fundamental tool for everyone to understand and use."

-Damas K. Mgani
-Tobi David olabiyi
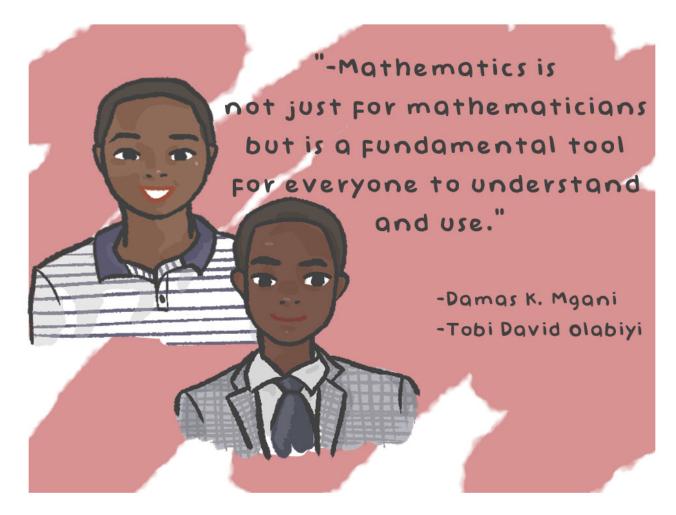
Illustration by Liani Malherbe

Mathematical literacy is becoming increasingly important in today's world. With the rise of technology and automation, many jobs that were once reserved for manual labor are now being replaced by machines. This means that workers must have a strong understanding of mathematics and computer science to remain competitive in the job market. Promoting mathematical literacy can also help to address social and economic inequalities. Therefore, by providing them with a strong foundation in mathematics, we can help to level the playing field and ensure everyone has an equal opportunity to succeed. Mathematics is a fascinating subject in its own right. It is a never-ending source of wonder and beauty, with intricate patterns, elegant equations, and mind-boggling concepts. Mathematics is a language that transcends cultural and linguistic barriers, and it has the power to connect people across the world.

How can Mathematics be for Everyone?
Everyone can access mathematics education by providing mentorship, scholarships, and opportunities to individuals from underrepresented groups. Historically, mathematics education has been dominated by certain groups, resulting in a lack of diversity and inclusivity in the field. Promoting diversity and inclusivity can help individuals from diverse backgrounds feel welcomed and valued in the mathematics community.

In recent years, there has been a growing emphasis on promoting diversity and inclusion in mathematics. The IDM provides an opportunity to address the underrepresentation of women, minorities, and people with disabilities in mathematics and to encourage their participation in the field. There are also efforts to make mathematics more accessible to people with visual impairments through tactile diagrams and audio descriptions. These initiatives aim to ensure that everyone can benefit from the beauty and usefulness of mathematics.

One of the most effective ways to make mathematics accessible is by emphasizing its relevance to everyday life. Many people struggle with mathematics because they don't see its practical applications. By showing how mathematical concepts are relevant to everyday situations, individuals can develop an appreciation for the subject and see how it can be useful in their daily lives. By engaging with mathematics in a fun and interactive way, we can encourage

more people to explore the significance of this fascinating subject. Whether you are a student, a professional, or simply someone curious about the world around you, Pi Day is an opportunity to celebrate the wonder and beauty of mathematics.

In many countries, mathematics is still perceived as a difficult and unapproachable subject, which leads to a lack of interest in the subject. This attitude towards mathematics needs to change, and this can only happen if we make mathematics more accessible and enjoyable for everyone. Traditional mathematics education methods can be dull and unengaging. By incorporating fun and interactive learning methods such as games, puzzles, and simulations, individuals can learn mathematics in an exciting and enjoyable way. These methods can also help individuals develop problem-solving skills, critical thinking, and creativity.

Individuals have different learning styles, and a one-size-fits-all approach to mathematics education may not be effective. Personalized instruction and tutoring can help individuals understand mathematical concepts at their pace and in a way that works for them. Mathematics is a subject that is closely intertwined with other fields, such as science, engineering, and finance. Encouraging interdisciplinary learning can help individuals see the connections between mathematics and other fields and develop an appreciation for how mathematical concepts are used in these fields.

Mathematics should also be made accessible to people outside of the classroom. There are many initiatives that are already underway to make mathematics more accessible. For example, there are online resources and apps that make learning mathematics fun and engaging. There are also organizations that promote mathematics education and provide opportunities for people to engage with mathematics outside of the classroom.

The International Day of Mathematics is an important event that highlights the relevance and importance of mathematics in our daily lives. This year's theme, "Mathematics for Everyone," emphasizes the idea that mathematics is not just for mathematicians but is a fundamental tool for everyone to understand and use.

Mathematics provides a framework for understanding the world around us, and its practical applications can be seen in various fields. Mathematics education can be made more accessible to everyone through various strategies such as emphasizing relevance to everyday life, using interactive and fun learning methods, offering personalized instruction, promoting diversity and inclusivity, and encouraging interdisciplinary learning. By making mathematics education more accessible, individuals can develop an appreciation for the subject, pursue careers in related fields, and contribute to the development of society. Celebrating IDM is an opportunity to engage people of all ages and backgrounds in the beauty and usefulness of mathematics and to promote diversity and inclusion in the field.

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Mathematics for Everyone: Including You

In this article, Daniel and Carl discuss how everyone has varying degrees of mathematical abilities. The author uses principles of logic and problem-solving to explain how mathematics is for everyone.
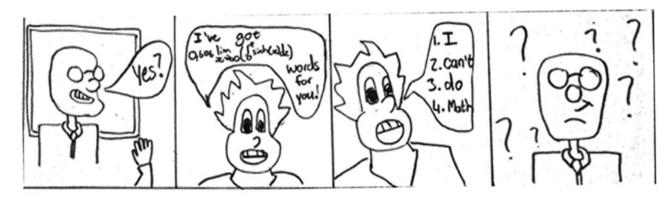

Illustration by Daniël Bester & Carl-Heinrich Hancke

Mathematics is often seen as a subject set aside for those with some rare gift, those who see things in a different way. This, however, does not have to be the case. Mathematics is an activity that absolutely anyone and everyone can and should participate in. Whether it is believed or not, everyone has some mathematical ability, albeit to varying degrees. In my opinion, this makes the pursuit of mathematical knowledge even more exciting, as different areas of Mathematics require different levels of mathematical knowledge and skill.

This means that you will always be able to find some interesting area of Mathematics that builds on the knowledge you already possess, starting at whatever level you are currently on — and this level can even be level zero. Using this kind of approach, everyone can enjoy at least some tiny part of the wonderful world we call Mathematics.

Mathematics is not only for the so-called gifted or genius. Mathematics can be of great use in everyone's daily life; its ideas can be incorporated in a variety of ways. To explore this more deeply, we will have to answer the following question: What is Mathematics? Now, unfortunately, or even very fortunately, there is no one answer to this relatively simple-looking question.

You will probably find as many answers to this question as the number of times you ask it. In a way, this is great. If a certain answer is not to your liking, you can search for another answer that makes it all sound more appealing, or better yet, make up your own.
To some, Mathematics is all about numbers, or at least it used to be right before they came to the conclusion that they are "not so good with numbers". To others, it is all about solving arbitrary problems involving graphs, shapes, sequences, probabilities... or data? All of these are fields of study in Mathematics, but what is it that binds them all together — what makes out the glue?

To me, the answer is quite simple: Mathematics is the science or study (just in case the term "science" is also a taboo in your mind) of logic, and it eventually leads to applying logical principles to problem-solving. Looking at Mathematics in this way might bring one to a realisation: Every field of study — every science — is, in some sense, a mathematical one, for if it were not, it would be illogical. And there is no point in pursuing something illogical (although it can, at times, be a lot of fun).

Logic is one of those fundamental building blocks that form part of the human experience, as opposed to the experience of the "lower" animals — just to be clear, an animal is in no way lower than a human; it is only an expression. The ability to think logically is very much a human thing, and this is why Mathematics can and does have so much meaning and use to so many people (people being humans, of course) around the world. To many, including myself, it is an escape (or at least it used to be before it got pretty damn hard). It takes one from the real world into an even more real one, where everything is precise, governed by the most fundamental of laws, nothing out of place, and everything in perfect peace and har-

Illustration by Liani Malherbe

mony. But before this becomes too philosophical, let's move on with logic.

The ideas of logic can be used in so many parts of life, especially when it comes to decision-making. Now, I am not saying that after studying the logical structures found in Mathematics, you will magically be able to make the perfect decision regarding every single situation of your life. It just does not go that way. Life is too complex: there are too many variables. That, however, does not mean that you cannot employ logic as an aid in making better – though maybe not perfect – decisions.

The best piece of all this good news is that once you have developed for yourself a good foundation in Mathematical logic, it becomes a part of you, and you will not have to actively summon it: no, it will automatically weave its way into your way of thinking. Have you noticed the word "develop" there?
That is right, the understanding of Mathematical logic is not a prerequisite for having some fun inside Mathematics; instead, having fun with Mathematics will lead to the eventual emergence of this understanding dormant within you. And with that, we head towards problem-solving.
The traditional belief is that Mathematics is only

for those with exceptional problem-solving abilities. However, as with logic, skill in problem-solving can be gained by studying Mathematics. See how almost everything can be flipped on its head? Some see natural athletic ability as a reason to pursue sports, while others see sports as a means of improving their athletic ability.

Let Mathematics be your sport, and you will find natural improvement in the skills you will eventually need to upgrade your level of Mathematics – that is, move on to a more challenging "sport". Remember that Mathematics is a tool: let it work for you. Also, remember that to become proficient at using a tool, you need to spend some time with it, so do not expect it all to simply come to you. Struggle with Mathematics enough, and it will make you strong, at least in the case where strength refers to the understanding of mathematical logic and problem-solving skills.
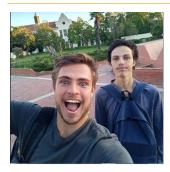
"Now that I have my little toolbox of problem-solving skills, how do I actually use it; what do I apply it to? There really are not that many Mathematical problems out there in the real world, you know." The common idea is that Mathematics is only for really specific, specialised problems. As with logic, however, problem-solving skills can be applied to a variety of real-life situations. It

is all about the skill and how you choose to apply it, not where you got it from. Imagine a world where humans could only use skills as long as they are working within the subjects they picked that skill up – no carry-over, no real-world application. Then we humans would probably be called the "lower animals" by our rulers: The Elephants…

There might still be a certain group of people entertaining the notion that Mathematics, in spite of all the above, just is not for them, that they just are not "mathematical" enough. Well then, if you are one of these, you have read the above all wrong, and you will have to read it repeatedly until you are convinced. MATHEMATICS IS FOR YOU! You, like everyone else, absolutely have the ability to think mathematically!

Studies in Mathematics Education have shown that Mathematics contributes to forming competent citizens. So, go out, get your Maths on, and conquer the world!

DANIËL BESTER

Mathematical Science, Second-year student, Stellenbosch University

CARL-HEINRICH HANCKE

Physics (Laser), Student of Stellenbosch University

Bibliography:

1. Marco Zarco Rotairo: "I believe that Mathematics should be for everyone because all of us have mathematical ability, but only with varying extent and degree. Also, we must let everyone enjoy the wonders of Mathematics. The notion that Mathematics is only for the gifted and the genius must change."

2. Blanca Margarita Parra Mosqueda: "Everyone needs mathematics in every aspect of their life. It is not only for specialised professional issues; it is not only for those who have a supposed gift. It is for everyone, every day."

3. Fin McLaughlin: "Many see themselves as not being mathematical or that maths is not for them, and yet it is for everyone, and everyone is capable of thinking mathematically."

4. Luis Miguel Paz Corrales: "In my opinion, access to mathematics should be democratised for everyone. Because traditionally, it has been believed that it is only for those who possess certain types of problem-solving skills. And research, mainly in Mathematics Education, has shown that Mathematics is compulsory all over the world because it contributes to the formation of competent citizens.

Actually, anyone can do Maths

William Marais explains how mathematics is for everyone, and should be seen as an inclusive, community undertaking.

Illustration by Tristan Barnard

Mathematics should be for everyone. Mathematics has the reputation for being daunting and difficult, and inaccessible to those who weren't born "Mathematically gifted", leading most of us to believe that Mathematics is only for the "geniuses" among us or those with a natural talent in the subject. But the fact that often alludes us is that Mathematics is for everyone!

Maths is used everywhere every day in our lives without us even realising it. From counting coins to save up for a new skateboard to measuring ingredients for a recipe, maths is a fundamental system we can all grasp to some extent, even if we feel like we aren't capable, we still possess a basic underlying understanding of maths that can be built upon with practice. The idea that some people are born with a "mathematical mind" is a myth. While it is true that some individ-

uals may find maths more accessible and easier to learn than others, there is no inherent genetic or biological factor that determines one's ability to learn maths. Our brains are highly adaptable and capable of changing in response to learning and experience, which means that all of us are capable of improvement in our mathematical abilities with hard work and time.

In maths there is a vast variety of way to perceive a problem, each person perceives in a different way and has their own strengths and weaknesses, some people may posess an incredible aptitude for arithmetic and calculation, while others my exhibit a proclivity for problem-solving. By recognizing these differences, we can make the maths community more inviting and inclusive.

The way maths is currently and has always been taught emphasises memorization and formulaic procedures, which can make the subject feel vastly disconnected to a person's life and their real-world problems. This approach makes maths feel dry and one-dimensional which often spurs distain for it especially among those who don't have a natural aptitude for it.

However, maths has many real-world applications through various disciplines and everyday jobs. By highlighting practical real-world examples to illustrate mathematical concepts teachers can make maths more engaging and relevant to student in all walks of life.

Societal and cultural factors can also impact a person's perception of their own mathematical ability. Socio-economic stereotypes and biases continue to affect performance and motivation for maths especially in underrepresented groups and minorities.

In our history, mathematics was for the elites and scholars, but as we progress to a better future, it is important to promote a more inclusive and diverse mathematical community that values and respects the unique perspectives of all its individuals. By overcoming these barriers we can empower people with the skills necessary to thrive in today's complex and data-driven world.

Maths is a subject that is for, and made by everyone. We all need maths whether we realise it or not, it is a necessary skill that we improve with practice and learning. By recognising that we all have an inherent mathematical ability that we

"The idea that some people are born with a 'mathematical mind' is a myth."

-William Marais
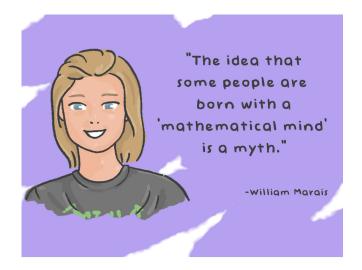
Illustration by Liani Malherbe

can express in various different ways of thinking, highlighting real-world practical applications and building an inclusive and diverse community, we can empower people to thrive in today's world.

Maths should not be seen as the subject that is "boring" and "hard" and only for those who "can" do it but rather as an essential skill that is necessary for today's world and a skill that we can all do, no matter where we come from, no matter who we are. Maths was built by us for us. Anyone can do maths.

WILLIAM MARAIS

2nd Year BSc Computer Science student Stellenbosch University

Mathematics is about the journey, not the destination

Join Rachel and Zea as they unravel the Journey of Mathematics, with their personal insights and perspectives.
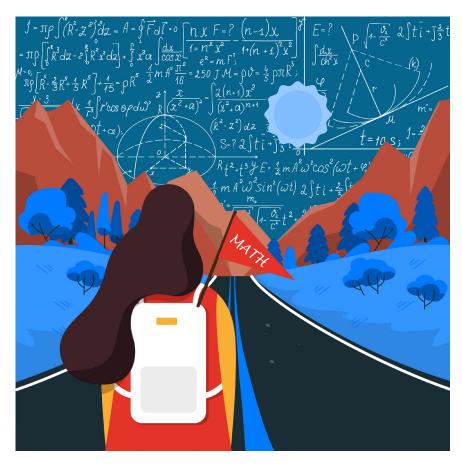
Illustration by Sara Eskandari

What is Mathematics?

Would you believe us if we told you that Mathematics is more than memorizing formulas, proofs, and difficult integration problems? Mathematics is the study of numbers, systems, structures, and change. It can be applied to many other subjects including physical sciences, engineering and operations research. We can think of Mathematics as a logical system from which axioms, (which are the rules of math) are derived. These axioms are then used to produce the theorems and models we've been learning about since preprimary.

Where is Mathematics?

To many, Mathematics is this pointless concept invented for the greatly talented, but math is necessary for everybody. Mathematics is essential for navigating daily life, from the rules of currency to telling the time and even cooking and baking which has ratios of ingredients. Thus, Mathematics appears everywhere in life around us, whether we realize it or not. The houses we live in were constructed by engineers through the use of mathematics. Our phones and computers operate on complex algorithms derived from Mathematics. Mathematics is also responsible for the pitch, tempo, and rhythm of music. Math is also present in nature's patterns, for example, the Fibonacci sequence in flowers. Mathematics is not a new concept, but in fact has been around for centuries. It was used to construct ships and was even used to build the pyramids in Egypt. Mathematics was also used to tell time through the use of sundials which relied on the angle of the shadow cast by the sun as it moved through the sky during the day.
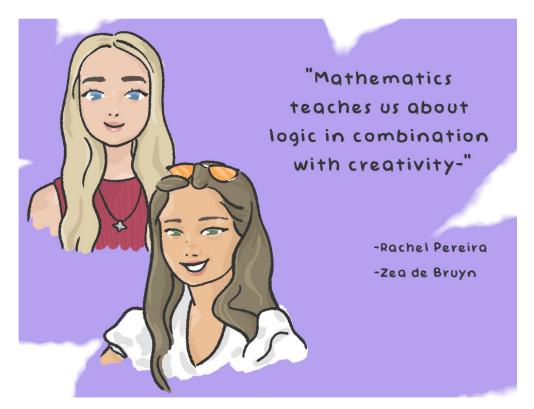
Illustration by Liani Malherbe

Is creativity in Mathematics a myth?

Some people believe they are more "right brain" or creative and are not made to think Mathematically. They believe Math is this uniform, rigid subject that just does not "click" with them. However, they could not be more wrong. Math requires creativity in being able to visualize concepts and being able to invent innovative ways to solve them. There are also aspects of Mathematics that require "left brain" thinking, and thus Mathematics requires a combination of analytical and creative thinking.

Mathematics teaches us about logic in combination with creativity, therefore it becomes a unique experience for everybody. There is no one right way to do Mathematics.

As long as the core principles are understood, they can be applied in infinitely many ways according to the limits of our creativity. Mathematics should not be a chore. Instead, it should be an entertaining way to ponder concepts that we are taught as facts in other subjects. Everybody should be able to experience the wonders, creativity, and enjoyment that should come with Math.

So, why do people view Math so negatively?

Most students have a negative outlook on Mathematics, with thoughts about Math being too difficult, stressful, and rigid. We believe this issue is due to both the way that concepts in Mathematics are taught, and how students deal with "failure" in Mathematics.

Most academic systems allow you to move on to the next grade if you achieved 50%. This, however, can be problematic because it means that a student continues to the next year where concepts are built on, without fully understanding the previous work. A vicious cycle of misunderstanding is created which makes it feel almost impossible to ever catch up. The focus of learning is then not on how interesting a new concept might be, but rather on trying to understand how the lecturer got there in the first place.

When a topic is taught, it is easy to memorize the given method, but it is the understanding that matters. The importance of understanding can sometimes be overlooked, with one way, the "right way", being given instead of exploring unusual ways that could be interesting.

How can we change this?

The ultimate goal would be for academic systems to have a different assessment method or measurement based on your understanding of Mathematics. Having levels of Mathematics in school that are independent of the grade the student is in. But this will take some time and will not be in place by tomorrow. For now, we can change our mindset towards Math.

Instead of thinking "How am I going to pass?" and "This has no purpose" we can try and think "Why does this method give this answer and what about a different method?" and "How can Mathematics be applied in my field of interest?" Maybe you can calculate how Mathematical principles apply to your music, gardening, or sports game?

We should realize that it is okay to struggle. Everyone struggles. The point is to try and try and try again until you eventually truly understand the problem and as a result, figure it out. Even though another person might snap a concept faster than you, it does not mean that you will not be able to get there. Once we change our attitude, we will be capable of so much more. We should remind ourselves that the aim of doing Mathematics is to make you think and not to memorize formulas and proofs.

What is the journey?

We thought about what makes Mathematics different to other subjects, and came to the conclusion that Math is not there to teach us facts or concepts, but rather to teach us how to think. Math is not about learning, but about understanding how to learn and think differently about concepts.

Therefore, Mathematics is an integral (mind the pun) subject that provides the core basics for learning about everything else in life. It teaches us the methods of problem-solving and critical analysis, which is a vital skill for everyone to have. Mathematics is not about knowing the answer to an equation but understanding the journey that brought us to the results. Mathematics truly is for everyone.

RACHEL PEREIRA

BSc Mathematical sciences, focal area Biomathematics Student, Stellenbosch University
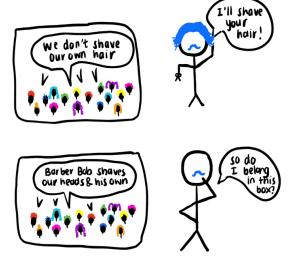
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Information found at:

https://www.tntech.edu/cas/math/what-is-mathematics.php

https://www.yalescientific.org/2008/11/how-do-sundials-work/

Title inspired by "Life is a journey, not a destination" by Ralph Waldo Emerson.

Russell's Paradox

Mathematics is for everyone!

Through her personal experiences, Ancois Huysamen delves into how the negative perception and unimaginative methods of teaching inculcate a fear and dislike for mathematics among students. She insists that Mathematics, if taught properly, is for everyone to use and even enjoy.

Illustration by Elham Ghaedi

Mathematics is part of our everyday lives. It's one of the first subjects we are taught from a young age. It is something any and every one can do and is free to be used, but most people see it as intimidating and scary due to the way it is perceived and taught. Many people can feel inferior to others when they are not able to think in the same way mathematically.

They may think that they are not 'good enough' to understand mathematics. It is true that some concepts in higher mathematics are more nuanced and deeply or easily understood by some than others, but this does not mean that one can't think mathematically.The world has perpetuated a wrong idea about mathematics over generations making people believe that they need to possess a certain special quality to do mathematics.

This way of thinking should be challenged and changed. Mathematics is a part of us. We use it in every field of learning and use it to convey ideto each other when we need to systematically prove that something is true. Everything is structured upon mathematics; it is the basis of everything we know.

Mathematics could be an intimidating subject and the way it is taught further negatively influences the perception of mathematics in people's mind. In high school mathematics is very restricted. We are taught what is prescribed by the department of education and there is no room for exploring other mathematical ideas.

This could discourage people from taking mathematics in high school since it demotivates them from further exploring it and seeing the wonders of it. It is true that there are certain things that we need to know to be able to do mathematics well but there should be a better way to introduce it to people such that it encourages them to do mathematics and not scare them off. It should be taught in a more engaging way and learners should be given the opportunity to explore it, have fun with it, learn from it but not in the regimented forced way they are being taught now.

The world has internalized this idea that if you don't do or understand mathematics you are inferior to others who are better at it and that you need to do mathematics to get somewhere in life. But this is not completely true. Mathematics is indeed very much a part of our day to day lives and we use it without even knowing it. You don't need to be a genius to know that 2+2 = 4!

Of course, there are concepts and problems in mathematics that have difficulty levels that might be too complicated or involved for some people to quickly understand or appreciate and that is okay

"The article delves into some important points regarding how mathematics is perceived and how students who do not excel in the subject are made to feel "less competent". The writer also shares her own experiences and how she came to overcome her fear of mathematics." Neeraja

"-there should be a better way to introduce math to people such that it encourages them to do mathematics and not scare them off."

-Ancois Huysamen

Illustration by Liani Malherbe

solving as there was no other way to do it. You must be innovative when creating new proofs, engaging with the work, and having fun with it. This helped me in my daily life as well, as it helped me develop the skill of thinking and problem-solving in a way I have never done before.

This is the way mathematics should be introduced to learners. By saying this I don't mean that normal problem-solving should not be taught anymore but there should be another aspect that should also be inculcated so that it makes it fun to learn mathematics and encourages the learners to explore the more creative aspects of mathematics as well.
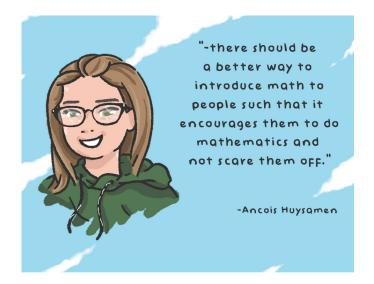
too. You don't necessarily need to understand all the nuance and abstraction associated with mathematics to appreciate its value and beauty. Mathematics is there for everyone to use, the kind of mathematics you use varies depending on what you need it for. For me personally mathematics has always been intimidating.

However, I have come to realize that it helps you to not only solve problems in your textbook, but it also helps you to solve daily life problems. It's one of the subjects that forces you to think further, to think outside the box. It develops the way you think and helps you to solve problems in a creative and easy way.

The way mathematics was taught to me in school made me narrow-sighted to what could be done with it. To me it was just a systematic way of solving a problem and nothing more, but I can see now that it is so much more. Mathematics 278 (a second-year course in Abstract mathematics at the University of Stellenbosch) showed me the beauty of mathematics. It challenged me in so many ways to think outside the box and really understand a problem. It also helped me evolve innovative ways to find a solution without that systematic way of
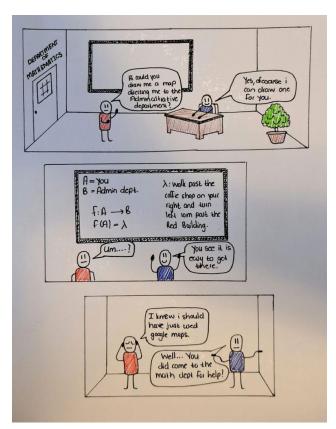

Figure 1- Comic strip drawn by Ancois Huysamen

ANCOIS HUYSAMEN

Third year student, Studying BSc: Abstract Mathematics, Second major Chemistry
Stellenbosch University, Stellenbosch.

Mathematics and the notion of inclusivity

Join Joel Lee in exploring how the universal language of mathematics enriches our daily lives and fosters inclusivity for all learners.
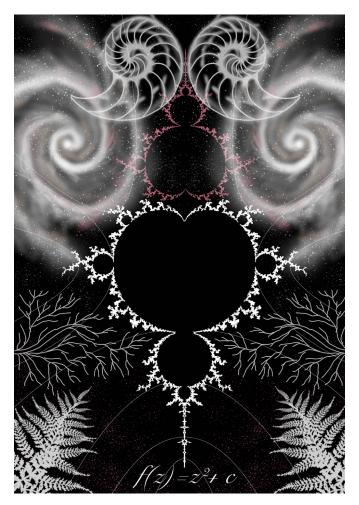

Illustration by Tristan Barnard

In our daily lives, we always make choices, even if we are not aware of them. Our subconscious choices are never questioned, like the language we choose to speak and how we string sentences together in a cohesive manner. What if we all speak the universal language of mathematics daily without any notice?

You start your day early to get to your nine-to-five. You must drive 30 minutes to get to work but you must be careful when leaving to avoid traffic. Unfortunately, you get there too early and are forced to wait for the security to open. So, you decide to order a coffee at your local garage. When you pay, your card declines so now you must use cash. You only have large notes so you must calculate your change to

avoid being ripped off. You drink your coffee and approach your desk. You adjust the angle of your adjustable seat as your parents warned you about bad posture. After a long day's work, you treat yourself to a meal. You are body conscious, so you question the menu items about their calories and their fat concentration.

The couple sitting across from you have been food poisoned! They ordered the calamari which had been spoiled (their storage temperature was raised from 30F to 40F). The restaurant closed and the manager apologized for using Fahrenheit over Celsius. After a dramatic day, you come home only to realize that your handbrake is now faulty. The brakes of the car are sufficient when parked up to a certain height on your inclined driveway.

Now you must calculate the weight of your car (in Newtons) and consider the applicable forces acting on the car while it is on the ramp. Naturally you give up on these calculations (to be fair, the coefficient of static friction was not given to you). You assumed that there was no friction. You were wrong and the car starts freewheeling downhill as you watch in horror. Nobody is injured but you are going to need insurance. They offer to pay up to 75% of the damages so you use a calculator to check your coverage. You have come to terms that you will not get your beneficial eight hours of sleep and start thinking about where you would ever use the mathematics you learned in high school.

The language of mathematics is spoken on a daily basis and sometimes we are more critical of how we speak it than how we speak our native language. For instance, in the education sector, many students who receive low marks on mathematics tests see themselves as incompetent and unable to change. They take the failure personally rather than as an opportunity to improve. It would be naïve to believe that all students think the same way about mathematics. A sly remark could be the tipping point for many students to disregard mathematics completely.

I remember many people taking mathematical literacy and embracing the idea of being inferior to normal mathematics students. I could not speak to their circumstances, but I do not think it would be fair to write them off as incapable

"The language of mathematics is spoken on a daily basis and sometimes we are more critical of how we speak it than how we speak our native language."
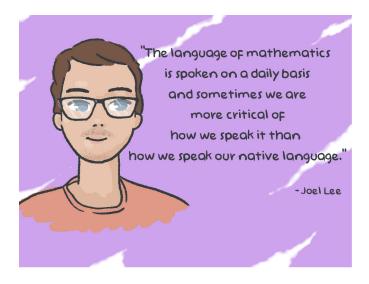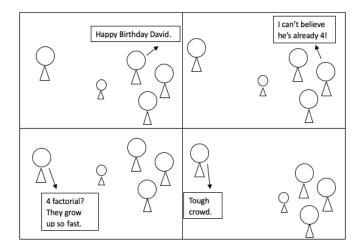
-Joel Lee

Illustration by Liani Malherbe

simply because they struggled to understand the way the work was taught. Throughout my time in university, I have had to rely on other sources, such as YouTube, to help me understand the work in my mathematics modules. Would that make me a mathematics write-off? Before even getting into university for Computer Science, I had to rewrite my mathematics exams. I did much better the second time and it gave me the confidence to believe in myself again. Whatever you choose to believe in your ability to do mathematics, you will be proven right.

It is a shame that many do not see the beauty in mathematics. It is easy to dismiss mathematics as a subject that relies solely on brute-force calculations. I never considered mathematics to be an art form until I heard about fractals. The most well-known fractal is called the Mandelbrot Set, named after the mathematician Benoit Mandelbrot. He demonstrated that fractals could be found in everything in nature, from ferns to galaxies. So, when you admire

the beauty of nature remember that all of it can come from the dimensions of mathematics!

In all, I believe that mathematics should be a compulsory subject because it teaches you many valuable aspects of life. Mathematics helps build problem-solving skills and perseverance; it took over 30 years to prove the 4-colour theorem of graph theory (so do not worry if you cannot solve a question immediately).

Mathematics encourages us to ask questions when we do not understand; these questions helped build the foundations of theorems that we still use today! To conclude, mathematics will always be a part of our daily lives. When we ask questions, we choose to acknowledge mathematics at a deeper level. In fact the majority of mathematics exists because many people ask; "Why does this work?". We should encourage one another to ask these questions because maybe one day we will find the answers.

A mathematician at a birthday party

JOEL LEE

3rd year student, BsC Computer Science, Stellenbosch University

Why Mathematics should be for Everyone?

Mpumelelo Mandyoli highlights the importance of making mathematics accessible to everyone, emphasizing its role in developing critical thinking and problem-solving skills. By promoting inclusivity and innovation, we can ensure that all individuals benefit from the wonders of mathematics.
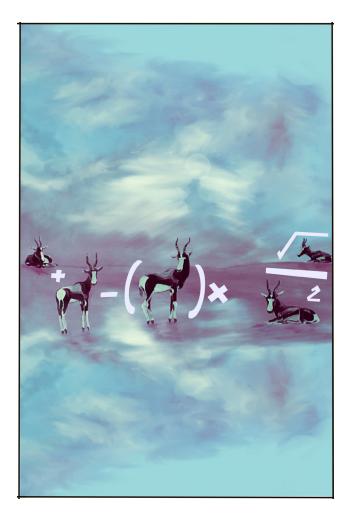

Illustration by Tristan Barnard

The International Day of Mathematics is celebrated on March 14th every year. The goal of this day is to promote mathematics and its role in society, as well as to highlight its importance for the development of science, technology, and innovation. Mathematics is a subject that is often viewed as difficult and inaccessible to many people. However, it is essential to remember that mathematics should be for everyone, and everyone can benefit from it in various ways.

One of the most critical reasons why mathematics should be for everyone is that it is a fundamental tool for problem-solving. Mathematics helps people develop logical and critical thinking skills that can be applied to many aspects of life. From managing personal finances to making informed decisions about healthcare, mathematics plays a vital role in our daily lives.

However, despite its importance, mathematics has often been viewed as a challenging subject, leading to many people feeling intimidated and excluded from learning it. To make mathematics more accessible, we need to change the way it is transmitted. One way to achieve this is by making mathematics more inclusive and welcoming to everyone. This can be achieved by creating a more supportive learning environment, using engaging teaching methods, and providing more opportunities for collaboration and discussion.

Another way to make mathematics more accessible is to highlight the many wonders of mathematics that people can experience. From understanding the patterns in nature to exploring the mysteries of the universe, mathematics has endless applications and can lead to many exciting discoveries.

However, despite its benefits, some people still feel excluded from mathematics, particularly those from underrepresented groups. Research has shown that girls and women, people from low-income backgrounds, and those with disabilities are often underrepresented in mathematics. This is due to a combination of factors, including cultural stereotypes, lack of role models, and inadequate resources and support.

To make mathematics more welcoming to everyone, we need to understand why some people feel excluded and take steps to address these issues. This includes providing more resources and support for underrepresented groups, increasing diversity in the field, and challenging cultural stereotypes about who can succeed in mathematics.

Another critical aspect of mathematics is that it encourages a flexible and open-minded way of thinking. Mathematics requires people to think critically and creatively, exploring multiple solutions to complex problems. This is a skill that is not only valuable in mathematics but also in all aspects of life. By encouraging more
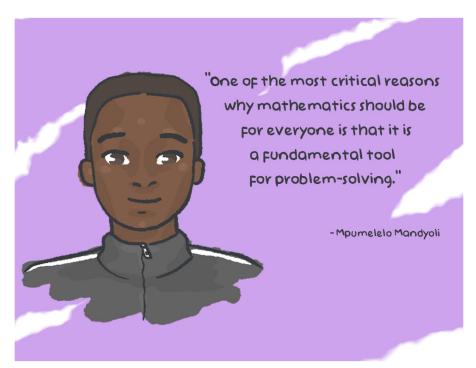
Illustration by Liani Malherbe

inclusive and creative thinking, mathematics can help people become better citizens of the world and come up with innovative solutions to complex problems.

Despite its many benefits, some people still believe that they are not able to think mathematically. This belief is often due to a lack of confidence or previous negative experiences with mathematics. However, research has shown that with the right support and resources, everyone can learn mathematics and benefit from it. In conclusion, the International Day of Mathematics is a celebration of the role of mathematics in society and a reminder that mathematics should be for everyone. By making mathematics more welcoming and accessible to all, we can help people develop (Boaler & Dieckmann, 2019) the critical thinking skills they need to navigate their daily lives and solve complex problems. By embracing the wonders of mathematics and promoting inclusivity, we can create a more innovative and diverse world where everyone can succeed.

MPUMELELO MANDYOLI

Bsc Bioinformatics Degree

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Attitude and Mathematics: A Path to Success

Mnandisi Siyabonga Sikiti emphasizes the importance of a positive attitude and inclusive teaching methods in mastering mathematics. His journey shows how changing one's perspective on mathematical challenges can lead to success and practical applications in everyday life.
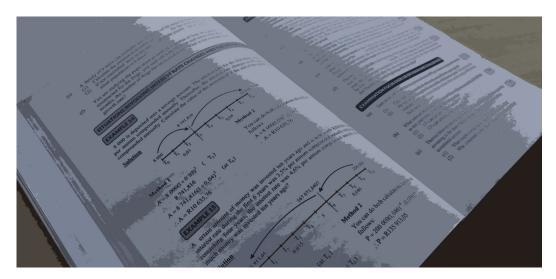

Illustration by Nino Mekanarishvili

Below is a story told by a learner at a Finishing School, for Matric learners who had not done well the previous year, in East London. On the first day of class my father's teacher, Mr Khumalo, said, "If you hate Mathematics, Mathematics will gladly return the favour. It will hate you right back! So, from today onwards, pretend that you're in love with Mathematics, then see what happens." The learner said that this statement remained with him for many years and taught him a great deal about life in general.

Yes, arguably one of the biggest problems regarding Mathematics, sometimes branded a "killer subject", is attitude. Presumably if learners and teachers can change their attitudes toward Mathematics, many positive results could be achieved. The mind, or the psychological composition of the learner, play a crucial role in achieving success in Mathematics.

What psychologists think

"To be successful in business and in life, spot the possibilities while others look for problems." (Robin Sharma, 2012)

The quotation above highlights the fact that a person with a positive attitude is more likely to succeed, not only in life and business, but in Mathematics as well.

Gqeberha-based Occupational Therapist, Busi More, asserts that the word "problem" is a worry word which makes the challenge even bigger than it is. Her opinion is that if learners could stop regarding Mathematics as "a problem subject', but rather as a challenging subject, then things would be different.

She says once you use the term "challenge" the brain gets ready for it – it musters all of its powers like what happens when a student wants to solve a mathematical equation. There is excitement in the brain at the prospect of tackling a new challenge and to ultimately overcome or conquer it. The term "challenge" awakens the brain because it is going to engage in something that is part of its main mandate as a body part that excels in sorting out issues.

Conversely, these powers shut down when the term "problem" is used. The cerebral cortex or part of the brain responsible for problem-solving is slowed down by this word, which is itself a huge obstacle. It is a "worry word". It carries a lot of negativity associated with it.

Busi says that she eliminated the word "problem" from her vocabulary many years ago, and that this has worked wonders for her. She says you must always help your brain to sort out any challenge by supplying it with relevant, positive

"Learning is lifelong and everyone needs the skills to be able to learn and grow."
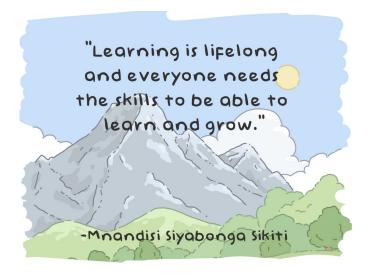
-Mnandisi Siyabonga Sikiti

Illustration by Liani Malherbe

and accelerative vocabulary. She says the brain becomes alert when the word "challenge" is used as one of its major functions is to help the individual to navigate challenges in life – to sort out issues from day to day. On the other hand, the negativity associated with "problem" dulls the brain's neurons.

What is said above underscores the fact that if children / learners can be conditioned psychologically, that is, taught the right skills that will enable them to be positive toward Mathematics and life in general, success becomes a distinct possibility.

Mathematics is all around us

My Mathematics teacher at high school used to say that wherever you are and wherever you go there is Mathematics. Mathematics is not just something abstract, but something practical, something that exists in everyday life. For example, when you teach learners about area and perimeter you should use their own classroom as the starting point. When you look around you, whether you're in a kitchen, lounge or bedroom, there is Mathematics – various shapes such as rectangles, squares, circles, cylinders, triangles, etc.

"Always believe there is light at the end of the tunnel, and you will have a better chance of continuing to move forward when faced with obstacles." (Robert Lowell, 2020)

Mathematics needs a holistic approach

Psychologists are of the opinion that a holistic approach to Mathematics mastery should be adopted. This makes a lot of sense. For example, the human body is composed of seven main dimensions – social, cultural, emotional, spiritual, economic, mental, and physical. These

dimensions are interdependent. Author Peter Mlambo states that "let's assume that your house consists of seven rooms. All these rooms need attention – you need to clean and tidy them regularly. If one or two are neglected, then things don't look good.

Psychologists talk about the Wheel of Life, which is a coaching tool that is used to create balance and consequently greater success in life. It is a fantastic foundation exercise for goal setting.

So, with regard to Mathematics, the same principle applies. We cannot focus on Mathematics content only, but we also must consider other dimensions that augment or make Mathematics content easier to assimilate. A great deal of scaffolding is necessary to assist each learner to attain his or her maximum potential.

The Effective Learner

A document that my father and I once read, titled The Effective Learner, developed by a Finishing School in East London, deeply impressed me. [See its Table of Contents – Appendix A]

Below is an extract from this Finishing School's Introduction to The Effective Learner:

This Manual is designed to help the learner to enjoy life and produce positive results by providing the following:

* Knowledge of who she/he is
* Time Management skills
* Skills to enhance self-esteem
* Study and exam techniques.

Learning is lifelong and everyone needs the skills to be able to learn and grow. The skills that this Manual provides should enable anyone who applies the principles and does the activities to succeed in life and in studies.

We encourage the reader to keep an open mind and carry out the activities suggested apply them regularly and turn them into habits. Human beings are essentially creatures of habit, and the subconscious mind helps to imprint the habits formed on the comprehensive tracks of the brain, so that after some time habits acquired occur automatically.

In answering the questions in this manual we strongly suggest that you are honest with yourself and very specific. For example, when you work on your goals decide what symbol you want in your Mathematics exam results. Decide what learning activities are necessary daily to allow you to attain that symbol.

Whatever you learn in this book, do share with your friends, peers, classmates, and family. This

will benefit you and them immensely.

Your life is in your hands, and you can make it good or bad, rich or poor, happy or sad. The choice is yours. You have a choice in your thinking, your habits, your actions, your attitude – and the choices you make will define who you are and who you will be.

This Manual has a set of activities that should help. Take risks and challenge yourself so as to enjoy life to the full. Best wishes in the adventure of life. We entreat you to seek excellence in your examinations, not just a mere pass that does not enable you to secure the best opportunities and jobs.

The extract above indicates some endeavors by this particular Finishing School to help the learner succeed in his / her studies in general, not just in Mathematics.

Conclusion

Due to time limitations, one is not able to tackle all possible angles when it comes to Mathematics and its ramifications for the learner. The fact that Mathematics teacher Mr Khumalo could produce outstanding results at the Finishing School mentioned above, does suggest that adopting a holistic approach can indeed help learners achieve their objectives and consequently a deep sense of satisfaction for the teacher concerned.

"Energy flows where attention goes. If you focus on setbacks and failures, your brain will attract these toward you. But if you focus on success, your brain will attract victory and fulfilment." (Chris Vusani, 2009)

MNANDISI SIYABONGA SIKITI

Second Year Computer Science Student, Stellenbosch University

Table of Contents – Appendix A

BREAKING DOWN BARRIERS TO SUCCESS IN MATHEMATICS
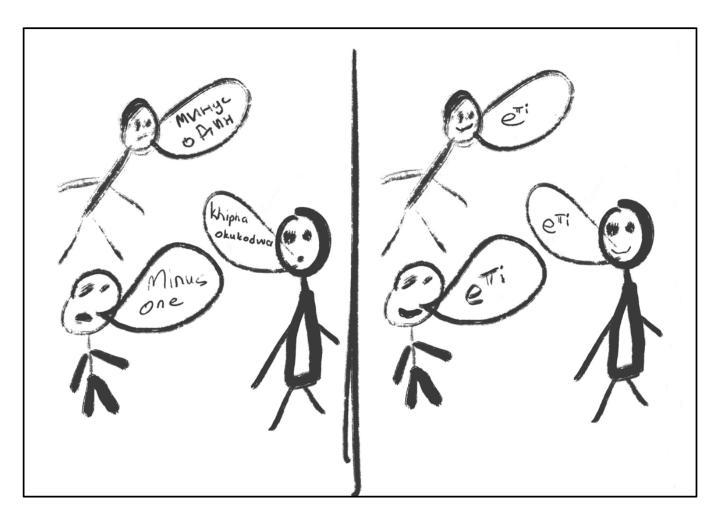
Mathematics For All

In this article, Carlisle discusses how mathematics should be accessible to everyone. He describes the different barriers associated with accessing mathematics.

Mathematics is a universal language

Mathematics is a subject that has often been deemed difficult, complex, and even intimidating by many. It is a subject that can make individuals feel discouraged, frustrated, and sometimes even scared. However, despite its reputation, mathematics should be for everyone. It should be a subject that is accessible, engaging, and enjoyable for all individuals, regardless of their background, age, or abilities.

Another reason mathematics should be for everyone is that it can foster a sense of achievement and confidence. For many individuals, mathematics is a subject they struggle with or even fear. However, with the right support and guidance, individuals can overcome these obstacles and experience the satisfaction of solving a challenging problem or mastering a difficult concept. This sense of achievement can boost an individual's confidence and self-esteem, motivating them to continue learning and growing.

Furthermore, mathematics has the potential to be a subject that is enjoyable and engaging for everyone. Mathematics is about more than memorizing formulas or solving equations. It can be a creative, fun, and even beautiful subject.

Mathematics can be used to create art, music, and even games. The possibilities are endless, and by exploring them, individuals can develop a love and appreciation for mathematics that will stay with them for life. Despite the many benefits of mathematics, there are still barriers that prevent individuals from accessing the subject. One of the biggest barriers is the perception that mathematics is a subject that only a select few can understand. Society, the media, and

"By limiting access to mathematics, individuals are being denied the opportunity to develop skills that are essential for personal and professional growth."

- Carlisle Kotzee

Illustration by Liani Malherbe

even educators often reinforce this perception. However, by challenging this perception and providing support and guidance, individuals can overcome this barrier and realize their potential in mathematics.

Another barrier to accessing mathematics is a lack of resources and opportunities. Many individuals do not have access to quality mathematics education or resources, which limits their ability to learn and grow in the subject. This is particularly true for individuals from low-income backgrounds or marginalized communities. However, by providing access to quality math-

ematics education and resources, we can break down this barrier and provide opportunities for all individuals to learn and grow in mathematics.

In conclusion, mathematics should be for everyone. It is a subject that provides opportunities for personal and professional growth, fosters a sense of achievement and confidence, and can be enjoyable and engaging for all. By breaking down barriers and providing access to quality mathematics education and resources, we can ensure that all individuals can learn and grow.

CARLISLE KOTZEE

BSc Computer Science (Third Year), Stellenbosch University

Breaking Down Barriers and Encouraging Inclusion

In this article, Lavela highlights how mathematics plays a role in different aspects of everyday life. He outlines the inclusivity of mathematics and some of the barriers to this inclusivity.
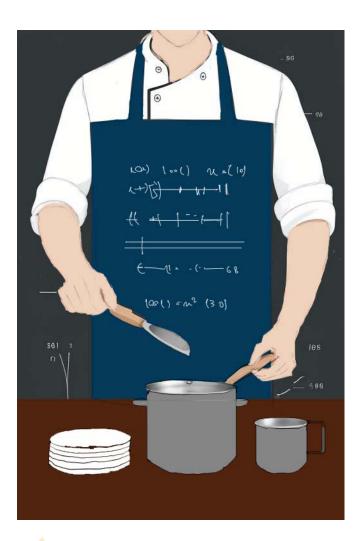

Illustration by Elham Ghaedi

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This article is not an academic publication; rather, it represents the personal perspective of the author, a second-year university student, at the time of writing.

The common misconception is that mathematics is purely for the most intelligent among us. This notion needs to change. Mathematics should be and is for all. It is essential in the day-to-day lives of everyone. In this article, we will explore the importance of mathematical inclusion and why the walls of the garden of mathematics need to be broken down.

The Importance of Mathematics to Everyone

Mathematics in everyday life

Although not always immediately apparent, it is true that mathematics is paramount for everybody. The average person may have concerns like financial planning and budgeting that they may not consider when addressing the topic of where they apply mathematics in their daily lives. Moreover, these calculations can become so complex that they qualify an entire field of study into them.

One may consider even a task as mundane as cooking a mathematical exercise. From the basic task of measuring the ingredients to be used in a meal to the more complex act of estimating the time necessary to cook the food given the temperature, you set the stove to. This is a mathematical exercise, although it may not easily be recognisable.

Mathematics and Careers
It is then quite apparent that mathematics is paramount in many fields of study and workplaces. In some, it is the foundation upon which the study is built. This is more apparent in STEM (Science, Technology, Engineering, Mathematics) fields. In nearly all scientific studies and discoveries, mathematics lies at the core.

For instance, when considering the behaviour of a microorganism in a biological study, you will find that the population growth rate is not only a number that can be calculated mathematically, but the very same formula is closely related to calculating the rate of any exponential graph in mathematics. Where there are discoveries made in the field of physics, the laws are based on a mathematical equation and proof. Until then, these laws are rarely even considered in the scientific community.

In the field of technology, mathematical theorems are the basis of modern computing. They are essential at all levels of computer science, including hardware and firmware. It takes extreme precision that can only be reached by applying existing mathematical theorems to make the hardware and use various forms of logic and systems based on mathematics, like binary code. Even at high-level computing, the average programming language often has a prebuilt library containing multitudes of mathematical functions and methods.

"Although not always immediately apparent, it is true that mathematics is paramount for everybody."
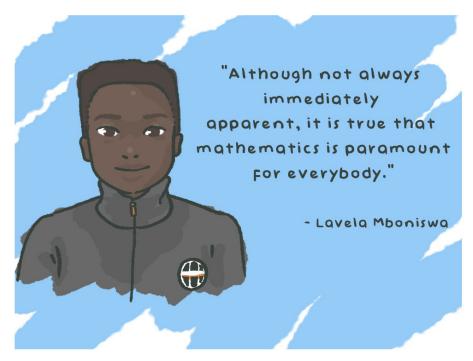
– Lavela Mboniswa

Illustration by Liani Malherbe

Where there is any economic study, it is all founded on mathematical principles, from the formulas used to decide the exchange rate of one currency to the other to the algorithms used in blockchain to create public and private keys. We use mathematics in businesses to calculate the profit per item to the total tax to be paid to the local revenue collection service of the country. Businesses even go as far as to use statistics (a largely mathematical study) to optimise marketing and increase sales as such.

Mathematics as a Powerful Tool for Problem-Solving
We encounter mathematics whenever we need to analyse data. This is largely seen in fields related to statistics and probability. We use it to make sense of large data sets (possibly collected from a group study or an open survey) and quantify it into a useful graph or even a simple statistic like a statement that men are more likely to be alcoholics than women. All this is not immediately apparent from the data that one would collect, but when subjected to mathematical formulae like conditional probability formulae, one can deduce this information. Such an analysis is impossible to get without the use of some level of mathematics.

Even when wearing a seatbelt, the reasoning (although this may be a thought that occurs in the minds of all people) for it to be made into law is that there is a higher likelihood of surviving an accident wearing one than without. This now-informed decision can only be possible through the rigorous use of mathematical principles to analyse large sets of data collected from various experiments and actual accidents.

Barriers to Mathematical Inclusion

Stereotypes and Negative Perceptions About Mathematics

Although there are many facets to mathematics, there are many that can prove quite challenging. This invokes a general sense of fear in the populous of failure. Others may find that being proficient in any study, especially one that can be as challenging as mathematics, is generally frowned upon in their community. This can cause dissuasion from the field and a lack of growth in the person with regard to it.

In other cases, it can be seen that there is a lack of diversity in the mathematical fields (mostly occupied by Caucasian males). This can dissuade others that are of a different ethnical background or gender profile. Even when an individual can overlook these factors, it is likely that they can grow to dislike the field, seeing it as "boring" when it is just that the greater idea of the field is not shared adequately.

Access and Resources to Mathematics

In addition to all the limitations and factors that prevent inclusion in mathematics, access to high-quality education and opportunities greatly determines how mathematically inclusive and diverse a community will be. "This can be seen with the alarming number of rural students who complete schooling pursuing trades rather than mathematically based fields" (Deslippe, D., & Kibler, A. (2019). The Stigma of Choosing Trade School Over College. The Atlantic.)

Teaching and Learning Opportunities

It must also be noted that the traditional teaching method may not suit all of those it is intended for. This, in turn, may result in fewer people being proficient in mathematics as they pursue to pass rather than obtain the knowledge.

The traditional teaching method, characterised by its emphasis on Western cultural norms and practices, is inherently biased against cultures that do not align with these norms. This cultural bias creates conflicts when trying to teach mathematics to diverse cultures, hindering the ability of individuals from non-Western backgrounds to fully engage and excel in mathematics education.

The teaching methods should be tailored to each community's unique needs and characteristics, and teachers should receive comprehensive training to effectively address the diverse conflicts that arise due to cultural, linguistic, and socio-economic differences.

Their focus should be on fostering a supportive and inclusive learning environment that prioritises the acquisition of knowledge and skills rather than solely striving for exam success. The curriculum should be structured to help students reach their full mathematical potential without the walls of exclusivity.

Encouraging Inclusion and Breaking Down the Barriers

Changing Attitudes and Perceptions Towards Mathematics

In the average community, the importance of mathematics and its relevance can be easily missed. There should be seminars and public lectures to inform the masses about this issue in a way they can relate to and understand. The knowledge of who great mathematicians were should not be a subject matter only for the classroom.

Biographies and movies about great mathematical discoveries must be made and heavily promoted. Competitions and awards should be a common issue amongst citizens to promote a positive attitude towards growing one's literacy and cognitive ability.

Providing Quality Learning Opportunities to All Learners

Investments into improving current educational systems and implementation of more advanced educational systems in all communities are paramount to curbing the scourge of mathematical illiteracy and overall disinterest in mathematics we see today.

Technologies that promote the use of the skills gained with mathematical literacy should be commonplace. Computers and computer-related subjects should be seen more among learners to promote their interest in enhancing their mathematical abilities.

Adopting Inclusive Teaching and Learning Approaches

Safe and supportive learning environments should be created to enhance engagement with the content of the curriculum. Students and learners should feel at home and comfortable making contributions without having information forced on them without an apparent reason or connection to their world.

A number of already existing and possibly new teaching styles should be adopted by teachers to ensure that learners are not forced to receive knowledge in a way that is not conducive to the growth of their cognitive abilities.

More diverse perspectives should be used when teaching. Learners should feel free to contribute to a class knowing their ideas or thoughts will be adequately entertained and their perspectives heard. This promotes more free thought and pushes students to want to know more about topics to possibly be able to contribute to the study.

We can thus conclude that mathematics is for everyone and is crucial both in everyday life and in careers. We must also consider, however, the barriers that exist and must be addressed. To encourage inclusion and break down these barriers, there will need to be a drastic change in attitude and perception about mathematics, more access and resources for all learners, and the adaptation of inclusive teaching and learning approaches. By doing so, we can ensure that everyone can develop mathematical abilities and reach their full potential. This will truly allow mathematics to be for everyone.

LAVELA MBONISWA

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Why Mathematics is to be embraced not feared

Chad Davies discusses how the fear of Mathematics results from a misunderstanding of what Mathematics truly is. We need to unlearn this fear, and change the way we view Mathematics and its relationship to the world around us.

Illustration by Elham Ghaedi

It was an informative article, articulating some reasons why Mathematics is not something to be feared, but rather embraces. The author gives us insight into his personal relationship with Mathematics, that of a powerful tool for describing the world around him, and why it is important for society to understand mathematics.

Why do people fear mathematics?

I believe people often fear mathematics because they fear being wrong or are afraid of failure. Mathematics is frequently imposed on us from an early age due to its importance, and the emphasis placed on excelling in mathematics can create anxiety. Most individuals perceive it solely as a subject they must learn to pass exams and cannot afford to fail.

How do I think mathematics should be viewed? While it may be unrealistic to expect everyone to be excited about mathematics, I believe a significant step forward would be for people to see it as it truly is: not just a set of answers, but a language for describing problems and reasoning through their solutions. It is not a dry, repetitive process but rather a field full of creativity and room for individuals to showcase their unique thinking.

Personally, as someone who loves physics, mathematics is how I understand and describe the world. It serves as the tool I use to attempt to comprehend that which is beyond my current understanding. Mathematics transforms the world into an intricate and beautiful puzzle I have the privilege of trying to solve. To draw an analogy, while most people may not aspire to learn to play a guitar, they can appreciate the music it produces and understand why some dedicate their time to learning it. I believe mathematics can be viewed in a similar way. While only a few may feel a deep calling to understand it intricately,

"Mathematics transforms the world into an intricate and beautiful puzzle I have the privilege of trying to solve."

– Chad Davies

Illustration by Liani Malherbe

many more might answer its call and fear it less if we were taught to see it as the creative and intuitive process it truly is.

Why should our perspective on Mathematics be different?

As most are aware, science can achieve remarkable feats. It can improve our lives, safeguard our environment, and make the world safer and more beautiful. To fear mathematics is to fear the language of science and the most effective means of describing our world. If we can overcome the fear of mathematics, we learn not to fear understanding our surroundings.
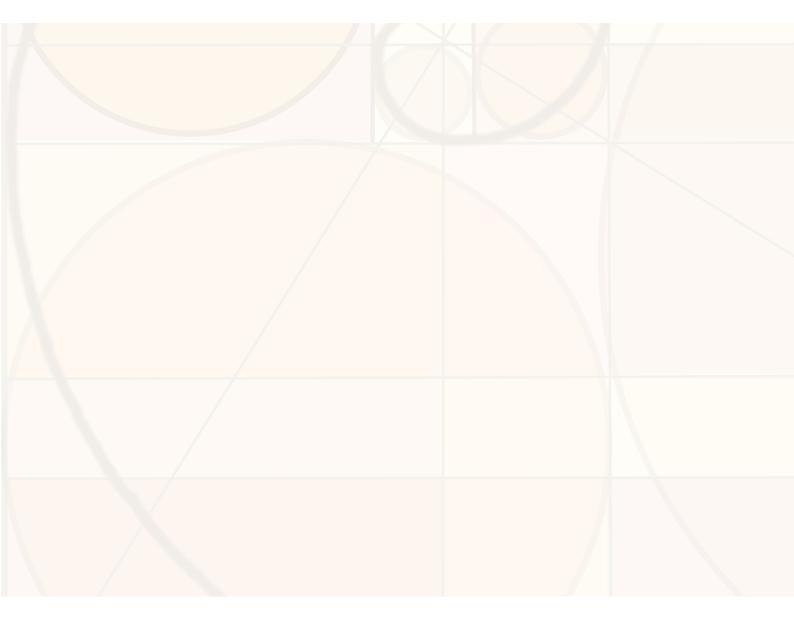
Ultimately, I believe that a society unafraid of comprehending its environment is best equipped to ensure the sustainable operation of that environment, maintaining its safety and progress while leaving future generations with more tools for prosperity and fewer problems to manage and mitigate.

CHAD DAVIES

3rd Year Bsc Theoretical Physics, Stellenbosch University

YOGA

TOPIC 3

THE UNIVERSALITY OF MATHEMATICS

Mathematics: A Universal Gift

In this article, Karlo Grobbelaar delves into the perception of Mathematics as difficult and beyond the abilities of the everyday man. He explores just a few of the ways in which mathematics is not only useful but integral in daily life. Read more about how Mathematics is the basis of all that surrounds us, and how we intentionally and unintentionally use this subject on a regular basis.

Illustration by Tristan Barnard

The article provides an opportunity to reflect on ways in which mathematics may be more prominent in daily life than we realise. It also reminds the reader that while not everyone will find mathematics easy, it is still a field that we can all engage with.

For a long time, Mathematics has been the bane of many students' existence, and many of them cannot wait until the end of the year to eagerly cast their textbooks into the fire and send them back to hell from whence they came. And then, there is a small minority who cannot quite fathom others' loathsome quarrel with this sophisticated subject.

For a long time there has been this rumour that mathematics is too difficult for the common man. This is simply not true. Mathematics is a form of applied logic, and it is thus logical to infer that this stereotypes have distorted many people's perception and experience with the subject, but it does not change the fact that it is something we can all try to harness.

Since the dawn of civilization, people have realized the importance of counting which led to arithmetic that has in turn been used by traders in the markets, craftsmen for measurements and even shepherds who had to count all their sheep to make sure that none were lost. For a long time, mathematics has been used to solve practical problems, and the notorious concept of algebra was only rigorously developed during the 9th century. Although algebra is the core of abstract and pure mathematics, it helped people further to solve practical problems!

I am not suggesting that people do not use simple mathematical concepts or constructs in daily life – such as counting, arithmetic etc., but rather that more people can make use of advanced mathematical constructs. I vividly remember a question from my old high school textbook about a farmer trying to span a fence with a limited amount of wire, and we needed to calculate the maximum area of the spanned pen using the "completing the square"-method. The problem could just as easily be solved using differential calculus. Differential calculus is clearly vital for farmers!

Unfortunately, a lot of people have imbedded the mindset that they cannot perform the necessary mental gymnastics to solve for x or y, and in turn imbed this mindset to others as well. If we want people to see the value of mathematics in their lives, we must first let them appreciate it as it is.

Many aspects of mathematics have an analytical and a geometric part, and the latter radiates brightly in nature. I cannot talk about maths in nature without mentioning the Fibonacci sequence, which appears in flowers and shells and population growth rates. Closely tied to this, is the golden ratio, which Da Vinci frequently used in many of his paintings to create perfect proportions.Even abstract concepts like complex numbers were used to yield wonders such as

"The idea that some people are born with a 'mathematical mind' is a myth."
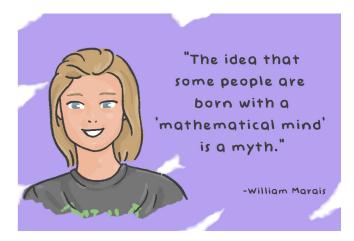
-William Marais

Illustration by Liani Malherbe

the infamous Mandelbrot Set, and of course we have the whole field of statistics. There is a theorem in statistics called the Central Limit Theorem, which states that if you have enough random samples of data, the distribution of the data will roughly approximate a Normal Distribution, that is, a symmetric distribution with a bell-shape. The fact that these precise mathematical structures can model nature and human behaviour is, for me, evidence that mathematics is indeed the pencil God used to sketch the universe.

"Mathematics, rightly viewed, possesses not only truth, but supreme beauty" – Bertrand Russell
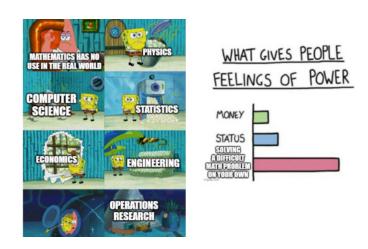
I believe that Operations Research is one area of Mathematics that most people will resonate with. It is an entire field of mathematics dedicated to finding optimal solutions to real world problems. We live in a world where problems are unavoidable. Mathematically speaking, the probability of encountering problems in your daily life is 100%. Mathematics can guide us towards effective solutions to our problems and as a bonus, improve our problem-solving skills. Sometimes, we must think outside the box and create new ideas to solve our dilemmas. In fact, calculus was invented by Isaac Newton mainly to help him with problems in physics. If physics is not your thing, calculus is also used in statistics, economics, engineering, logistics, biology, medicine, and many other fields that may pique your interest.

Although there are a minority of people like me who appreciate the abstraction of math, and like to ponder on proofs, even those that appear to be quite rigorous, most people can benefit by the applica-

tions of mathematical concepts and constructs. The more we learn, and the deeper we delve into the mathematical rabbit hole, we can find that mathematics can be fun, and even weird, in instances like using principle of mathematical induction to prove that all horses are the same color, or to evaluate the sum of all natural numbers to a value of negative 1/12!

In high school, I always felt alone in my passion for mathematics. I was the only one competing in the Olympiads, and had to constantly listen to my friends talk about the thing I consider hobby as being the cause of their downfall. Now at my university, they teach roughly 700 first year students integral calculus each year. I mathematically infer that countrywide thousands of students learn integration every year, with many more worldwide. I feel less alone now, knowing that the mathematics forum on Reddit has 2 million members, and that the YouTube channel Numberphile, which is all about mathematics, has over 4 million subscribers. I rejoice in the fact that what I perceived as an insignificant minority is not so minor after all.

"Without mathematics, there's nothing you can do. Everything around you is mathematics. Everything around you is numbers." These are the words of mathematician Shakuntala Devi, an Indian woman best known as the "human computer", and she is quite correct. There is, therefore, no reason for this long standing negative stigma against mathematics to endure. Mathematics is not something that is constrained by elitism but is, on the contrary, an inherently applicable instrument to be used and even, perhaps, mastered by everyone.

![Photo of Karlo Grobbelaar]

KARLO GROBBELAAR

BSc Mathematical Sciences (2nd Year) Student at Stellenbosch University

Mathematics is for Everyone

Aimee Harris and Ella Gerber show how Mathematics permeates every aspect of life, debunking the notion of 'not being good at math'. They feel that by focusing on real-world applications and delaying formal notation until core understanding is achieved, we can cultivate a greater appreciation of Math, affirming its inclusivity for everyone.
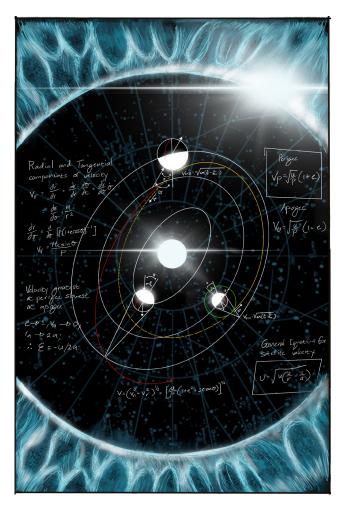

Illustration by Tristan Barnard

It was an informative article, providing a solid perspective on the importance and universality of Mathematics, dismantling common misconceptions about who can or cannot excel in this field.

Almost 400 years ago, in "The Assayer," Galileo wrote: "Philosophy is written in this grand book… [But the book] is written in the language of Mathematics." Mathematics is a universal language, independent of your origin or spoken language. Yet, many people still doubt the legitimacy of the statement that 'Mathematics is for everyone.'

A degree in Mathematics is not meant for everyone, and this essay doesn't aim to convince you otherwise. Instead, it seeks to highlight that regardless of your chosen degree, Mathematics will play a part in it. Mathematics forms the foundation for communication, technology, understanding natural phenomena, and gaining insights into the universe. While this is often undisputed, Mathematics is also employed in everyday tasks like time management, shopping, or even baking.

Since Mathematics is an integral part of daily life, knowingly or unknowingly, we can assert that Mathematics is for everyone. When you hear 'Mathematics is for everyone,' you should think, 'How can I make it work for me?' You don't need to search for where Mathematics fits into your life; it's already there, waiting for you to acknowledge it.

Social constructs around Mathematics, often created by students themselves, such as 'not being a math person' or 'not being good at Mathematics,' should be discarded. Just as one cannot simply be good at poetry, Mathematics involves making mistakes, struggling with problems, and finding it difficult at times – all essential parts of the learning process. In class, we are taught to question and prove everything, even the most basic concepts. This questioning and analysis lead to a deeper understanding of seemingly familiar concepts.

Mathematics should focus not just on questions and answers, but also on how to find solutions, interpret problems, and ultimately prove your answers. While Mathematics often has a single correct answer, there are various paths to reach it, and discussions are valuable.

Mathematics should provide an open space for sharing and discussing ideas, answers, and theorems, fostering a deeper understanding and the development of reasoning skills. It should be presented in a way that multiple types of people can interpret, understand, and relate to. While formal language and notation are important, they aren't the only way to think mathematically.

For some, Mathematics should be seen as a tool for adult life, improving critical thinking and logical skills beyond test scores. Mathematics ed-

Illustration by Liani Malherbe

ucation should go beyond traumatic school experiences and be recognized as a concept that relates to everything. Making Mathematics more accessible starts with how it's taught and understood, shaping our perception of the subject. A solid understanding of Mathematics concepts can reduce the struggles students face when solving problems. When students grasp the origin and real-world applications of Mathematics, it gains more meaning.

The study of Mathematics should not be viewed as optional; it's a fundamental human activity that fosters critical and analytical thinking. Formal language and notation should come after understanding the subject matter, not before. This approach will promote a greater appreciation for Mathematics. When people appreciate Mathematics, it truly becomes a subject for everyone.

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ELLA GERBER

2nd year BSc Mathematical Sciences (Focal Area: Mathematical Statistics) student, Stellenbosch University

Mathematics as a Universal Tool for Empowerment and Understanding

In this article, Luke highlights how mathematics is applied in everyday life. He goes on to outline his personal experience to stress the importance of mathematics.
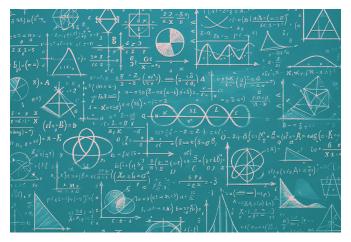

Illustration by Nino Mekanarishvili

Mathematics can be considered an unseen realm of the environment; it is a natural, objective phenomenon that can be used, interpreted, and experienced by all. Abstraction was a discovery, not an invention, and it is assumed that the first mathematical abstraction to be made was the 'concept of numerical value'. Two apples and two rocks that have nothing else in common could be related abstractly by their quantity value, and this could be done by all animals. Mankind, however, continued to evolve and develop its understanding of this concept of mathematical abstraction. The use of this phenomenon known as math has allowed mankind to shape, develop and, to some extent, restructure its environment. For this reason, Mathematics should be considered an "enabler" for all people.

Mathematics presents itself in everyone's lives and forms the backbone of many education systems. This is because mathematics is the tool that shapes and defines reason. In fact, it could be said that Mathematics forms the basis of just about everything. From science to agriculture to business, and some might say even religion uses and relies on the structure of reason that mathematics provides.

"Pure math is, in its way, the poetry of logical ideas" -Albert Einstein. Math is, therefore, for everyone. It is a divine gift that allows us to distinguish truth from contradiction and logic from chaos. It is a tool that rightfully belongs to all human beings.

It seems peculiar that so many people are so disconnected from Mathematics. According to the US Department of Education, algebra is the most failed topic/course in schools across the US. The same is true of South Africa. Seeing as math is a logic-building tool, this is an important statistic to consider. Logic is an important skill for a human, and it is a concern that so many learners would rather not do the math. Is it how math is presented to young learners, or is it a lack of appreciation on the learners' behalf?

Math seems to be a difficult concept for young learners. A common and rising concern of many researchers is a condition known as Math Anxiety. This condition overwhelms the working memory, an important section of the brain that contains and interprets a small amount of current information that is used when doing calculations. Working memory is part of the brain that one uses when trying to remember the recipe of a certain dish or remembering to carry the 1 to the tens column when doing an addition problem. Math Anxiety is a common condition in young students due to their less-developed brains that are not as capable of dealing with the stress that math can cause.

The working memory of the brain can also directly affect the amygdala, which is known as the brain's emotion centre. The IBE did a study on the relationship between working memory and the amygdala. The study showed through an MRI scan that the amygdala of students with math anxiety fired up in unison with the working memory while solving an arithmetic problem. In other words, it is an emotional experience for the student, and this emotion can suffocate the working memory. In some cases, the student would look blank, unable to solve the equation as if they were a frozen computer. Which is a rather good analogy for understanding what is happening in their brain.

$$Z_1.Z_2.Z_3.....Z_K$$
$$K \in \{Z'\}$$
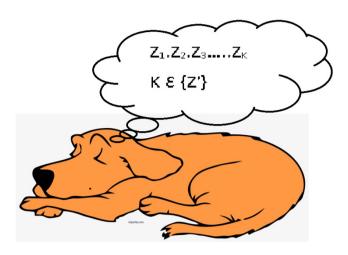
Illustration by Luke Bydawell

Mathematics, for me, has been a rocky path. As a child, I was also a very anxious learner. My concentration was not good, and I constantly struggled to keep up with my peers. My eldest sister had the same problem, and I assumed that I would never be good at math like her. My saving grace was that I was good at sports and I was highly competitive. My mathematics career took off once I discovered that competition was possible in the classroom as well as on the sports field.

This might not be the answer for most. However, it tells me that there are ways of overcoming the struggle that math can present. Now math is an asset in my life. When overcoming my struggles with math in school, not only did I improve my math mark, but I improved my marks for all my subjects.
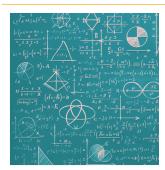
The answer to this dilemma is unknown. Perhaps young students need to be introduced to math in a more comfortable environment where the pressure from their peers is removed, or perhaps students should only be taught math later in schooling to allow further brain development. My opinion is that the ideal way for a child to be introduced to arithmetic and mathematical reasoning is by their parents at home. This takes away many factors in school that can contribute to a young learner's anxiety and stress.

As I continue my Mathematics career into my second year of university, I am often dumbfounded at the magnitude of Math concepts that I have yet to learn and also the magnitude of math concepts that are yet to be studied/proved or discovered. Mathematics is still a wide-open field of research, and I am excited to see what lies in the future of math. What new theories will be made? What will their applications be?

And where will it take mankind?

LUKE BYDAWELL

BSc: Biomedical Mathematics

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Is Mathematics Actually for Everybody?

Isabella weaves a brilliant persuasive argument that Mathematics is not only applied by Scientists, Doctors, engineers and etc however it is applied in all facets of life for example: From counting likes in social media to social media algorithm, its applied by artists from mixing paint to sketching a painting. Maths is with us from the cradle to the grave. The poem captured the application of maths through our lives vividly.
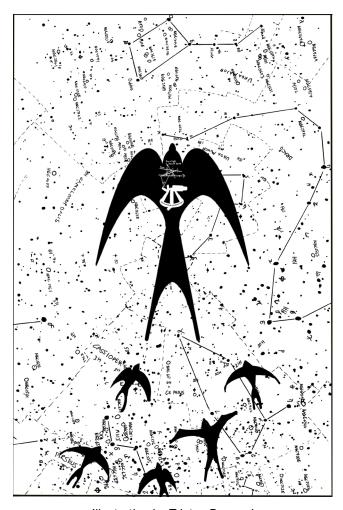

Illustration by Tristan Barnard

Is Mathematics actually for everyone? The average person would confidently answer "no," purely based on the assumption that "Maths is only for doctors, engineers, and scientists." However, that could not be further from the truth. Most, if not all, people use maths and skills developed from maths in everyday, simple activities.

By taking a deeper look at everything humans do, use, and create, it becomes evident that maths makes the world go round. From simply being able to tell the time, to working out a monthly budget, to being able to read a map. Maths is the common denominator in all these situations. Hence Math is

an unavoidable characteristic of almost all activities of the basic human being, despite, most people "hating" mathematics.

By looking at something most of humanity uses daily, it is apparent that humans are unaware of the fact that mathematics is everywhere. So, by diving into the world of social media it can be seen just how much most people should actually love mathematics. Whether you use Facebook, Instagram, or Whatsapp; a wide range of mathematics is behind the app. First, there are basic maths concepts, such as counting likes and views or time stamping posts, comments, and texts. However, there is another world of mathematics behind creating and upkeeping a social media app. Think about the algorithm that simply keeps your Instagram feed suited to you or how all the adverts spread amongst these apps are specifically something you recently searched for. This is the magical world of mathematics.

Furthermore, when looking at a circumstance that is not obviously involving maths, it is easy to forget that the underlying principles are derived from the concept of mathematics. Something as simple as painting a picture involves quite a lot of math, even though at first sight it is not evident. By examining the process of painting, usually it starts with drawing an accurate grid, in other words dividing the canvas in equal and accurate parts so that there is a guideline when beginning to draw. Another step-in painting is mixing colours. This process uses fractions in a way that is not obvious. Let's take light pink as an example; when mixing light pink, we subconsciously use fractions by adding four parts of white paint, one part of red paint and further adding red or white until the desired colour is achieved. This is something most people will do without even thinking twice. Thus, proving that mathematics is engraved in almost everyone's head.

So now that it is seen that maths is basically a universally used tool, let's indulge in some of the life skills and qualities mathematics gives us as humans. The most obvious skill maths gives you, is problem-solving. Maths is all about thinking outside, inside, and how to be the box. It creates a way of looking at situations with ten different lenses on and yet there is still another logical way of viewing

"Something as simple as painting a picture involves quite a lot of math, even though at first sight it is not evident."

- Isabella Spies

Illustration by Liani Malherbe

the problem. In addition to this very obvious skill, there are other skills and qualities hiding in the shadows. A few of these traits are critical thinking, time management, precise and accurate working as well as logical reasoning. All these traits are used subconsciously throughout life and hence add value to the world.

Ultimately, whether you love or hate mathematics, it is undeniably an important instrument in everyday lives. From the maths behind basic activities everybody does to the maths behind devices everybody uses; it is impossible to say mathematics is not for everybody. So, the challenge for you is to learn to love maths, even if you will not admit it.

ISABELLA SPIES

BSc Mathematical Sciences (2nd Year) Student at Stellenbosch University

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Why Understanding Mathematics is Important?

The Becker-Du Plessis "Conjecture"

"Abstract" is exactly right. The fact that the paragraph is a useful summation/generalization of the contents of the article supports the primal point of the article itself. This is very similar to how a meme is a quick generalization of a large urban concept. Mathematics is the study of concepts. We use mathematics without even realizing it.
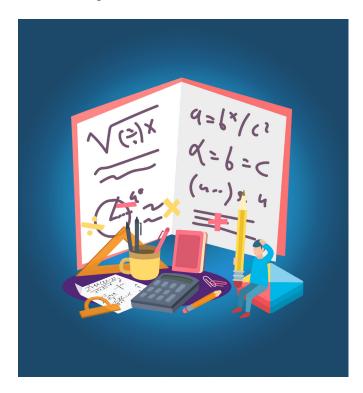

Illustration by Sara Eskandari

Introduction

We would like to propose that the following conjecture could be defined:

The concept of memes is closer to the fundamentals of mathematics compared to how mathematically fundamental high school arithmetic is.

Grounds will be given by first establishing formal definitions and concepts for abstraction, memes, and an estimate of high school arithmetic. The relation between the concept of a meme and abstraction will be elaborated. Furthermore, we will discuss the mathematical fundamentality of abstraction and use all these baselines to make an argument that informally defines the conjecture stated above facetiously calling it the Becker-Du Plessis Conjecture. We believe this conjecture to be profound because if the "conjecture" is true, most people (especially the youth) "use mathematics" without even realizing it.

Definitions and concepts

(A) A formal definition of mathematical abstraction "If S1 and S2 are statements such that S2 refines S1 then we say S1 is more abstract than S2 if and only if S1 is shorter than S2." (Ward, 1996, p. 3). Abstraction is also described as the process of generalization, eliminating inessential detail, or removing inessential information. Abstraction allows for potential implementations, moving to a lower-level means restricting the number of potential implementations. (Ward, 1996, p. 1)

Examples: Compare:

One:
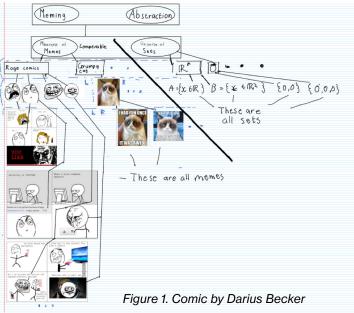
- Calculate the product of a and b and store the result in c.
- Calculate the product of a and b using only addition and store the result in
-

Two

- A certain value x is larger than another value y
- A certain integer value x is equal to another integer value y after adding 1 to it

Ward argues that (a) is the most abstract (Ward, 1996, p. 2)

Comic

Figure 1. Comic by Darius Becker

(B) A formal definition of memes

Figure 2. First grumpy cat

"(Internet memes) often take the form of pictures, videos, or other media containing cultural information". (Meme | Definition, Meaning, History, & Facts | Britannica, n.d.)Internet memes can be thought of as a means of conveying a concept, specifically in the realm of culture, without explicitly stating it. For example, consider a picture of a frowning cat in Figure 2, which people might use to convey faux anger. Nothing about the image makes that particularly obvious, but when one person sends the picture to another, the recipient understands it is not meant to just be a random picture to look at or that the sender is not legitimately angry with them, and the sender does not need to state it explicitly. This idea is understood, largely thanks to cultural context.

Figure 3. Typical high school arithmetic

Number patterns are a topic that one can find in most high school textbooks. (Urban, 2008, p. 54). For the purposes of this report, we will consider this as typical high school arithmetic as, slaving through these exercises, is what our student's minds when thinking about high school mathematics.

Sets and set theory is considered quite fundamental. A set is considered determined if a formula with a free variable is used to define it. A vector space is a type of determined set. A vector space is a set with 2 operations and a designated zero vector. Specific rules to be followed. The Vector space must be closed under addition and multiplication and must have a designated zero vector. There are 9 different rules that must be followed to even be considered a vector space. There are
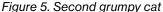
several different vector spaces, of which the cartesian vector space is merely one example.

$$V = \{ x \in \mathbb{N}, \; x + x = 2x, \; x - x = 0 \}$$

Figure 4. Arithmetic vector space

This vector space has restrictions which include those needed for number patterns. A typical reader who hasn't studied any true mathematics yet might not even understand what it all means and that it is our point. (David Poole, 2011, p. 445)

Relation between the concept of a meme and abstraction

Figure 5. Second grumpy cat

For similar reasons as stated in 2. b Figure 5 can also be used to convey the same meaning. Two different pictures and yet we understand them to mean the same thing. These two and a seemingly infinite number of pictures of frowning cats can be used to convey the same thing. As discussed above, you can easily draw parallels between these internet memes and abstraction. The idea, in this case, faux anger, can be seen as an abstraction, and all the possible pictures are specific implementations.

"We believe we have made a strong case for the close correlation between internet memes and abstraction."

-Darius Becker
-Pierre du Plessis

Illustration by Liani Malherbe

Mathematical fundamentality of abstraction

Abstraction can be seen as a way of hiding inessential details. This is crucial in mathematics, especially considering modern mathematics complexity level. What if mathematicians had to prove associativity, commutativity, etc. every single time they wanted to use one of these properties? One can only imagine how much this would slow down mathematical progress. In saving time, something which hides unnecessary detail is most definitely useful. It's also useful for generalizing certain truths. Instead of explaining why commutativity works in a specific case, every time, we can explain why it works in general, then the specific implementations follow.

Argument for the informal conjecture out of what is conceptualized

From what we can glean the very idea of abstraction has to be established before even initializing working with sets. We generalize ideas into concepts so that we don't have to repetitively prove or elaborate redundantly. This is like what a meme does in the way explained in 4

Figure 1 provides a visual representation of what we are trying to convey. We presented several different sets. The lowest level is all considered sets. While all the sets with only zero elements can be examples of the zero vector. All the comics on the left-hand bottom corner are examples of rage comics. They are also considered to be memes on their own. Similarly, the specific grumpy cat memes are on the same level of abstraction as the comics.

We hope the following can be gleaned: Making memes and abstraction are very similar. Abstraction is more fundamental to mathematics than high school arithmetic is. That means memes are more mathematically fundamental compared to high school arithmetic.

How the informal conjecture means math is for everyone

If the conjecture is true that means that most people, especially the youth use maths without even realizing it. Most of today's youth often interact with memes. They take ideas like "faux anger" and make memes out of it so that transfer of information can be optimized. The study of concepts i.e., mathematics is for everyone. Abstraction of ideas could be seen as so essential to communication that the concept took form automatically in memes.
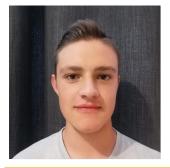
Conclusion

Our initial "conjecture" was that memes are more closely related to the fundamentals of mathematics than simple arithmetic. If we consider especially abstraction as the mathematical fundamental in question, We believe we have made a strong case for the close correlation between internet memes and abstraction. Furthermore, we have shown how this relates to the topic of Mathematics for Everyone.

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Taking Inspiration for Mathematics in the World Around Us

Neve Buckmaster Border reflects on her journey with mathematics, highlighting that memorable lessons, such as learning about the Fibonacci Sequence, reveal the beauty of mathematics in the natural world. She believes that fostering an inclusive and explorative learning environment can inspire more people to find their place in mathematics.

Illustration by Elham ghaedi

Of the memories I do have, one rings out the loudest above the rest. This was the day I learned about the Fibonacci Sequence. Of course, I don't remember word for word what my teacher said, but what I do remember is staring outside the window with the sun streaming through, looking for the golden ratio in the exploding spring greenery. It was awe-inspiring to me that something discussed in class and on paper could be displayed so vividly in the natural world surrounding me every day.

This lesson was not part of our syllabus for that year. To me, this was what truly made the lesson so memorable. There was no looming exam, no deadline, and no repetitive sequence to be memorized in order to solve a problem. We were just allowed to enjoy the beauty of mathematical phenomena and explore for ourselves.

Despite my excitement for mathematics, I've found myself struggle to feel like I completely belong when studying the subject. I know I'm not the only one and I think that the reason many people believe they are not welcome in mathematics is because they are intimidated by the way the subject is taught and the anxiety surrounding examinations.

If mathematics was taught the same way that it was taught to me that day, I believe many more people will find their place in the subject. By uti-

When contemplating the topic of 'Mathematics for Everyone', I took time to reflect on my own personal journey with mathematics and what events inspired me to continue studying the subject until this point. What comes to mind are theorems, formulae, and techniques for solving complex problems;. however, I have few memories attached to learning these skills, nor of the class or the reason for learning the skill. I also rarely find myself thinking of these topics outside the boundaries of a classroom.

The 'honeycomb conjecture' was proven by mathematician Thomas C. Hales in 1999 and states that a regular hexagonal grid or a honeycomb pattern is the most effective way to divide up a surface into segments of equal area with the smallest perimeter.

Despite my excitement for mathematics, I've found myself struggle to feel like I completely belong when studying the subject.

- Neve Buckmaster Border
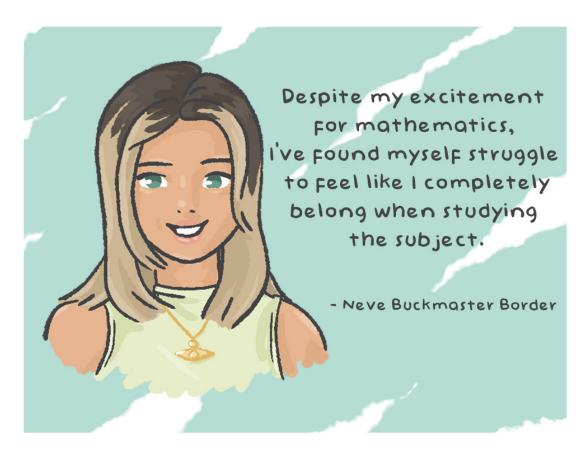
Illustration by Liani Malherbe

lizing teamwork and having group discussions about new topics, exploring more real-world examples, and taking away the pressure of an impending high-stakes exam by having regular small assessments, we can showcase everyone's individual mathematical talents.

When learning about the Fibonacci Sequence, we also learned about the 'honeycomb conjecture', which inspired my drawing for my piece on this topic. The image of the bees against the honeycomb is a metaphor for everyone having a place in mathematics the same way that all bees have a place in the hive. Everyone has a place in mathematics. Perhaps someone takes more time to create a small segment, whereas someone else may contribute large chunks of 'honeycomb', but overall, the hive that is built belongs to everyone

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YOGA

MATHEMATICS: AN INTEGRAL PART OF EVERYDAY LIFE

Mathematics for Everyone

In this article, Marc and Kian highlight how mathematics plays a vital role in everyday life. They outline how the inclusivity of mathematics and access to math education has led to the development of new areas of study.
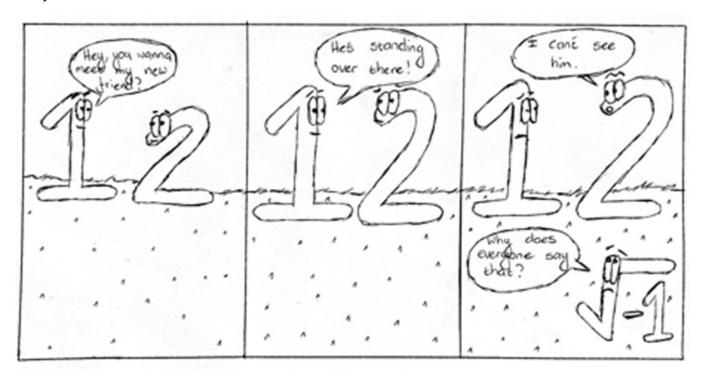
Illustration by Marc Jevon and Kian Anderson

Mathematics has the power to transform lives, communities, and civilizations, but its benefits are often inaccessible to many due to social and economic barriers. However, mathematics is not just for the privileged few but for all, regardless of their circumstances or history. Mathematics is essential for our everyday lives and impacts all over the globe, thus making it of the utmost importance to make it accessible and enjoyable for all.

Atallah (2003) describes that mathematics can be part of every person's understanding and can have an important role in the liberation of human beings, where they describe liberation as the removal of all barriers to a person's creativity. It can free us from ignorance, superstition, and irrationality by providing us with a logical and systematic way of understanding the world. We can use mathematics as a tool for inclusivity and social justice. Individuals from marginalized communities can be empowered by providing them with access to education and mathematical careers, thus creating diversity and equity in society.

It is explained by Danowitz and Tuitt (2011) that Higher education's inability to align its practices with demographic shifts occurring in the United States has been well documented and is evident

in the failure of certain institutions to develop adequate responses to the access and achievement gaps facing students of colour. With such compelling data, it is evident that challenges are still faced in providing equal and applicable education to students. Moriña (2017) describes inclusive education as an educational approach proposing schools where all the students can participate and all are treated like valuable school members. This can be seen as a basic human right and the basis for a fair and equitable society.

Philosophically inclusivity is a concept that refers to the idea of creating an environment or society in which all are respected and valued regardless of their differences. In the past, access to education was limited. As it has become more available, it allows us to learn more about mathematics in addition to it being represented in a better light to cultures all over the globe. As new branches of mathematics have developed, they have opened up new areas of study and research that are more inclusive and relevant to diverse communities. Advancing practical applications in everyday life, modern technology and science. Overall, while there is still work to be done to ensure that math is truly inclusive, many positive changes throughout history have made it more accessible, relevant, and inclusive for diverse communities. We

"Mathematics can be part of every person's understanding and can have an important role in the liberation of human beings-"

- Kian Anderson
- Marc Jevon

Illustration by Liani Malherbe

mathematics. This large proportion of math that is disregarded may be the fields that students enjoy. The study by Hannula et al. (2005) shows that the three closely related elements, those being belief in one's talent, belief in the difficulty of mathematics, and liking of mathematics, affect one's outlook on the subject. School mathematics differs immensely from university, and there is no bridge that prepares a student for the vast world of mathematics. If some of the other branches could be introduced earlier, this could widen a young student's view on mathematics and change their attitude towards it.

The idea of "Math for Everyone" is a call to action to make mathematics more inclusive and accessible to all people, regardless of their background. Although we have already come a long way, gaps still need to be filled to provide proper access to everyone. By recognizing and embracing diversity and promoting equal opportunities, we can make math truly accessible and relevant to all people and unlock its many benefits.

can promote mathematics in education by introducing more branches such as applied math, discrete math, combinatorics, etc. These branches tend to be more complex; however, these fields are never introduced until one reaches university

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Celebrating Pi Day: The Significance of Mathematics in Everyday Life

Tristan Delderfield explains how Pi day promotes the mathematics that we all need in our lives.

Illustration by Elham Ghaedi

The International Day of Mathematics is celebrated every year on March 14. March 14 can be written as 3/14 which is also the approximation of the mathematical constant Pi, which makes it a very appropriate day to celebrate mathematics! The day is intended to honour and raise awareness of the importance of mathematics in society, particularly the role it plays in the advancement of science and technology. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has stated that the festival will have a different topic each year to encourage innovation and highlight the connections between mathematics and everyday life. Mathematics is a crucial aspect of life and a necessity in our daily activities. You utilize math every day, even if you don't realize it.

From telling time to grocery shopping, your brain is continuously using mathematics. We can celebrate the big day in this wonderful field, just like we do in every other element of our lives that we value (RitiRiwaz, 2023). The theme for 2023 International Day of Mathematics is: Mathematics for Everyone. It often feels as though maths is reserved for nuclear physicists working at CERN, or for aerospace engineers working at SpaceX; this couldn't be further from the truth! If you bake, go shopping, play an instrument or even just look at the time, maths is for you (Pi Day, 2021).

Analogue clocks are divided into twelve numbers, representing both the twelve-hour intervals we use to divide up our days, as well as the sixty minutes we use to divide up those hours. Without a basic understanding of fractions and counting, telling the time would be incredibly difficult. A recent study showed that 80% of children in Oklahoma City could not tell the time on an analogue clock (Pi Day, 2021). Besides analogue clocks, 24-hour clocks would be impossible to understand without basic addition and subtraction. Arithmetic can be useful for budgeting since it will help you learn how to make sure that your expenses are less than your income.

For instance, balancing one's bank account is a crucial life skill, and calculating interest or loan repayments can be vital when making financial decisions. In cooking and baking, a good foundation in fractions can be very handy, especially when adapting recipes for different amounts. For example, doubling a recipe that calls for a quarter cup of milk would now require a half cup. Maths is employed in countless professions. While math is often associated with scientific occupations, this is not always the case. Even operating a cash register requires that one understands basic arithmetic. People working in a factory must be able to do mental arithmetic to keep track of the parts on the assembly line and must, in some cases, manipulate fabrication software utilizing geometric properties (such as the dimensions of a part) to build their products.

Besides its practical use in everyday life, learning mathematics has some other benefits too. Research at Stanford University, led by Dr Tanya Evans, indicates that children proficient in math can access particular brain regions more reliably, and have higher grey matter volume in those regions, than those who perform more poorly in

math. High-achieving children's brain regions were linked to a variety of cognitive activities involving visual attention and decision-making. This study suggests that the same brain regions that assist in math are used in decision-making and attentional activities. Arithmetic improves our ability to reason clearly and analytically. Critical thinking about our surroundings is referred to as analytical thinking. Our capacity for reasoning is what allows us to approach problems logically.

Analytical and reasoning skills are essential because they help us solve problems and look for solutions. While it may seem far-fetched to believe that solving math problems can help you solve real world problems, the skills that you use in framing these problems, identifying the knowns and unknowns, and taking steps to solve these problems can be a very important strategy that is applicable to other problems in life (Pi Day, 2021).

In conclusion, the theme for this year's International Day of Mathematics is important to show us that math is not just for scientists and mathematicians but is a crucial skill that everyone can use in their daily lives. Math is employed in countless professions – from budgeting your finances to working in a factory, to even simply telling the time, it is an essential tool for problem-solving and analytical thinking. Therefore, it is vital to promote the importance of mathematics and encourage people of all ages and backgrounds to embrace the subject, as it truly is for everyone.

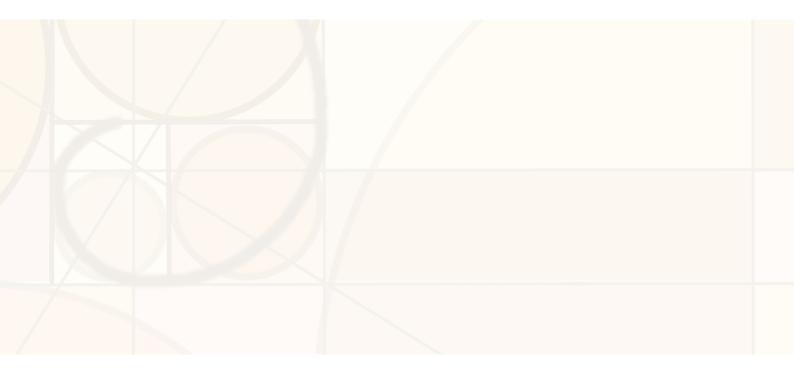**Was this a causal link or a correlation?**

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Student at Stellenbosch University

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Everyday Application – Everyday Mathematical Ability

How Math Weaves Into Our Lives – Delve into the insightful column by Mickayla that unravels the mathematics in our daily routines, showing that mathematics is not just for the academically gifted but for everyone.

Illustration by Elham Ghaedi

The International Mathematical Union directs an annual project; the International Day of Mathematics, celebrated on March 14th; for which the theme for 2023 is "Mathematics is for everyone". Marco Zarco Rotairo of the Trece Martires City National High School in the Philippines, who suggested the theme for the annual celebration, voiced that he 'believe [s] that Mathematics should be for everyone because all of us have mathematical ability, but only with varying extent and degree' and went on to say that the belief that Mathematics is only for the 'clever' and the 'intellectual' must be changed'. If we take a moment to think about how often we, unknowingly, apply mathematics to our daily lives, we will start to question just how much mathematical ability we possess as individuals, regardless of the extent or degree. Mathematical ability, as described by Karsenty (2014), is the ability to perform mathematical exercises and to constructively solve given mathematical exercises. I believe that mathematical ability can be described as trying to solve a mathematical problem, even if it ends in failure and to keep trying to improve instead of simply solving the problem. Moreover, it can be described as the ability to apply mathematical principles to any situation you may find yourself in; any calculation you make, any problem you may need to solve, anything you may need to or try to decipher.Mathematics involves many principles, many laws, and many strategies, many of which we may be unknowingly applying to our everyday habits or simple human experiences. Let's assume you, like most human beings, follow a routine when waking up. Let's assume that you use an alarm to wake yourself in the morning, or any time of the day for that matter. Provided that you need to prepare yourself to be somewhere (work, school, university, etc) after waking, you would need to plan out your schedule to determine your time of departure before even setting your alarm. The act of setting an alarm based on the time you require to get yourself ready for your day ahead involves calculations of time, and preparations ahead of time – it involves mathematics.

Let's review something that occurs more frequently in our day-to-day – consumption of food, sustenance, as well as the preparation thereof. Preparing food involves measurement of ingredients, even if you're eyeballing them. Purchasing the ingredients to prepare a meal requires analysis of money available to use and the expense of said groceries. Even the act of dishing your food requires calculations based on your appetite. The above instances use methods of calculating, problem-solving, planning, analysis – methods which are used in and picked up whilst doing mathematics. We use Mathematics more often than we realize and can go as far back as our preschool years to review our connections with Mathematics. Clements (2001), author of 'Mathematics in the Preschool', wrote that pre-schoolers 'possess informal mathematical abilities and go on to show unpremeditated interest in Mathematics' explaining that many pre-schoolers expand their geometry and number abilities which extend from counting of numbers to forming shapes before entering further schooling. Our ability to grasp concept at a fundamental level, even at pre-school level, implies mathematical ability.

Memories of fitting shapes into their appropriate moulds, scrutinizing and fitting puzzle pieces togeth-

Illustration by Liani Malherbe

er to perfectly recreate the guideline picture on the puzzle box come to mind. Memories of preschool years where bean bags were thrown into a bucket a short distance away, after aiming and calculating for the perfect toss. Simple games or ways to develop analytical skills? The fitting, the scrutinizing, the analysis of the puzzle pieces, all deductive measures used to succeed at play. Though this may not have been everyone's experience, the aim is only to paint a picture of how one's earliest experiences could have been disguised as an introduction to mathematics. This might be read into too deeply but try to think about it for a moment. Think about your experiences, and how mathematics may have been involved. But what happened the shapes did not fit perfectly, the picture was not recreated using the puzzle piec-

es, or the attempt to make the perfect toss failed? You tried again, right? You learned from that mistake and tried to improve; however, mistakes often lead to despondence with regards to mathematics. Many of us self-diminish our mathematical ability based on the presence of mistakes in our mathematics, that our mathematical ability is tied to the absence of mistakes. Our mistakes should be embraced. Our mistakes help us improve, slowly but steadily. Might it be added that even some of our world's best, most respected academics have made mistakes! For example, British Mathematician, Andrew Wiles had proved Fermat's last theorem, which states that no three positive integers, namely a, b, and c, can satisfy the equation $a^n + b^n = c^n$ in 1993, after working on his proof for seven years. Unfortunately, a flaw or gap in the proof was found in 1993. Wiles then went on to correct his proof by 1995. One of the world's best mathematicians made a mistake, in a subject he had been doing, practicing, almost all his life. Even those who are masters at their crafts make mistakes. They are still human. Their abilities are not questionable due to faults. Their faults lead to more opportunities in which to succeed.

Our ability to do mathematics will always be within most of what we do. We need just do, see, think, read, write, and explore what every day has in store for us. We need just see the world through the mathematical lenses. The column concludes with a quote by Shakuntala Devi, popularly known as a "Human Computer", and writer, "Without mathematics, there's nothing you can do. Everything around you is mathematics. Everything around you is numbers." We all possess mathematical ability, and mathematics is for everyone.

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Rediscovering the Magic of Mathematics: Embracing a New Mindset for Education

Nina Smit explores how mathematics is intrinsically woven into the fabric of our physical world, emphasizing the need to rekindle passion and curiosity for the subject in today's educational system. She argues that overcoming psychological barriers and shifting our mindset is essential for making mathematics accessible and enjoyable for everyone.
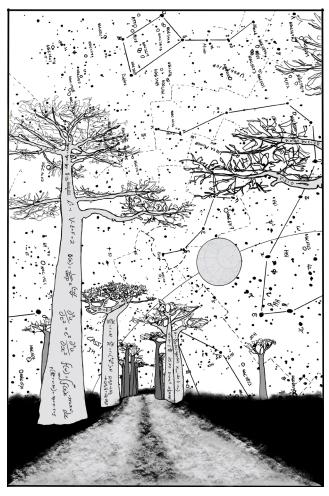

Illustration by Tristan Barnard

Mathematics, as an abstract of concept as it is, is in reality also physically present all around us. Every system, every object that one can perceive with the eye, hear, or touch is encoded with some type of mathematical description, whether known or unknown to us. The idea of exploring and identifying this embedded mathematical secret information is very valuable in detecting and solving problems in the real world in all areas and just profoundly interesting.

This concept that the traces of mathematics can be found all around us and not merely in dusty old textbooks, is what I believe proves that it is indeed for everyone.

Unfortunately, as technology advancements continue to rule our lives and the current poorly structured educational system remains unresolved, mathematics is one of the subjects, if not the subject, that has experienced a decline in interest over the past decades. Fortunately, there are solutions to this problem, but first one must look deeper at the root of the problem.

Whenever I learn of Mathematicians who made breakthroughs in the world of science or in abstract mathematics, they predominantly seem to have lived in the 19th or 20th centuries. So, I often find myself reflecting on my generation and the ones to come, thinking "Will there ever be another to match Albert Einstein or Carl Friedrich Gauss?" What can everyone learn from these mathematical giants? They all had one thing in common, a passion and curiosity for mathematics, and that is exactly what we are lacking in today's classrooms.

If someone brings up Mathematics in a conversation at a party, one can almost guarantee that it would be in the form of a joke. There is this idea that some people can do mathematics and others can't, but I believe it is actually a case of mind over matter, of being able to but not wanting to. Some way or another, this idea has wormed its way into the fresh young minds of students from an early age, but how?

It may be due to the teaching methods at school, and the parenting style and thus it is impossible to find only one answer. I have been tutoring grade 7's and 8's math for the past year, and an observation I made is that the unwillingness (or equivalently, laziness) to learn and do mathematics is actually a psychological matter. The students tend to over-hastily think they cannot do a given problem, sometimes even before seeing it. This lack of confidence is actually the crux of the matter, not necessarily the lack of skill. Even in the university during tutorials, working on problems, I still find myself guilty of this. This lack of

confidence is almost certainly due to the fear of failure, which is obviously not in line with our goal of perfection, because "we strive for perfection". But perfection is not the essence of mathematics. Yes, we do need the answers to big-world problems, but we tend to forget that every mathematical problem has its own unique journey approaching the answer, which makes it an adventure because of the road leading towards it. And the facts are, we will never come to the answers to all problems, so we might as well enjoy that journey. Who knows? Maybe you discover unexpected landmarks on the way. This curious, adventurous mindset is what cultivates my love for mathematics.
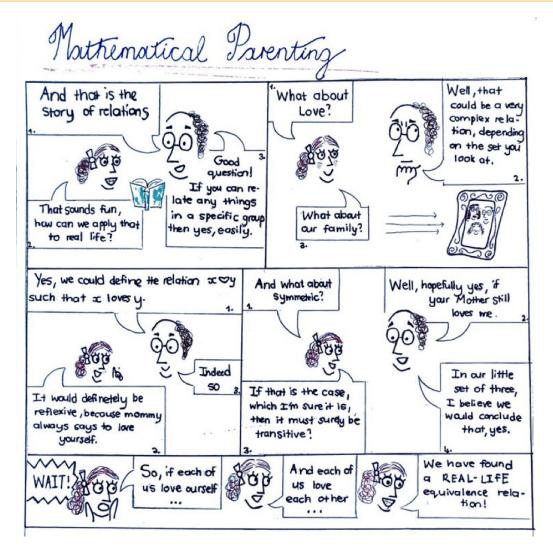
We could go down this path forever, but overall, we can summarize that in order for mathematics to be welcomed by everyone, it is going to start with our mind, and it is going to require a big positive mind shift. The problem is not that there is no solution; it is the reluctance to start exploring the vast and working together to achieve that goal.

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Mathematics for Everyone: An Excerpt Detailing the Importance of Mathematics

In this article, Italo and Caeden discuss how mathematics should be accessible to everyone. They describe how mathematics can be used in the different aspects of life.
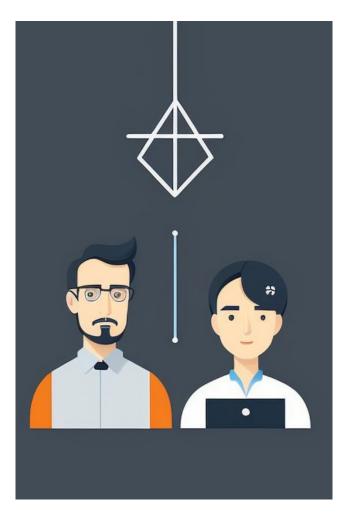
Illustration by Elham Ghaedi

The official International Day of Mathematics theme, "Mathematics is for everyone," is a call to action to challenge the notion that mathematics is only for the "really intelligent." Mathematics is a fundamental subject that underpins many areas of life, from science and technology, finance and medicine, to art and music. In this article, we will discuss the accessibility of mathematics to everyone as well as its value in all areas of life by drawing links to topics covered in the Foundations of Abstract Mathematics (FAM) 278 course, headed by Prof. Zurab Janelidze at Stellenbosch University. Set theory is a fundamental discipline in mathematics that can be applied in various

branches of the field. The study of sets is essential to many areas of mathematics, including topology, number theory, and algebra. However, the beauty of set theory is that it is not limited to the realm of mathematics; it can be understood and applied in everyday life (Stanford, 2023).We all possess a natural intuition for the concept of a set, even if we do not use mathematical language to express it. The idea of a set is intuitive and can be applied in various contexts. For instance, we may discuss the set of books we own, which can be used to organize our reading materials. We may also discuss the set of individuals we know, which can be used to classify and categorize our social relationships (Stanford, 2023).

Moreover, set theory can be used to describe abstract concepts that may be difficult to understand without the use of mathematical language. For example, the concept of infinity can be difficult to comprehend, but it can be described using set theory. The set of natural numbers is an infinite set, and we can use set theory to describe the properties of this set. Subsequently, the study of axiomatic incidence geometry, which focuses on geometric objects and their relations, including the properties of objects such as points, lines, and planes, is also an essential topic that demonstrates the universal nature of mathematics. The field of incidence geometry helps individuals understand and describe their innate sense of space and geometry more precisely. The practical applications of incidence geometry make it a useful tool for everyone. Whether you are an architect designing a building, a surveyor mapping a plot of land, or a physicist studying the behavior of light, the principles of incidence geometry can be applied to solve problems and develop new ideas (Stanford, 2021).

The usefulness of incidence geometry extends beyond the technical applications mentioned above. Understanding the principles of incidence geometry can aid us in better understanding the universe we live in. For example, by understanding the concept of intersecting lines, we can better understand the relationships between different objects in space. By studying the nature of space and the relationships between objects within it, we can gain a deeper appreciation for the beauty and complexity of the universe (Stanford, 2021). Axiomatic arithmetic, another critical area of mathematics, examines the properties of natural

"The accessibility of arithmetic can help break down barriers between people from different cultures and backgrounds."

-Italo Marini

-Caeden Telfer

Illustration by Liani Malherbe

numbers and their relationships, including the basic operations of addition, subtraction, multiplication, and division. Individuals employ arithmetic in various daily activities, such as computing the total cost of groceries or calculating the tip at a restaurant. Axiomatic arithmetic offers a better understanding and definition of these operations, enabling individuals to view the underlying relationships between them (Stanford, n.d.). Furthermore, the accessibility of arithmetic can help break down barriers between people from different cultures and backgrounds.

Mathematics is a universal language that transcends cultural and linguistic boundaries. By understanding the principles of arithmetic, individuals can communicate and collaborate more effectively with people from diverse backgrounds. Consequently, it is essential to recognize that mathematics can be enjoyable. Mathematics is not just a dry and abstract discipline solely applicable to academics and professionals. There are various ways to make mathematics engaging and entertaining, such as art and music. By making mathematics enjoyable, we can incentivise more individuals to engage with the subject and recognize its relevance in their daily lives.

The significance of these topics is that they all provide individuals with tools to comprehend and describe the world around them. By studying sets, incidence geometry, and arithmetic, individuals can acquire a deeper understanding of the world and the relationships between different objects and concepts. Furthermore, mathematics is not only essential for understanding the world but also for problem-solving and making new discoveries.

Mathematics is used in a wide range of fields, including music, literature, and philosophy. By studying mathematics, individuals bridge the gap between abstraction and reality. Pyotr Ilyich Tchaikovsky was one of the greatest composers of the Romantic era. Tchaikovsky had a deep interest in mathematics, so much so that he would frequently discuss mathematical concepts with his friends and colleagues.Tchaik-

ovsky was particularly interested in the mathematics of music theory, specifically the application of mathematical principles to his composition. He was fascinated by the mathematical relationships that exist between musical intervals, chords, and scales, and he believed that understanding these relationships was essential to composing music that was both structurally sound and aesthetically pleasing. One of Tchaikovsky's most famous compositions, the "1812 Overture," is an example of his interest in Mathematical symmetry. The overture is structured symmetrically, with a central theme that is repeated in a modified form at various points throughout the composition. This use of symmetry creates a sense of balance and unity that is integral to the work's grandiosity (Britannica, 2021).

Another notable example is French troubadours. During the Middle Ages, French troubadours are said to have invented the common ABAB rhyming scheme that we have all come to love today. The ABAB rhyme scheme is another way in which mathematics can be used in seemingly unrelated fields such as poetry. Due to the cyclic and arithmetic nature of this rhyming scheme, this gives rise to the auditory pleasure that a listener experiences. Another noteworthy individual was Plato. He was a philosopher who recognized the importance of mathematics in understanding the world. He believed that mathematics was not just a tool for measuring quantities but a way of grasping the nature of reality itself.

In Plato's view, mathematical concepts were not just abstract ideas but were rooted in the real world, and the study of mathematics was a way to access the underlying forms or ideas that constituted reality. Plato also recognized the importance of mathematics in the education of the ruling class. He believed that the study of mathematics was essential for the development of the mind and for the cultivation of the virtues of wisdom and justice. In his famous work, "The Republic," Plato argued that mathematics should be a central part of the education of the philosopher-kings who would govern the ideal city-state (Stanford, 2009).

Mathematics is a subject that should be accessible to everyone, regardless of their background or natural abilities. It is not an innate talent that some people have but rather a skill that can be developed through practice and hard work. Srinivasa Ramanujan, a self-taught mathematician from India, is a perfect example of this. Despite having no formal education in mathematics, Ramanujan made significant contributions to several areas of the field (Stewart, 2015). Ramanujan's early life was not easy. He grew up in poverty and had to drop out of school due to financial difficulties.

However, he continued to pursue his interest in mathematics on his own, reading books and working on problems in his spare time. His work eventually caught the attention of a British mathematician named G.H. Hardy, who recognized Ramanujan's talent and invited him to study in England (Reddy, 2021) (Stewart,

2015). In England, Ramanujan continued to make significant contributions to mathematics, including developing new theories and formulas in areas such as number theory and analysis. His work has had a lasting impact on the field and has inspired many other mathematicians to pursue their interests and passions (Reddy, 2021) (Stewart, 2015).

Ramanujan's story demonstrates that mathematical ability is not limited to individuals with formal education or high IQ scores. It is a skill that can be developed through dedication and hard work. By promoting the idea that mathematics is for everyone, we can encourage more people to pursue their interests in the subject and make important contributions to the field.

In conclusion, the official international day of Mathematics is celebrated under the theme "Mathematics is for everyone," which challenges the idea that only the "really intelligent" can excel in mathematics. The text discusses how mathematics is accessible to everyone and has value in all areas of life. The study of sets, axiomatic incidence geometry, and arithmetic provides individuals with tools to comprehend and describe the world around them. Mathematics is used in a wide range of fields, including music, literature, and philosophy, bridging the gap between abstraction and reality. By making mathematics enjoyable, more individuals can engage with the subject and recognize its relevance in their daily lives.

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Mathematics: A way of thinking

Patrick de Wet emphasizes that mathematics is an essential tool in everyday life, enhancing problem-solving skills and providing a sense of accomplishment. He shares his personal experience of how practicing mathematics in high school improved his problem-solving abilities and believes that making mathematics more accessible and comprehensible can inspire more people to embrace it.
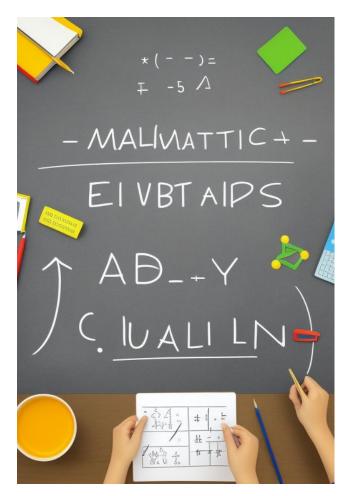

Illustration by Elham Ghaedi

Mathematics is a tool that can be used in everyone's everyday life. It is a concept that everyone on this planet should use. It can not only help in problem-solving but bolster someone's already-existing problem-solving abilities.

Since I started to practice more mathematics in high school, my problem-solving skills have greatly improved. Mathematics can provide a sense of accomplishment in people's lives, as the feeling of solving a mathematical challenge can be rewarding, which is the reason I enjoy mathematics so much.

Mathematics occurs in almost every aspect of life. When you need to work out how much you would have to budget for a holiday trip to a resort or a day on campus, mathematics is incredibly helpful in calculating that budget. When a test is around the corner and you need to manage how much time you will need for your studies and the subsequent rest hours, you will need mathematics to figure out a suitable schedule. These are all examples of when mathematics came in handy in my day-to-day life. Mathematics is certainly useful in everyday life, but unfortunately, not everyone is good at it, and some even try to avoid it.

Mathematics can feel very unwelcoming to many individuals, as they were not taught properly how to understand or utilize it. Some others just do not have a brain for mathematics and would rather focus on other activities such as sports or the arts, etc. Mathematics can also be extremely overwhelming, as there are a lot of theorems, methods, equations, and calculations that someone could be introduced to and could find it difficult to incorporate into what they already know, whether they are good at mathematics or not.

Trying to make mathematics easier to comprehend would be a strenuous task, but there are some ways this could be possible. Using analogies and visualizing mathematical problems for students could help them understand. For example, using a real-life problem of sharing four apples between two children would be a great way to introduce learners to the concept of division. Encouraging students to take every failure when dealing with mathematics as a learning experience not only assists them in finding the correct solution to a problem but also helps them to embrace mathematics and not revere it.

These are just a few ways that can help students understand mathematics; however, these methods aren't guaranteed to always work, as not all learning methods are helpful to all students. In primary school, I was quite poor in mathematics because I found it hard to understand, but after my seventh-grade teacher used these methods of teaching, I was capable of doing math to a good standard.

Mathematics should be compulsory, at least to a basic degree. Mathematics helps tremendously with someone's ability to solve problems. That method of solving that specific problem gets taught to another person, and from there to another. This method could spread so far that almost everyone can now use it to solve that problem, and it could even be used to solve an entirely different problem. Someone could even improve

"The accessibility of arithmetic can help break down barriers between people from different cultures and backgrounds."

-Italo Marini

-Caeden Telfer
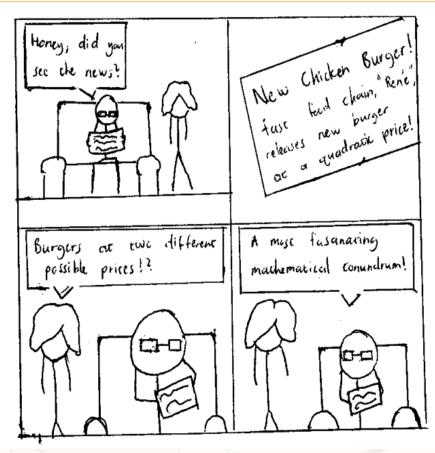
Illustration by Liani Malherbe

upon this method and create a new one that not only works better but also solves more problems than the original method. This new method spreads and gets improved upon again, and the cycle continues. Everyone thinks in their own unique way.

Someone could be introduced to a way of solving a problem that they had never thought of and combine that method with their own to create another method. This leads to more methods arising, people collaborating to form innovative ideas, and more people having an open mind. A world with more individuals collaborating to solve problems, knowledge being shared, and people being able to consider another person's viewpoint is all possible with mathematics.

PATRICK DE WET

Student (2023)

I Believe in the Beauty of Math

Leesan invites you to explore the beauty of mathematics that touches every aspect of life, from the simplest daily tasks to the grand designs of our world.

The article offers a unique perspective and insight into the mathematics of our daily lives, and how we can come to see it's beauty." Aidan Pellow-Jarman

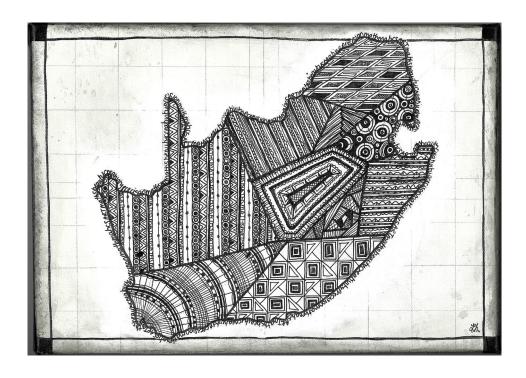Mathematics, to me, is far from just a cold and impersonal set of immutable laws; I believe in its beauty. It embodies a remarkable synthesis of logical precision and human creativity. Mathematics is the universal language facilitating human connection and understanding across centuries. In its essence, it represents beauty and elegance in their purest forms, used to sculpt and enhance our world.

The beauty of mathematics is in its universal relevance; its ability to touch everyone who encounters it. It has become the driving force for innovation; propelling human achievement throughout the ages, granting us the ability to create marvels that transcend the ordinary confines of logic. Its beauty is not reserved for the prodigies among us—it is there for all to appreciate. The role of mathematics in our daily existence is as fundamental as the air we breathe. "Without mathematics, there's nothing you can do. Everything around you is mathematics. Everything around you is numbers." (Shakuntala Devi, Twitter, 2021)

The Shadows that surround its beauty
For many, mathematics appears as a dull and tedious chore, dressed in a guise of difficulty and despair, obscuring its true beauty. For most, school experiences have instilled an aversion towards mathematics. Yet, those who truly explore mathematics and delve into its profound depths will come to recognise its true beauty. The intrinsic beauty of mathematics emerges from its abstraction, purity, simplicity, and symmetry – a brand of aesthetics unrivalled. Despite its complexities, the beauty of mathematics can be seen everywhere. Open for all of us to experience in the patterns of our daily life.

Mathematics touches all of us.
Cashiers routinely employ algorithms to accurately determine the change due to customers, this practical application of mathematics ensures efficiency and accuracy in everyday transactions.
Engineers' lives revolve around mathematics; it is the foundation upon which they design and construct enduring structures. Chefs must master the art of measurement and proportion to achieve the exact taste profiles in their culinary creations. Mathematical precision ensures flawless replica-
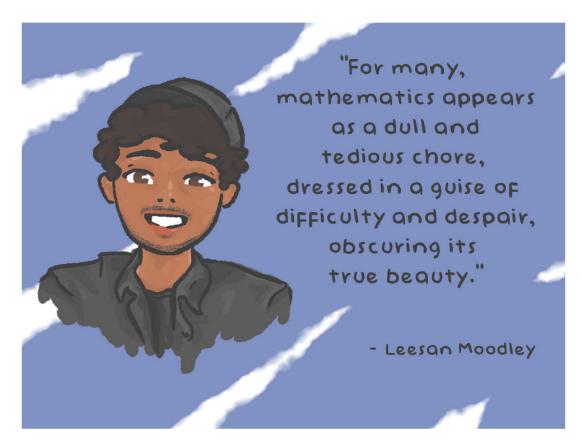
Illustration by Liani Malherbe

tion of flavours in every dish. The essence of music is deeply rooted in mathematics. Its elements, governed by mathematical relationships, combine to create soul-stirring compositions. While mathematics is indeed a universal language, its true allure extends far beyond this. The beauty of mathematics lies in its dynamic nature: it is constantly evolving, adapting, and integrating to every facet it encounters. For this very reason, Mathematics is an invaluable tool that can be used to enhance our daily lives through its applications. Ultimately, we find ourselves at a crossroads: to either embrace the beauty of mathematics or to overlook it. Many grapple with the intricacies of its charm, yet all of us possess the potential to comprehend it. Mathematics can be and should be utilized by everyone to improve their daily lives. I've always believed that mathematics has the power to better our world, especially in South Africa. If we used mathematics to its fullest beauty here in SA, we could address numerous challenges, improving the lives of millions. It is for that very reason that I believe that Mathematics is truly beautiful.

LEESAN MOODLEY

Student BSC Computer Science, Stellenbosch University

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YOGA

TOPIC 5

RELEVANCE OF MATHEMATICS

A Simple Structure

Carlyle Stewart shares his thoughts on the perception of mathematics in society, illustrating how mathematics is both a form of creative thinking and an innate ability to each of us.

Illustration by Nino Mekanarishvili

In the subtle hum of all that is arounda thread of song emerges tangling itself in the infinite sound of the structure from which it surges. As beings, we are drawn to it and we seek to entangle ourselves too to turn our minds into meaning without words and become one with the sounds of the world. We find in it a certain beauty that resonates deep within a harmony that speaks to our duty to understand the world we're in

For through the patterns and the order we glimpse a truth that's pure and we feel our spirits grow broader as we fall ever deeper into its lure. So let us embrace this music of thought let us dance to its rhythm divine for through its melody we uncover a glimpse of the universal design.

The perception of mathematics in society is that it is an activity that takes place only in a classroom, with pen and paper, involving some or other calculation. Although activities such as these can certainly be considered as mathematical, in terms of the beauty that they capture, it is very far from the complete picture. At its core, mathematics is a form of bounded creative thinking.

It may sound paradoxical to talk about bounded creativity, but as humans, we experience a certain ecstasy from observing patterns and order. In poetry we are bounded by language and words, we are satisfied when a piece of writing is both meaningful and obeys certain rules. In music, we are restricted to the world of sound, and a song is particularly pleasing when it possesses elements of novelty, while still conforming to existing musical structures. Another criterion we sometimes have for the beauty of an artwork is that it must not yield all its content instantly. We appreciate it if there are various layers of meaning, that only become apparent upon extensive reflection.

Mathematics is no different. It lives in the world of thought, and it is bounded by the rules of logic. What is interesting about this restriction, is that every human seemingly possesses (to some degree) the ability to decide whether or not certain thoughts are logical, without ever having been taught what the rules of logic are. An example of a "rule" that everyone intuitively understands, is what is referred to formally as "modus ponens", it involves taking 2 statements, and forming a third:

"Whenever the sun rises, a new day follows" could be the first statement, and

"The sun has risen" could be the second.

Then most humans would agree that the most natural statement to conclude from these would be:

"A new day is on its way!"

"At its core, mathematics is a form of bounded creative thinking."
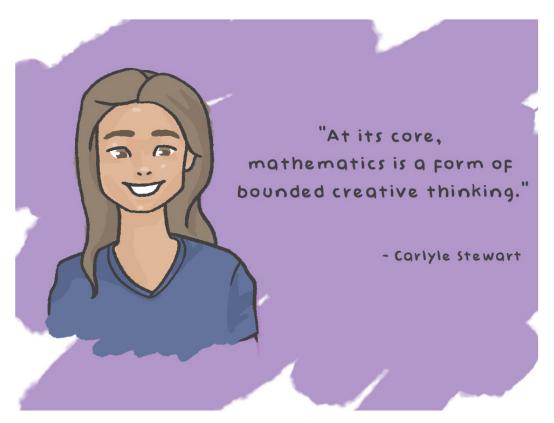
- Carlyle Stewart

Illustration by Liani Malherbe

What most humans don't realise however, is that in reaching this conclusion, they have engaged in mathematics! And this is not said as a joke, or as an endearing motivational comment. The process of reaching the above conclusion is genuinely much closer to the true nature of mathematics, than the manipulation of numbers on a sheet of paper. The rule that describes a conclusion like this underlies not only all of mathematics, but it is so deeply engraved into our minds that we cannot even imagine an existence where it is not true.

In terms of layered meanings, and the reluctance of a thought to reveal its true nature, mathematics trumps all other art forms in versatility: There are mathematical thoughts such as the one we looked into above, that are simple enough for a young child to understand, and then there are lines of thought that are complicated enough that it may take someone a lifetime to fully grasp. It goes even further, with thoughts that are so complex,

that it requires the joint effort of humans over many generations to uncover their true meaning. A sad truth about the status of mathematics today, is that the first exposure many children have to it, is being forced to pretend that they have understood some line of thought that took humanity decades to fully understand. It is not surprising then that some people have an aversion to the subject years later; It represents a time in their life when they felt inadequate for not achieving something that was framed as being simple, when it was incredibly complex.

This leads me to say that the way to change the outlook of society on mathematics is not to attempt to frame it as something fun (which it certainly is) or as something simple (which it certainly isn't) but to have compassion when introducing it to people for the first time and to help them realize that in fact, they already are a mathematician, and we are only helping them uncover something that they already possess inside.

CARLYLE STEWART

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Mathematics: The Fabric of the Cosmos

Josef Oosthuizen & Emily Sacke Explore the Beauty and Relevance of Mathematics in Our World. From Simplicity to Complexity, Mathematics Shapes Our Lives and Minds.
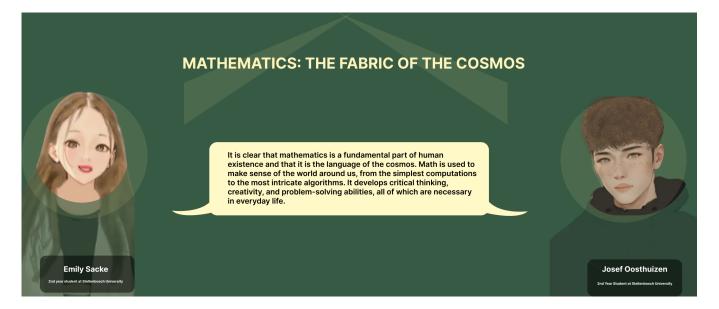

Illustration by Elham Ghaedi

Mathematics is in everything around us, woven into the very fabric of our society and daily lives. It affects us in a variety of ways that many might not even be aware of, from the simple calculations we perform when we make purchases at our local Spar to the sophisticated algorithms that drive our digital gadgets and financial systems. It enables us to move around the world more confidently and precisely, making defensible judgments and logically resolving issues. Without mathematics, we would be unable to make sense of the intricate systems and processes that define our world and would be trapped in a sea of ambiguity. Learning mathematics cultivates critical thinking, creativity, and problem-solving abilities, all of which are fundamental life skills. It encourages students to approach problems logically, reason abstractly, and communicate their ideas effectively. These skills enable students to think more creatively and critically, preparing them to handle the intricacies of the outside world.

We believe that everyone should appreciate the wonders of mathematics. If more people were aware of its beauty and importance, they would be more eager to learn about it. For millennia, mathematicians have been captivated by the concept of infinity, both in theory and practical applications. The infinite series used to determine pi and the Hilbert space with unlimited dimensions are just a couple of examples. The idea of infinity continues to inspire new mathematical discoveries and insights. Fractals are geometric shapes that exhibit self-similarity at different scales, this concept is another fascinating aspect of mathematics.They can be found in nature, such as in the branching patterns of trees and the forms of snowflakes, as well as in computer graphics and art. Mathematicians have been fascinated by the concept of prime numbers for ages. They are numbers that can only be divided by itself and one. One would think that the qualities of prime numbers aren't that interesting, but extensive studies about the distribution primes have proven otherwise. They have important applications in many fields such as cryptography and number theory.

Symmetry is a beautiful mathematical concept which can be applied in various ways, especially when applying geometry not only to equations, but also to art. The fact that mathematics is an integral part of how art is created and how our mind interprets and decides what is aesthetically pleasing is quite special. Chaos theory is a subfield of mathematics that studies the behaviour of nonlinear dynamical systems, including weather, the stock market, economics, meteor-

We believe that everyone should appreciate the wonder of mathematics. If more people were aware of its beauty and importance, they would be more eager to learn about it.

-Emily A Sacke
-Josef E Oosthuizen

Illustration by Liani Malherbe

ology and planetary motion. These applications have prompted the creation of new mathematical methods and tools for the purpose of predicting the future. An intriguing mathematical concept that is strongly related to chaos theory and fractal geometry is the Mandelbrot set. It is named after Benoit Mandelbrot, a French mathematician who initially discovered the set in the 1970s while researching on problems connected to complex numbers. The collection of complex integers known as the Mandelbrot set are those for which an iterative mathematical formula does not diverge to infinity. The Mandelbrot set's distinctive and complicated patterns are produced by this formula, which yields a collection of values that may be displayed on a two-dimensional plane. Both mathematicians and artists have been captivated by the set, and the beauty and intricacy of the set continue to spur new mathematical ideas and discoveries.

Game theory is another subfield of mathematics that examines how actors interact strategically in fields like economics, politics, and biology. Game theory enables and assists our understanding of market behavior, the development of social norms, and the dynamics of conflict and cooperation. Everything in the universe can be boiled down to basic mathematics. Mathematics is, after all, the language of the universe, and it is through mathematical principles that we can gain insights into the workings of the physical world around us. Another marvel is that mathematics is the "be all end all" of music. It enables the comprehension and control of the numerous sound waves that produce musical tones. The mathematical principles of frequency, pitch, and amplitude of these waves are all essential to the production of music. The link between mathematical ideas and musical tones has been extensively investigated in the scientific community, and research suggests that using these concepts can result in novel and creative methods to music composition. When we examine the physical laws that govern the behavior of objects and particles, we find that they all have the ability to be expressed mathematically. For instance, the Schrödinger equation provides a description of the wave functions that govern the motion of small particles. Similarly, the laws of thermodynamics are based on mathematical concepts like energy and entropy and can be expressed using equations that describe the behavior of systems in terms of energy transfer and transformation.

Mathematical methods can be used to analyze seemingly non-mathematical concepts such as emotions and psychology. Models have been used by researchers to better understand the dynamics of social networks and the spread of ideas and information. These models have also been used to study crowd behavior and the emergence of collective behavior in groups. Some aspects of the world may be difficult to simulate using mathematical techniques. Technology and our understanding of mathematical principles are constantly evolving and with that, we will hopefully find new ways to use mathematical language to describe and predict the complex behaviors of the universe.

Individuals can grow a deeper appreciation for the beauty and power of mathematics by investigating the previously mentioned and many other topics. Although many marvel at the beauty of mathematics, it can unfortunately be intimidating to certain people. This is a frequent occurrence due to a combination of internal and environmental factors. Women and minorities have historically been underrepresented in many scientific fields and have suffered systematic prejudices that prevent them from pursuing jobs in the area. Others may lack confidence in their abilities to think mathematically as a result of previous unpleasant experiences or a lack of support and encouragement.

Conventional teaching techniques frequently emphasize memorization and rote learning, which can be challenging and uninteresting. This method might be especially difficult for individuals who study differently or have learning impairments. For example, students with dyscalculia may struggle and believe they are unable to think numerically, not knowing that there are techniques that can help them. Many students also fail to recognize the relevance of mathematics in their lives and may not grasp how the principles they are learning apply to real-world situations.

We believe that everyone is capable of mathematical thinking. It is critical to emphasize that mathematical ability is not innate and can be developed through practice and hard work. We can help students develop a more positive attitude and improve their performance by fostering a growth mindset, which stresses the importance of effort and perseverance in learning. Mathematics is utilized in several practical ways, from

calculating a tip at a restaurant to managing personal finances and comprehending fractions and ratios for following cooking recipes. Individuals who grasp concepts like inflation, and compound growth may make more educated judgments about saving for retirement or investing in the stock market.

Mathematics can be made more accessible and enjoyable for all students by changing teaching approaches to better fit diverse learning styles. Instructors may help to create a more inclusive atmosphere by fostering collaboration and debate. In mathematics, there are, more often than not, numerous ways of coming to the same conclusion. Therefore, it is important to stress the diversity of mathematical approaches and viewpoints. Pupils who are having difficulty may benefit from focused assistance such as tutoring, peer mentorship, or more resources. We can help students overcome learning barriers and achieve success by providing support that is tailored to their specific needs.

In conclusion, it is clear that mathematics is a fundamental part of human existence and that it is the language of the cosmos. Math is used to make sense of the world around us, from the simplest computations to the most intricate algorithms. It develops critical thinking, creativity, and problem-solving abilities, all of which are necessary in everyday life. Despite the challenges faced by individuals in learning mathematics, we believe that everyone is capable of thinking mathematically. With the right support and tailored teaching approaches to different learning styles, mathematics can be made more accessible and enjoyable for all.

As technology continues to evolve and our understanding of mathematical principles broadens, we can only expect to find new or improved ways to use mathematical language to describe and predict the complex behaviors of the universe. The beauty and importance of mathematics cannot be underestimated, and everyone should get to experience and appreciate its wonders.

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EMILY ATHALIE SACKE

2nd year student at Stellenbosch University

Major Mathematical Advances in History

In this well-written piece, Hlumelo states some of the milestones of Mathematics namely use of a zero, Geometry, Algebra, Calculus, and Infinity. He gives good content as to why a character or the body of knowledge was added to Mathematics.

Illustration by Elham Ghaedi

Introduction

Mathematics has taken a great deal of time and effort from various different parties across large expanses of time to become what it is today. No one person can claim the development of maths by themselves and so too was there no one event that revolutionized maths in one fell swoop. Within this essay, there will be a brief recalling of the greatest advances in mathematics.

Zero

While the use of zero within mathematics is intuitive today, there was a time when the concept of zero didn't even exist. Before the modern-day im-

agining of zero, ancient Babylonians used empty spaces to indicate the early concept of zero. It was in ancient India (when) that the concept of zero was adopted and refined among Islamic mathematicians and then spread throughout the Middle East and eventually Europe. Today, zero is a fundamental part of mathematics with practical applications in every part of our lives.

Geometry

At least in my opinion, geometry has to be the prettiest mathematical branch to ever be made. That being said, its origin was actually very practical and not just for artistic expression. The Egyptians used Geometry to survey and build complex structures such as the pyramids (give some time frame as to when this happened). Euclid then later formalized the rules of geometry and its study in his work. His work was then later expanded on and that produced the field of trigonometry and so on. Geometry has been a fundamental part of mathematics since near the very beginning and that is still true today. From completing the square in ancient time to modern-day computer graphics, geometry shows its undoubtable utility for us all.

Algebra

Algebra is the part of mathematics that deals with symbols that represent quantities and the rules for manipulating those quantities. The earliest known use of algebra was among the ancient Babylonians who used it to solve their problems ,. Algebra has then been developed over time to help in many various fields such as engineering and physics. The development of algebra was necessitated by the unbelievable expansion of various fields that need an increasingly detailed level of understanding to maneuver and analyse. It is also an exciting field to study that many believe still holds secrets we are yet to find.

Calculus

Curb-stomping brains left right and center, you may think calculus was invented only to punish the young eager 19-year-old but that isn't the case. The desire to analyze curves in a rigorous manner had always pestered mathematicians all the way since the ancient Greeks. The field was finally properly instantiated by Isaac Newton
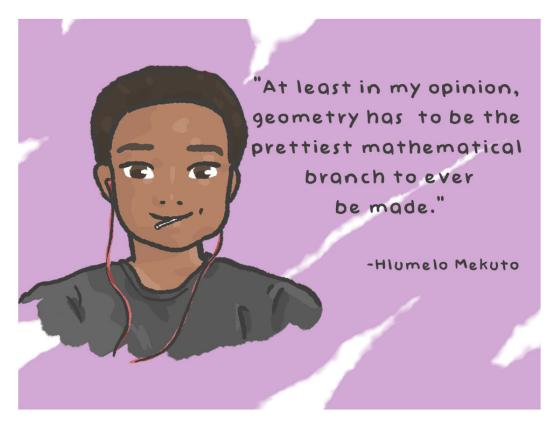
Illustration by Liani Malherbe

and Gottfried Wilhelm Leibniz in the seventeenth century. The development of this field allowed mathematicians all over the globe to understand, analyse and study the nature of curves in a far more comprehensive way than ever before and has played an integral (pun intended) role in advancement of modern-day technology.

Infinity

The concept of Infinity has fascinated humans since it was first conceived. The earliest attempts to formalize the concept were made with the intention of proving its physical impossibility. Initially, infinity was very heavily tied to subjective symbolism from various different cultures, with many believing the universe was infinite or that there were an infinite number of gods. As mathematics progressed, we got more and more insight into infinity. In the 19th century, Georg Cantor considered different sizes of infinities. By providing an explanation about physical phenomena such as black holes, the study of infinity continues to play a crucial role in mathematics and physics.

Conclusion

There are obviously way more leaps in mathematics worthy of recognition without a doubt however the ones documented above are some of the most impressive feats of intelligence and coalition the world has ever seen. The development of such complex concepts is proof of human ingenuity and dedication to improving our models of the world, while the relentless gathering of knowledge is a testament to the human desire for understanding and exploration. May we continue to read learn and decode the universe around us for years to come.

HLUMELO MEKUTO

Student (2nd Year), Computer Science, Stellenbosch, Wilgenhof

Mathematics for Everyone:
Why It Matters

Cole Brady Kisten emphasizes the significance of mathematical literacy in everyday life, advocating for its promotion through various strategies to ensure equal opportunities for all individuals in our data-driven world.

Illustration by Tristan Barnard

Mathematics is an essential subject that is crucial for our daily lives. From counting and measuring to making decisions based on data and understanding the world around us, mathematics plays a crucial role in various aspects of our lives. Therefore, it is crucial to celebrate the official International Day of Mathematics with this year's theme, "Mathematics for Everyone." In this article, we will discuss why mathematics is essential, how it can benefit everyone, and why we need to promote mathematical literacy.

Mathematics is a universal language that everyone can understand regardless of their cultural, linguistic, or geographic background. It is the foundation of science, technology, engineering, and other fields, providing a framework for understanding

and solving complex problems. Mathematics is necessary for everyday life; we use it for budgeting, saving money, cooking, and measuring ingredients. Understanding mathematical concepts like fractions, decimals, and percentages is essential for financial planning and budgeting. For example, if you want to save a certain amount of money each month, you need to know how to calculate percentages to determine how much you need to save. Similarly, when cooking, you need to measure ingredients accurately to ensure that your dish turns out well.

Mathematics is also important for career development; it is essential for many careers, including science, technology, engineering, and finance. In these fields, mathematical concepts like algebra, calculus, and statistics are necessary for problem-solving, data analysis, and research. For example, engineers use mathematics to design and develop products, while data scientists use mathematics to analyze and interpret data.

Mathematics helps us make informed decisions in today's world, where we are inundated with data. Mathematical literacy is crucial for understanding and interpreting data, whether it's for personal or professional purposes. By learning how to read and interpret graphs, charts, and tables, we can make better decisions based on data. Mathematics is essential for scientific and technological advancement.

It is the foundation of science and technology, providing a framework for understanding and solving complex problems. For example, mathematics is essential for the development of computer science and artificial intelligence. Without mathematics, we wouldn't have the technology that we have today. Despite the importance of mathematics, many people struggle with the subject, leading to a significant achievement gap in mathematics education. Many students, particularly those from disadvantaged backgrounds, struggle to understand mathematical concepts and perform poorly on standardized tests. Therefore, promoting mathematical literacy is essential to ensure that everyone has the opportunity to succeed. Here are some ways in which we can promote mathematical literacy:

Emphasize the relevance of mathematics:

Many students struggle with mathematics because

"By emphasizing the practical applications of mathematics and its relevance to various fields, we can motivate students to learn and excel in the subject."
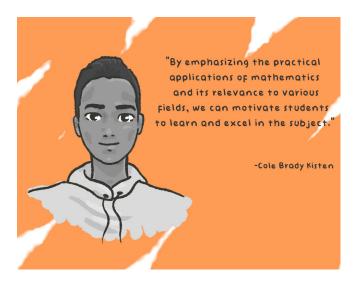
-Cole Brady Kisten

Illustration by Liani Malherbe

they do not see its relevance to their daily lives or future careers. By emphasizing the practical applications of mathematics and its relevance to various fields, we can motivate students to learn and excel in the subject.

Provide resources and support for struggling students:

Many students struggle with mathematics and need additional resources and support to succeed. By providing tutoring, extra practice materials, and other resources, we can help struggling students improve their mathematical skills.

Encourage student-centered learning:

Traditional mathematics education often relies on rote memorization and repetition, which can be ineffective for many students. By encouraging student-centered learning, where students are actively engaged in the learning process, we can help them develop a deeper understanding of mathematical concepts.

Integrate technology in mathematics education:

Technology can be a powerful tool for promoting mathematical literacy. By integrating technology into mathematics education, we can provide students with interactive and engaging learning experiences. For example, online resources and interactive software can help students visualize and explore mathematical concepts, making them more accessible and engaging.
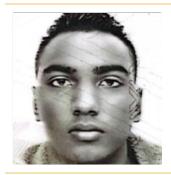
Promote diversity and inclusivity in mathematics education:

Mathematics education must be accessible to all students, regardless of their background or identity. To promote diversity and inclusivity in mathematics education, we must provide resources and support to students from underrepresented groups and actively work to reduce bias and stereotypes in our teaching practices.

Train and support mathematics educators:

Mathematics educators play a critical role in promoting mathematical literacy and need the training and support to effectively teach mathematics to diverse student populations. By providing professional development opportunities and resources for mathematics educators, we can ensure that they are equipped with the skills and knowledge to promote mathematical literacy among their students.

In conclusion, promoting mathematical literacy is essential for ensuring that everyone has the opportunity to succeed in our increasingly data-driven world. By emphasizing the relevance of mathematics, providing resources and support for struggling students, encouraging student-centered learning, integrating technology, promoting diversity and inclusivity, and training and supporting mathematics educators, we can work towards a future where mathematical literacy is a fundamental skill for all.

COLE BRADY KISTEN

Student: Stellenbosch University

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Mathematics, an aid to reason

Lian shares his academic and life experiences linked to mathematics and comments on both the abstract and numerical side of mathematics.
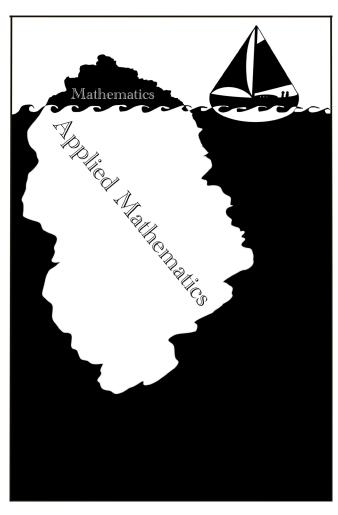

Illustration by Tristan Barnard

My experience

In primary school, concepts in Mathematics were quite simple, but intimidating. The start of algebra was difficult. What it was used for in the real world was not very clear. It was only till grade 11 that I had a decent idea of what algebraic equations could represent. These equations were mainly used to construct graphs. It was in Physics that we saw how these graphs can be used to represent acceleration, velocity, and displacement relative to time. Trigonometry was also used in physics to perform calculations with regard to forces (square boxes on slopes).

Primary school and high school mathematics were just the tip of the iceberg. University revealed the scope of mathematics. I found the numerical, conceptual, and abstract side of Mathematics. It was a test of a person's ability

to reason and conclude. Applied Mathematics showed us how to use mathematics to model the growth of fungi, the decay of a radioactive molecule, predator versus prey numbers, hydrodynamics, relative displacement/velocity/acceleration in a 3D space, etcetera. Hence the word 'applied' in the name 'Applied Mathematics'. Mathematics in general, focuses on the concept and abstract side of mathematics. This was something completely new. A structure for proof-writing and a way to logically conclude things based on starting assumptions was given. But with this new foundation on proof-writing and logical thinking, a professor pointed out a logical conclusion within our model that disproved my view of mathematics.

I always assumed that mathematics had no flaws or gaps. I worked in absolutes. In academics and in life in general. In Mathematics 278 we were working in the Natural Number System. We came upon the discussion of proving truth within the axioms and definitions we knew. We soon realized that it was impossible to prove truth, because to prove truth, we require the usage of truth in the proof. We cannot use what we have not constructed yet. Something I felt uncertain about was the concept of faith. The professor (the coordinator and lecturer for Mathematics 278) pointed out that we as students have faith in mathematics that its conclusions are robust, truthful and would bear fruit. The ideology of absolutes fell apart.

It led to some changes in my perception about mathematics and life in general. Within the methods of Abstract Mathematics, we receive tools to reason and conclude that can extend beyond mathematics. In mathematics, understanding the problem/topic is everything. If we do not understand the entire scope of the problem, then we cannot solve the problem with certainty.

Same statement can be made for our social lives. I have had difficulty in socializing and maintaining friendships due to self-doubt and not understanding or knowing a person's intention. My idea on how to maintain friendships was flawed. Admittingly it was thanks to very patient friends that I was able to extend my toolset on my social life that was less flawed (still learning).

I am still learning new uses of Mathematics. The beauty of it is its scope. From life lessons to numerical calculations in the developing and ever-expanding world.

Is it for everyone?

Interpreting Mathematics and applying it is a skill. Skills require us to sacrifice our time to learn them. I believe that everyone is capable of understanding and applying mathematics. The supporting reason to why people feel uncomfortable about it is its stereotypical difficulty. Yes, it is difficult, but not impossible. Resources, such as time, study material, experienced tutors who can articulate themselves properly, and the will to learn are required. I believe Mathematics to be a necessity. Especially the abstract side. This will teach people to think, reason, and conclude that is not limited to mathematics. It could help them in difficult times and help them make well-thought-out decisions that could prevent horrible mistakes.
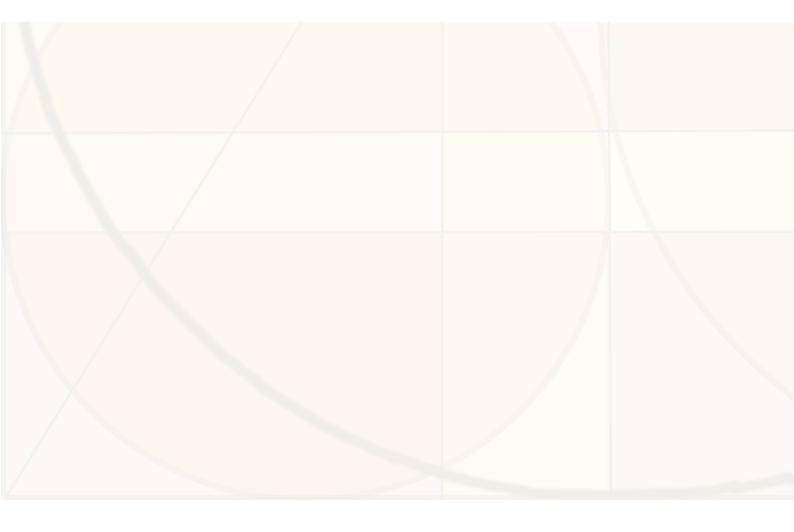
Should changes be made to the way it is taught?

I believe more focus on the application of the concepts of Mathematics would help us understand the concepts themselves. Studying the origins and construction of a concept is invaluable. The one field I think is completely lackluster in primary and high school is Abstract Mathematics. That ability to reason and solve a complex problem is a wonderful skill to learn because it can be applied to other subjects (Accounting, Physics, Chemistry, EGD, IT, Biology) in primary school and high school. It is a transferrable skill.

LIAN CUTLER

Year 3 BSc (Mathematical Science Student, Stellenbosch University

Mathematics is useful

Mathematics helps us think analytically and solve problems in everyday life, enhancing both reasoning and creativity, as illustrated by Jade Daniels.

How does maths help us in life?

Maths can help us think analytically.
Analytically means
That you are thinking critically,
Think critically about the choices you make
Sometimes it can help you,
For example, saving money
Then in the future you will not be left with situations
that are so crummy.
Maths can help you understand
And solve many problems in life.
It can help you with your career
And can help you to strive.
People can become more practical
With the help of maths,
It can even put you
On the correct career paths.
Learning maths is good for your brain.
Because it helps develop some parts of it.
It also improves your reasoning skills
Which is something very helpful and will not
have you running for the hills.

Who is mathematics for?

It is for everyone you see
We use it to help us in our everyday life
Even if we use some probability.
Even if we use some algebra,
Maybe some calculus or geometry,
Even some algorithms
Or maybe some set theory.

What is the probability you may ask?

It is how likely something may happen.
We could use it in games, investing even the forecast of weather
But to be honest, the use of probability was never a passion.
The passion was more for the use of algebra
If I can say.
It was always fun to calculate what was x or y
Even if I used a different way.
There are many ways we can solve problems in maths
But how would we do that in calculus?
I would leave that for you to find,
But just make sure that you do not wreck your mind.
Sometimes I would wreck my mind when it came to geometry,
I would say this deals with points, lines, angles and surfaces and much more
Did you know that there is so much depth to geometry.

Maths can help you understand
And solve many problems in life.
It can help you with your career
And can help you to strive.

– Jade Daniels

Illustration by Liani Malherbe

What do some people love to explore?

A step-by-step procedure to solve mathematical questions.
That is what algorithms are
So use algorithms if you want to be a singer, actress, or whatever
And you might actually become a star.

Did you know stars can also become sets?

This leads to the next topic, set theory
Which is a collection of objects called sets that contain elements.
So a collection of stars are sets which is a constellation that is an inspiration.
There is so much more to maths that I have not mentioned
Mathematics can be for everyone
Even for those who do not like it
So don't think that when you give up on it, you are just done.
Everyone can learn and understand mathematics,
Even if it is in their own way.
It can help develop creative thinking
By solving problems in more than one way.
Maths can have many ways
To go about finding an answer.
That is the type of work that can
Be very powerful brain enhancers.
Sometimes people may encounter some struggles in the education of maths.
It might be the class pace or teaching style that might be wrong
Or maybe not being confident that you can succeed in maths,
But once you realize you can actually understand maths, you will realize it was easy all along.
One way to get through the struggle of maths,
Is to practice maths questions.
Practice some on a daily basis
And it will have you loving and solving equations ever so gracious.
Maths can also help people learn about failure.
It is just something all of us have to get through and learn about at some point.
Failure is not an easy concept to handle for some people.
We can learn from our mistakes with the use of maths and change our viewpoint.
So if there is a maths question,
Try and understand it from a different point of view.
Learn from the mistakes with maths
And how fun it can be too.
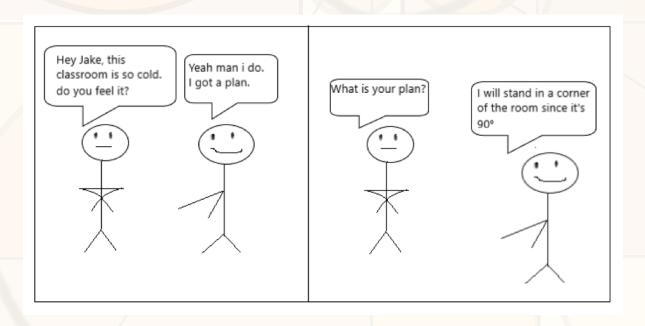Maths is everywhere around us.

What is the distance from point A to B?

How we prepare food,
And how many times our food should be chewed?
Even shopping includes maths
And how to save money when shopping is done.
At the end of the day, you get what you need
And it is fun.
Maths helps with decision-making
As well as communication.
But although it helps us,
It can also be frustrating.
Frustrating by not knowing where
To start or end with an equation.
But once we know how to solve it
It can become an inspiration.
Leading us to want to solve mathematical equations
And wanting to go deeper into maths.
Wanting to explore all the unknowns of it
And maybe it will take you to be first in the class.

JADE DANIELS

BSc Biomedical Mathematical Science, Stellenbosch University

YOGA

TOPIC 6

HOW CAN WE MAKE MATH FOR EVERYONE

Mathematics for everyone:
Insights from Socratic teaching

Lian shares his academic and life experiences linked to mathematics and comments on both the abstract and numerical side of mathematics.
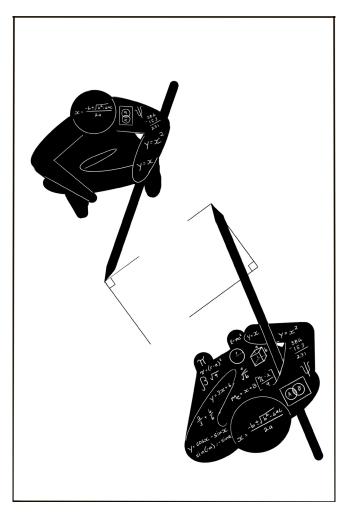

Illustration by Tristan Barnard

In Plato's dialogues, he recounts a conversation between Meno and Socrates (Cooper, 1997). In this specific dialogue, Socrates is discussing virtue with his fellow interlocutor, Meno, and whether it can be taught.

Socrates interrogates Meno, forcing him to provide definitions and clarification. Meno fails to satisfy Socrates, so they decide to tackle the problem together.

But Meno is hesitant. He realises that they cannot discover what they do not know since they would not be able to verify if they truly know. It at this point when Socrates suggests to Meno that learning is process of recollection; that all

the knowledge a person learns is merely remembering what they already know. A ridiculous but compelling idea.

To illustrate this, Socrates makes one of Meno's servants demonstrate and explain a geometry proof, knowing that the slave, a boy, has no mathematical education. To further illustrate his theory of learning, Socrates tells Meno that he will not "teach" the boy but rather ask him questions and from that, the boy will prove a known fact about a square and its double.

He goes on to question the boy and takes notes in the sand. At first the boy seems to demonstrate an adequate mathematical understanding but as soon as Socrates asks the boy to apply his understanding, the boy can only utter incorrect answers. Socrates, undeterred by this, alters his line of questioning and not long after that, the boy gains a simple understanding of squares and successfully proves a geometric theorem.

This story serves to illustrate a fundamental truth: that mathematics is a sense, an instinct that can be refined just like a sense of rhythm. In this short story, the process of mathematical education is clearly demonstrated. The student has an intuition about the world or makes an observation and thereafter decides to investigate.

Through reason, the student arrives at a conclusion and has subsequently learnt more about the world. Obviously, the guidance of an astute teacher plays a significant role in the process. We can see from Socrates example that a high quality education, especially a mathematical one, is where that student is an active participant. It is the teacher's responsibility to instil the natural curiosity that burns within each learner by guiding them towards asking the right questions and refining their natural curiosity.

It is also important to note that the boy fails at first. But this is also part of the mathematical learning process. Refinement only comes through correction and there is no doubt that the slave boy left that scene having a slightly stronger instinct for mathematics. He did not become a mathematician but became more mathematical in his thinking. Anyone can endeavour to refine their mathematical sense. Its starts by training their natural ability to observe, to question and

to abstract. Mathematics is the endeavour to understand reality through abstract concepts and logic. It involves the discovery of properties of abstract concepts and the use of reason to prove these properties.

Mathematics furthers our instinctive ability to abstract by formalizing it. It allows us to communicate our abstraction to others and record them in a concrete and meaningful manner. The socialization of abstractions allows for greater and more complex understanding of the concepts an individual can develop. Concepts can be reviewed, revised, or added to. Thus, given the right teacher and learning environment mathematics is for everyone.
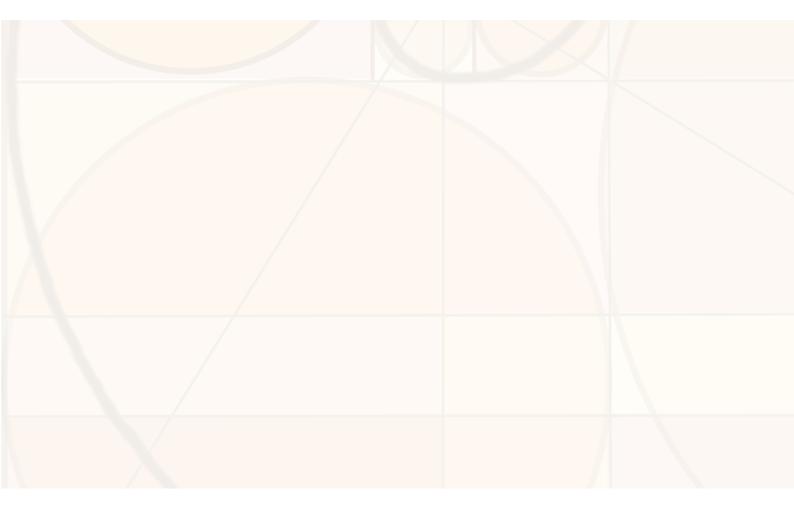
LRD ENGEL & CT THERON

BSc Mathematical Sciences Student's

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Mathematics: An Inclusive Language of the Universe for Everyone

Through real-world examples and personal experience, Ms Ezeakum argues that, with practice and dedication, anyone can harness the universal language of mathematics.
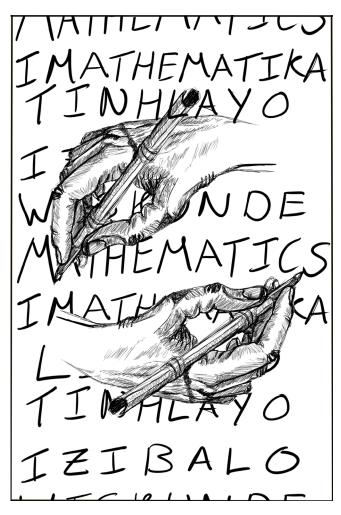

Illustration by Tristan Barnard

Mathematics is a term we hear often when someone is referring to complexities involving numbers and calculations to solve an equation or equate variables and/or constants. This is true, but mathematics is broader and more useful than the parameters and context we often hear it in. It is embedded in any and everything that we do, in all aspects of life, and is used by everyone, knowingly and unknowingly. The omni-presence of mathematics further reinforces the idea that mathematics is for everyone. According to the Oxford English Dictionary, mathematics is the abstract science of number, quantity, and space, either as abstract concepts (pure mathematics), or as applied to other disciplines such as physics and engineering (applied mathematics). According to the theme of the 2023 International Day of Mathematics, everyone has mathematical ability. In this text, we will discuss the validity of the statement that mathematics is for everyone.

Let us look at how mathematics can be applied in a non-academic and everyday aspect. Take for instance deciding what route to take when travelling a long distance; you would probably prefer to take the shortest route that will get them to the destination quicker to save time and save petrol, which in turn saves money on the total petrol cost. This is a use of mathematics by calculating for optimization, which is a skill that can be learnt.

Another more common example is tracking how many steps you take in a day, using a phone or smartwatch as a device of measurement, which is also an application of mathematics. You can also use mathematics by estimating how much mass you can carry for a certain amount of time until you start to get tired; for instance, carrying a 5-liter bottle of water will result in weariness for different people of different masses over a certain distance, and your limits can be figured out either by trial and error or by estimation and analysis. This is another involuntary, yet non-academic use of mathematics that anyone can assess, further proving that mathematics indeed is for everyone. Other examples include:

- Money management, in terms of how much one would need to save to get through the month;
- Probability in terms of estimating how badly it will rain by observing the weather and making a decision on what clothes to wear or if they should stay in or go out;
- Estimating how much space is needed to fit something into the boot of a car; and
- Counting in general. Further applications include activities as simple as preparing food (deciding what temperature the oven should be on and the meal prep time), understanding sports, and simply telling time.
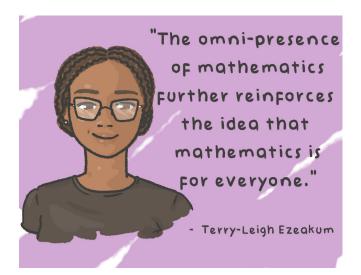
Illustration by Liani Malherbe

Recent scientific studies show that everyone is born with the innate mathematical ability to perform at least basic mathematical calculations. With a good foundation in the fundamentals of mathematics, it is possible, with a great amount of practice and dedication, for anyone to be able to understand the complex and professional use of mathematics as well as in academic fields.

Mathematics builds on itself, and with constant use of it in everyday life, one can get better at it and not worse. Mathematics itself is seen in many different ways by people as people use it for many different things in various ways. At the end of the day, 1 + 1 will equal 2 for everyone across the globe no matter what anyone says and this is what mathematics is all about; it is for you and it will always be even if you are not a professional mathematician.

Mathematics is the language of the universe, and as with any other language, everyone has the capacity to learn it. It provides an effective way of building mental discipline and encourages logical reasoning and mental rigor; in addition, mathematical knowledge plays a crucial role in understanding the contents of other school subjects such as science, social studies and even music and art. An anecdotal experience is that I was not very good at mathematics in primary and high school because I lacked the basic foundations that I needed to understand it properly. This left me feeling that it might not be for me, even though I knew I loved it.

My love for mathematics encouraged me to practice every day, and build this foundation in order to be good at what I love, and through hard work and dedication I came out with outstanding results and am now a mathematics major in a top university (Stellenbosch University). This is to show you that anyone can be proficient in mathematics, as it is all around us and in constant use in all aspects of life. You just need to practice for proficiency because practice makes perfect! Mathematics should be for everyone because, even though the involuntary basics are important, in the ever-so-changing technological world we live in, it is becoming even more crucial to be mathematically inclined. Complex mathematics as we view it today will form the basics of what needs to be known in the near future, and you do not want to miss out. Performing complex calculations will become as necessary as knowing how to read. This in turn would mean people who view mathematics as "only for geniuses" or "too difficult for them" should start to approach it in a more intrepid and tenacious way.

Mathematics is the past, present and the future, and will always be relevant, so it is better to believe and accept that it is for you, rather than not and be left out of the loop. This text has proven that everyone uses mathematics in one way or the other, academically and non-academically, professionally and colloquially, and generally every day. A better form of teaching mathematics should be introduced in the future so that it is more inclusive to diverse group, and to destigmatize that mathematics is only for certain individuals. This will ensure and reinforce that it is indeed for everyone.
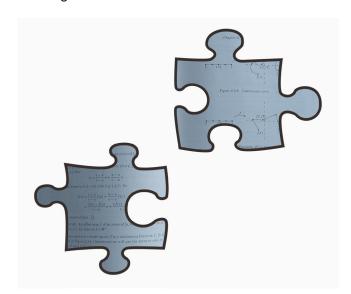

TERRY-LEIGH EZEAKUM

Student. Mathematical Sciences (Focal area: Applied Mathematics)

Reframing Perceptions of Mathematics to Build a Mathematically Literate Society

Kerry and Emily make a persuasive argument that we should learn Mathematics with understanding on how it is applied to our daily lives. They made a compelling augment that most schools present Mathematics as a difficult subject. They further argue that the emphasis of most school curriculum is grades and not pragmatic understanding of Mathematics.

Illustrations by Nino Mekanarishvili

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The article is a well-knitted compelling read and with a call for action conclusion for more discussion on in-depth learning and more understanding of Mathematics

I think Mathematics is misunderstood by most people. It is not some big revelation that many people don't quite 'get' fractions or concepts of trigonometry; articles upon articles are written about the poor performances of school students in standardised mathematics tests, and while that is concerning in its own right, perhaps the bigger loss to society is not in the misunderstanding of mathematics syllabi, but actually in the misunderstanding of mathematics as a science.

Mathematics is a logical framework that triggers critical thinking, abstract thinking, and creative thinking, and that fosters effective communication. The public image of mathematics paints it out to be some exclusive practice for the gifted, that is done to display intellectual prowess, or to solve some problem that appears in the work of only maybe an engineer or a physicist. Mathematics is not arithmetic. Studying mathematics is not redundant in your life just because you have access to a calculator, and search engines. To reiterate: The importance of studying mathematics does not lie in the ability to restate theorems and 'do sums', just as how the importance of studying a language does not lie in the ability to apply grammar rules and identify parts of speech, but say perhaps rather in the interpretive, analytical thinking, and communicative skills that a school student may learn when studying a piece of literature.

Mathematical skills have applications in everyday life. For example, logic is a fundamental aspect of mathematics; mathematical proofs begin with an assumption and end with a conclusion that is reached through logical reasoning. Common sense is just real-life logic! Most decision-making involves the process of predicting which decision shall have the outcome that is most favourable to your needs. In other words, you are predicting the outcomes of decisions through logical deduction.

To provide a simple example: If you see that the weather forecast predicts that it is going to rain (you are treating the occurrence of rain as your assumption), then by that assumption you further predict that you will get wet when walking outside, (because you have a 'rule' or an 'axiom' in our natural world that says that walking in the rain makes you wet) and so you decide to bring an umbrella with you today (because you also know that an umbrella will protect you from getting wet). In making the simple decision to carry an umbrella with you when rain has been predicted, you have unknowingly applied multiple mathematical concepts such as an implication (rainy weather implies getting wet if you walk in the rain), and a proof by axioms, achieved using logical deduction.

What would life be without logic? It would be pure chaos! People would constantly be doing things without any common sense. Problem solving is a fundamental skill of mathematics and is very

useful in everyday life. Unfortunately, it is a rather underdeveloped skill. Schools heavily focus on teaching pattern recognition of problems rather than how to actually solve problems in general. Often the reasoning behind the solution is disregarded.

Perhaps if there was a higher focus on developing problem-solving skills in mathematics class at school, we would all benefit from it. Sometimes people who achieved distinctions in mathematics at school fail their introductory mathematics courses at university because the skills are quite different. At university it's impossible to just memorise what to do when you see something of a specific form, but the skill of how one can use their knowledge to find the answer and make a logical conclusion.

A better understanding of logic and improved problem-solving skills will help one better manage their time and money, a very helpful skill in life. Mathematics is visible all throughout our lives, and although a person does not need to take a maths lesson to know to bring an umbrella out in the rain with them; the development of mathematical skills will allow them to tackle more difficult life problems tactically and effectively.

For example, a person who is more mathematically literate, would be less susceptible to falling for seemingly cheap payment plans that amount to far more than an items retail value, or they could better explain their reasoning for making a decision to someone else, as they'd have an enhanced ability to follow logical process in each step of coming to a conclusion. Problem-solving skills are so sought-after and useful, and so it would make sense to take full advantage of the potential that mathematical teaching has to develop such skills among other important skills that are developed through mathematics such as creative thinking and effective communication? Unfortunately, the public persona that mathematics currently has does not associate it with

Illustration by Liani Malherbe

universally relevant and accessible skills beyond maybe basic arithmetic skills which are felt by many to be more and more redundant as basic technology becomes so widely accessible.

You cannot blame people for not seeing the relevance of learning mathematics to their lives, because mathematics is consistently misrepresented in school classrooms and in media. By portraying mathematics as an inescapably difficult subject that only a small minority could possibly enjoy, apply, and succeed in studying, a psychological block is placed on students who consequentially struggle to believe that they could ever understand mathematics. Film characters who take an interest in mathematics are portrayed as 'nerdy', and abnormal. When school students aren't part of the top performers in their school mathematics class, then they conclude that they are not one of these 'nerds', and thus they are not suited to do mathematics. When do we ever see stories about students who are passionate about mathematics, but not necessarily 'good at it'? In reality: studying mathematics is not a binary: You aren't either great at it or awful at it, and you do not have to explore high-level concepts to gain most of the skills that mathematics can give you. Sure, maybe the 'nerd' will go on to be an actuarial scientist or a mathematician, whose career is centered in mathematics, but the everyday student will still be living a life surrounded by mathematics, as has been described previously. School students would be more inclined to consider the importance of mathematics in their lives if they could see that there is actually a place for them in mathematics regardless of their perceived academic abilities.

Schools teach content for students to acquire academic results and ultimately qualifications, not to acquire skills. School students are not exposed to enough real-world examples of the concepts that they study, and so the importance of studying mathematics in their lives appears to be just a means of obtaining grades and achieving qualifications. Grades can be incredibly misrepresentative of a student's mathematical abilities and understanding. The use of grades as a measure of a student's mathematical understanding leaves students thinking that just as how good grades imply good mathematical understanding, so too does a good mathematical understanding imply that you achieve good grades, or else your understanding is inherently poor (may the irony of the incorrectly evaluated implication stand as a case study). Grades holding the highest position of importance means that understanding the content is often not attempted if decent grades can be achieved without having to understand the work. For example, students try to recognize and reiterate patterns in the solutions to problems rather than obtaining the solution to the problem by solving it themselves. The students will obtain the marks because of their correct solutions, despite having no understanding of how that solution was reached. In addition

to not encouraging proper understanding, the heavy emphasis on grades can also misrepresent the capacity of a student's mathematical understanding, as perceived by the student. If you are going to equate a grade with a student's understanding of mathematics, then students are going to consider the maximum grade that they can achieve in mathematics to be representative of their learning-capacity, and in turn, the maximum level of 'value' that mathematics can provide to their lives.

Mathematics is an existing subject in school systems that, can be used as a vessel to develop important skills in society. Until schools prioritize understanding over grades, school students will continue to neglect the importance of understanding in learning mathemat-

ics. Until school students are cleansed of the belief that they cannot pursue, enjoy, or benefit from studying mathematics unless they are the top performers in their class, then most school students will feel that mathematics is not worth their while.

Mathematics is relevant in the lives of everyone – Not just people whose occupations have them writing down calculations on a daily basis. We believe encouraging more discussion surrounding the appearance and relevance of mathematical concepts in real life will also assist in building up students's investment in pursuing and understanding the subject. It is possible to create a mathematically literate society that thinks more critically and creatively and communicates more effectively.
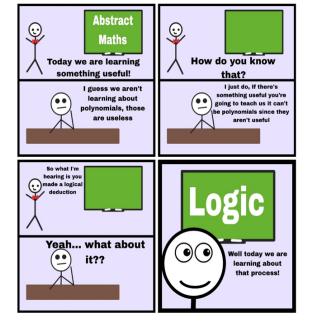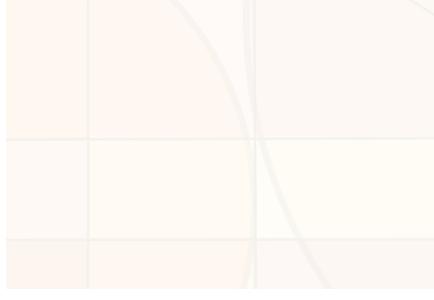

KERRY PORRILL

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EMILY ATHALIE SACKE

BSc Mathematical Sciences (Focal Area: Mathematics), 2nd year

Dual Nature of Mathematics: A Challenging Journey and an Everyday Necessity

Stefke Tolmay sees the benefits that additional help at primary school gave them in their mathematical journey leading them to a deep appreciation of maths in and out of the classroom.

Illustration by Tristan Barnard

Sometimes mathematics is non-welcoming

At an early age I was introduced to mathematics. When I was about five years old my dad used to set up worksheets with basic mathematics operations like multiplying, dividing, addition and subtraction. He wanted to give me a head start before starting primary school.

He learned from what my sister struggled with. Primary school mathematics was of a high standard, making it easier to transition to high school. At the age of twelve some learners' parents could no longer help them with their home-work because of the way it was taught. Some learners fell behind at an early age because they did not have the additional help required to master it or simply because the way it was taught was not in a way which suited them best.

Coming out of a school with a good foundation of mathematics required at the age, the first two years of high school was a walk in the park. Students from other primary schools had a harder time transitioning to high school mathematics. Because mathematics was such a feared subject, many students enrolled in extra classes.

Some students did not have this luxury and needed to find a way to master it themselves or if not in most cases got left behind. The tests were set up in such a way which made it difficult for some students to pass. They were set up in such a way to keep the "stronger" students in the class and let those who were struggling move to mathematical literacy with the focus on getting the best possible results for the matric final exam.

It left some students feeling that they would never be able to do mathematics. If it was not for all the help I received, I too would have felt that mathematics was not for me and is non-welcoming. Most young people stop with something when it gets hard and without the correct support structure most will fail in a school system. When the school system is actually failing them by only following one way of teaching and assessing the students.

Everyone needs mathematics in their life

Even though the class group split into two different types of mathematics, both learned valuable skills that can still be used in their everyday lives. Everyone has a different understanding of what mathematics means to them. Mathematics is in our everyday life without us realizing it.

For myself it not only includes my studies at university but also in everyday life. Some simple examples are working out a budget when sharing a ride to university or just working out a monthly budget planner. Something valuable

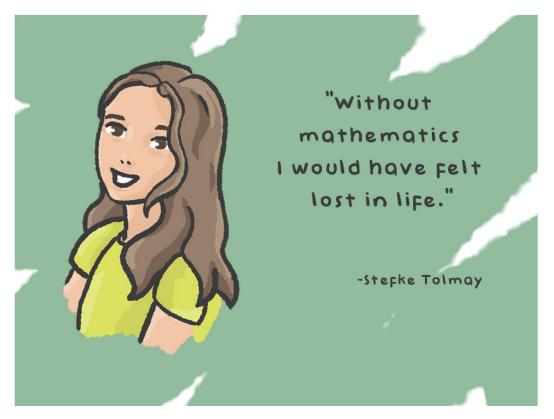"Without mathematics I would have felt lost in life."

-Stefke Tolmay

Illustration by Liani Malherbe

I learned from Pythagoras is how to choose the shortest route between my different classes during the day. You do not have to be a genius to do mathematics, but you need time, practice and resources that can lead you on the correct path. For some students, mathematics is a walk in the park and for others it takes a bit longer, or a different way of teaching is required.

Mathematics taught me the self-discipline to put in extra work to enable me to succeed in my everyday life. Mathematics also gave me the opportunity to develop problem solving skills which most modules in school did not teach. Without mathematics I would have felt lost in life. It gives me such pleasure when solving difficult problems or discovering new topics.

STEFKE TOLMAY

2nd Year BSc Computer Science student, Stellenbosch University

Empowering Minds: Making Mathematics Accessible and Enjoyable for All

Explore the beauty of mathematics with 'Mathematics for Everyone,' Montana unveils the joy and accessibility of numbers as a foundational element of life.

Illustration by Elham Ghaedi

The article is informative and addresses a unique perspective by framing mathematics as an enjoyable and essential life skill.

The mathematical subject has been a daunting mountain that children have feared climbing for centuries. Its symbolic language has always been considered 'too tough' or difficult for any 'normal' young student to understand, merely mumbled numbers and lines of gibberish equations. But it is not just that to every soul, because to some, mathematics is written poetry of extraordinary shapes, structures, and patterns.

To master the subject is to be crowned a master of critical thinking, problem-solving, and logical reasoning. The skill is helpful in enabling not only young children but also adults to explore and uncover new ideas or concepts, leaving one searching for the right solution. However, quality education remains inaccessible for those limited by the cruelty of poverty, lack of facilities, inadequate resources, etc.

By investing in the interest of accessible education is to enable children's rights to quality teachers and facilities. These primary needs are often considered the responsibility of the local government but could also include the help of private education institutions or individuals who can work together to make mathematical education more accessible. And yet, the availability of technology and the internet has enabled those curious souls. Everyone can access online resources specifically designed and tailored to their strengths and weaknesses, aiming to improve at their own pace and understanding level. Children are more capable at learning when it is at their own pace and terms, free from the pressure of expectations. Even with this safety, the internet does not bear the responsibility of maintaining the learner's interest in the mathematics subject.

Studying should never be advertised or considered as a chore, it should be made out to be an enjoyable process and experience which stimulates the mind, encourages curiosity, and matures unique thinking. When it is made out to be a chore, it hinders students' engagement with their teachers or the material, increasing their frustration as they fall behind, which can lead to a pattern of failure.

If the material is found to be enjoyable, then the audience is more likely to pay attention in class and more willing to ask or answer questions without shame. When you can teach a love for math, you'll find your students pursuing such related hobbies, catch them reading articles about math, or discuss their goals of studying and going into a STEM related career path, such as astronomy or architecture. With math teachers encourage support and the creation of a

"When you can teach
a love for math,
you'll find your students
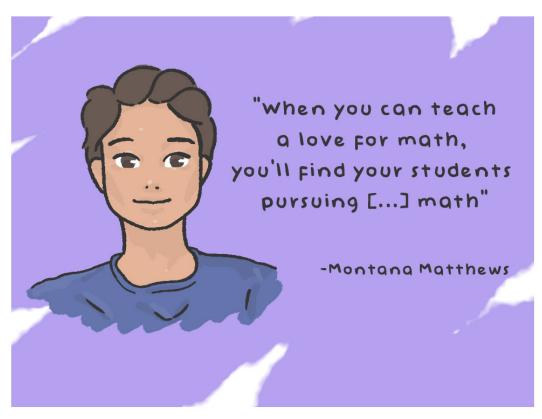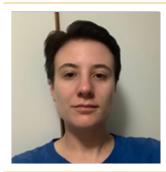pursuing [...] math"

-Montana Matthews

Illustration by Liani Malherbe

non-judgmental learning environment that brings a sense of safety to their students. They can create curiosity and eagerness to learn by providing mathematical skill-advancing board games, puzzles, or friendly class competitions. For example, instead of droning on about the theory of probability and percentiles, rather start a friendly gamble with a game of 'What are the odds,' a version of truth or dare.

This outlook is what makes Pi Day such an ideal model for math appreciation; Pi Day is a day off from usual routine school work, where kids bring along round-shaped foods to school to examine and discuss fractions, area and volume, all while enjoying their special snack. Children should be afforded this playful freedom to practice their skills, as these are, in fact, essential daily life skill. Humans use math all the time, from Children to Elders, from cooking or calculating the right angle to approach a parking spot, to playing an online quiz to get you and your significant others percentage compatibility or sharing a snack into two completely even halves.

"Mathematics for everyone" is not just a slogan, it is a subject equally interesting and foundational to life as we know it. Math is not just there for scientific and technological advancements; therefore, everyone should have an equal opportunity to study it, regardless of social, economic, or cultural background.

MONTANA MATTHEWS

Bsc Mathematics (3rd Year), Stellenbosch University

Unlocking Mathematical Potential: The Path for All

CJ Wessels explores the accessibility of mathematics, challenging the notion that it's reserved for the intellectually elite. Through insightful comparisons and motivational reflections, Wessels demonstrates how dedication and perseverance can empower individuals from all backgrounds to excel in mathematics
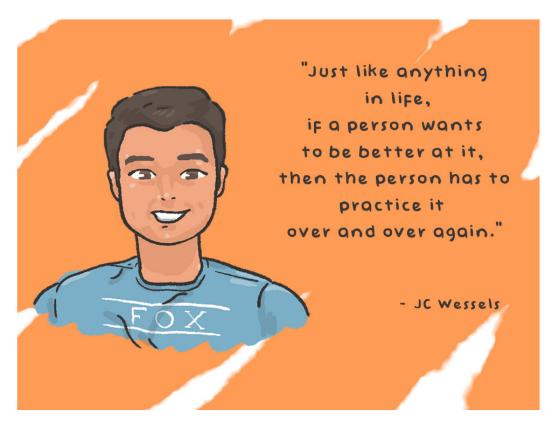

"Just like anything in life, if a person wants to be better at it, then the person has to practice it over and over again."

- JC Wessels

Illustration by Liani Malherbe

Is mathematics for everyone? Some say yes, some say no, and some say it is only for the genius or the "very clever people." Nevertheless, what does it mean to be clever? People say doctors are clever, but a doctor cannot do the job of a mechanic, yet a mechanic is perceived as "not as smart as a doctor," and a mechanic cannot do the job of a doctor, but that does not mean one is cleverer than the other. Different people are drawn to different things; some people respond to different stimuli better than others, but that does not mean one is more intelligent or better than the other. It may only mean some have to work harder than others. So, is mathematics for everyone? Let us read on for the explanation. Let us look at two athletes; one is a swimmer, and the other is a bodybuilder. A swimmer and a bodybuilder are built very differently; they seem to have a different genetic code; one is a more petite build than the other, and one is more aerodynamic than the other, but that does not mean they are eliminated from participating in each oth-

er's sports. A swimmer can still lift a weight, and a bodybuilder can still swim. However, a swimmer will always beat a bodybuilder in the water because of the swimmer's experience, build, and talent. Nevertheless, a dedicated and committed bodybuilder can eventually be like or even beat the swimmer in the water if we compare this to children in school who have their first exposure to arithmetic mathematics. Some children have a better build for mathematics due to their genetic code, but some children will have a better build for sports or any other activity the school can offer. Some children have a better natural ability to respond to the stimuli of mathematics, and they grasp mathematical concepts faster and at a higher level. Some people are more "built" for mathematics, but talent can only take you so far. Just like anything in life, if a person wants to be better at it, then the person has to practice it over and over again. During practice, mistakes are eliminated, and form is perfected; ultimately, the person will improve in that area. For

example, swimmers must practice diving to perfect their form and eliminate what is holding them back. With mathematics, the same principle applies. To perfect the method of addition, we have to practice examples where addition is required; this eliminates the chances for error, perfects our methods, and builds our foundation of addition. The previous statement furthers the opinion that mathematics is not limited to any group of people; it can be learned and practiced by anyone regardless of age, gender, race, or background. Like any sport, there are specific equipment and resources that can further our development, and the same goes for mathematics. There are hundreds, thousands of resources on the internet that enable us to practice questions plus, in school, we have teachers in school and professors in university who are willing to help us, but we have to be the ones who ask. If we maximize our resources, we develop proficiency and gain a deeper appreciation of mathematics.

If we look at daily activities, from managing finances (arithmetic calculations) to making food with a recipe (measuring the ingredients), we can relate it to mathematics. Mathematics is a fundamental tool for understanding and making sense of the world. With university courses like Physics (arithmetic operations), Economics (calculations), Engineering (arithmetic operations), and even English (counting the number of words in an essay), there is an element of mathematics. Some courses require a higher degree of understanding of mathematics, but everything relates to mathematics one way or the other.

There is sufficient reasoning as to why mathematics is for everyone, but why do some people struggle with it, and why does it feel that "mathematics is not for me?" One thing to remember is that people respond to stimuli differently, primarily due to their genetic code. However, other factors, such as mentality towards stimuli, can determine how well a person responds to them. Some people have a "natural gift" for mathematics, enabling them to pick and understand topics quicker and to a higher understanding than others. If these people mix their mathematics talent with a hard-working work ethic, they far surpass the average person doing mathematics. However, this does not mean that a person who works hard but does not have talent cannot succeed in mathematics. We can debate that someone who works hard will always beat someone who has talent. Unless a person works hard, their talent is well-spent, the top athletes in the world, the top physicists, and the top business people work hard to succeed in the area that they are in. Regardless of their talent in their work, these men and women worked hard to push their limits and break through what they thought was not possible.

People find mathematics is not for them because of many factors. Some people did not get the necessary support both in a verbal sense and a physical sense. Sometimes if the person struggles with mathematical concepts, then the person can start to feel demotivated to continue onward with trying to understand the concept. However, a big part of this is the person's childhood. Did their parents push them to achieve high grades in school? The child will then start to build a mindset of "I do not want to do well, I cannot accept having average grades." There are a lot of different factors, but ultimately, the top factor is that it is ultimately a choice. It is a choice to work hard to grasp concepts eventually, and it is a choice if a person wants to be average or not, it is a choice to have a positive or negative mindset. When performing anything in life, a person must ask themself, "how far am I willing to go?" Furthermore, "how much am I willing to sacrifice?".

In conclusion, we all have unique mathematical abilities, but we limit our abilities. Hard work and dedication will push a person further than what they initially limited themselves to. People need to renew their minds and attitudes toward things they are struggling with. Sometimes we may not understand mathematical concepts, but that does not mean we cannot do the math. When we struggle with something in mathematics, that is an area we can grow. We have to start being more confident in our abilities but not be arrogant to the point that we are not willing to accept our mistakes but rather have confidence in our abilities and stay humble when we make mistakes to position ourselves to grow.

The greatest achievers had confidence in their ability, the greatest athletes, the greatest business people, the greatest scientist, and the greatest mathematician, never thinking they were better than anyone else but staying humble with their mistakes.

CJ WESSELS

Making Mathematics More Accessible

Athini Mafu argues that the misperception and the negative view of mathematics stems from the way it is taught. He contends that the art of Mathematical reasoning and how various topics within mathematics relate to each other should be introduced at school level.
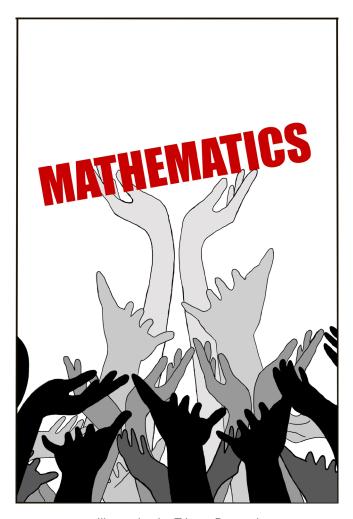

Illustration by Tristan Barnard

To properly give an answer to the question of "how to make Mathematics more accessible" I will discuss my brief journey with mathematics and how it has been presented to me at different stages in my education. This will give a better context as to why I believe my answer would make Mathematics more accessible to people.

My earliest memories of Mathematics was in the first grade when we were first introduced to addition, subtraction, multiplication and division. I remember this as being satisfying. Being able to take the difference of two numbers then add it to the smaller number and get the larger again! Looking back, I think that this made

mathematics look very concrete and I liked how everything fit together like puzzle pieces. This was my general experience with mathematics in primary school. Most math concepts made sense in this way.

By grade five, I started participating in Math olympiads. This opened up my view on what Mathematics was. I would always struggle in the later rounds as I would regularly not even be able to understand the questions. This paradoxically made me enjoy mathematics more as I wanted to know why I couldn't understand how to approach those questions, let alone solve them.

I thought the more I did high school mathematics, the closer I would get to finding an answer, but unfortunately, I didn't. I would only understand why I couldn't years later when I took the course on the foundations of Abstract Mathematics. High school Mathematics was enjoyable, yet it seemed a little surface-level. No matter the section or the topic, I would always wonder how these formulae and laws had been derived.

I would think of Euclid and Pythagoras and be in awe of how they could discover such fundamental truths. At this point, Mathematics had a veil of mystery that I was unable to lift. The mathematics we learned in school was fun but shallow and I felt more like recognizing patterns and applying a memorized formula instead of actually doing mathematics.

I felt like the real good stuff was behind this veil which I was not 'worthy' to lift and I felt reminded of that every time I would encounter an olympiad question that I didn't even know how to approach let alone understand.

Foundations of Abstract Mathematics changed a lot of how I thought in general. It taught me the process of mathematical reasoning. This was at first very painful but became fun and exciting as we learned more. I felt so empowered. Looking back, I think that's the problem as to why mathematics is not more accessible.

Most people are taught mathematics from an early age but very few ever get taught the art/science of mathematical reasoning. This seems

to me very odd and the main reason why mathematics is so misunderstood. People are given the problem without being properly equipped with the mental tools to be able to solve the problem. I feel that I struggled with Olympiad questions because I was never taught the process of mathematical reasoning. I think that as soon as we first introduce mathematics to children, we should also introduce mathematical reasoning to them.

How to think about a problem, how to ask the right questions to better understand the problem, how is problem A related to problem B at a fundamental level, and so on. This way I believe people will not only better understand mathematics, but will come to truly appreciate its beauty and the expanse.

"-the main reason why mathematics is so misunderstood: People are given the problem without being properly equipped with the mental tools to be able to solve the problem."

-Athini Mafu
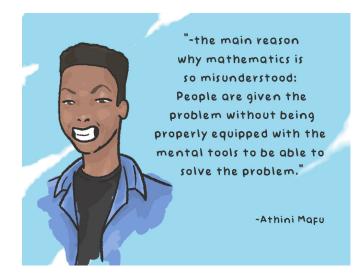
Illustration by Liani Malherbe

ATHINI MAFU

Bsc Mathematical Computer Sciences, Stellenbosch University

Maths is for Everyone. Most People Just Don't know It Yet

Andrew's personal story demonstrates how a creative teacher can motivate student learning in maths. Maths can be fun. All we need is someone to show us that maths is not for the few "gifted" ones, maths is for everyone.

Illustration by Elham Ghaedi

Anybody can do well in math if they have a teacher to make it fun.

In April of 2019 I started working as a teaching assistant to help teach kids maths at an independent secondary school in the Western Cape. Originally, I just went there to help one specific kid, a 4th grader who had exceptional mental math abilities but due to his ADHD had difficulty focusing on the work before of him especially if there were word problems.

He'd do well for about 20 minutes and then he'd be unable to focus after that so I came up with a way to effectively reset his focus, his main problem was the work was static and nothing moved so his concentration drifted so I grabbed a set of playing cards and said "I'll flip two cards over and I want you to multiply them together then we'll see how many you can get in a minute." Every time I would put down the next two cards on top of the previous ones. This constant movement helped the student to stay focussed. I always made sure to keep track of his score, so he knew his abilities were improving but all he saw was his own score nothing to compare it with, which is rarely as effective as competition. Thankfully he had siblings who attended the school, and they were interested in playing the game.

Now it was bragging rights among siblings which made the game way more interesting. Next, their friends joined, and the friends of their friends joined about 3 months later. I asked permission from the principle to play the game with every student of the school once per week so long as I made sure it wouldn't disrupt the normal learning process because it's just one to two minutes of a day for the individual student. The principal, having seen the improved abilities among those who I had worked with, agreed.

From grade 4 up to grade 12, about 100 students in total. Some kids thought it ridiculous and a waste of time, others found it very fun so I made a deal with them; if any student grade 4 or 5 got 20 cards once they didn't have to do it again for the remainder of the term, grade 6 to 8 had to get 26 and grade 9 to 12 had to get 30. However, if they still wanted to play that was fine. If any of them got 40, regardless of their grade, I would buy them an 80g chocolate that they got to choose – only available once per month per student – and whichever student had the highest score among grade 4 to 5, 6 to 8, 9 to 12 over the course of an entire term got another chocolate as well.

I was not prepared for the number of chocolates I'd have to buy, nor the level of competition this would create. The students in turn were surprised by my leniency, any time they'd been stuck on a question for 5 seconds I'd stop the clock and explain a trick for the multiplication: stuck on a 9 times table use your fingers, a 12 break it into a 10 and 2 then add them stuck on 13*11 look at 5*7 it's 35 1 less than 6*6 3*5=15 1 less than 4*4 so 13*11 will be 1 less than 12*12,

"Maths is something everyone can enjoy if it's presented to them as something fun, something that anyone can be good at, not just those who are really gifted."
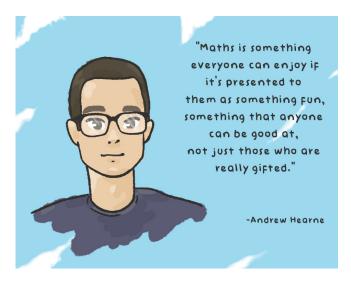
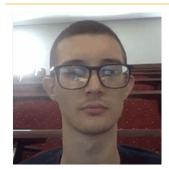*-Andrew Hearne*

Illustration by Liani Malherbe

this was always hilarious when they then learnt $(x+1)(x-1)=(x^2-1)$ was the reason for this pattern. What I had done was take the multiplication tables that we're taught in primary school, and I added incentives. This might seem unimportant in the grand scheme of learning maths, but the difference is that the kids looked forward to it and that was my goal.

Make the kids view maths as something to look forward to not something you have to do. As a result, the average ability to do maths went up among all the students, even the 12th grade students despite most of the new concepts having very little to do with multiplication. I believe this is because any of the multiplication needed for the problems was no longer something they needed to focus on and so they could concentrate on the new portions of the work alone instead of needing to stop for a calculation along the way and it was a challenge instead of something they had to do. All that was needed was someone willing to teach them, be patient instead of harsh and a bit of chocolate.

In 2020 I was hired by the school instead of just volunteering, but at that point I'd already been helping any of the kids who were struggling with their problems for about 3 months, so nothing changed aside from needing to go get a tax number, that was a mission and a half, but I finished it. Over the next 2 years I taught many kids at this school, and I noticed the following; some of the kids coming to me for help instead of their teacher, a continued increase in most of their scores at the game, and those scores being a point of pride just as much as getting a higher score on a test.

Maths is something everyone can enjoy if it's presented to them as something fun, something that anyone can be good at, not just those who are really gifted. For these students it started by making it a game to play and see if they could get the answer faster than anyone else, for others it was fun facts like the formula for area being discovered so people would pay the right amount of taxes. Anyone can learn to love maths, as long as there is someone willing to slowly teach them. To reiterate the title Maths is for everyone, now we just need to convince those who don't believe it.

ANDREW HEARNE

2nd year Mathematics BSc student, Stellenbosch University

Mathematics for everyone

Iain shares his passion for mathematics and his views on how mathematics is universal and empowering. He suggests that a change in the perception of mathematics and the way we teach and learn mathematics will make everybody come to the realization; that mathematics is for everyone.

Illustration by Tristan Barnard

Mathematics is empowering. It provides the tools to create and explore with only a pen and a piece of paper. It allows us to answer our own questions about why and how certain things work the way that they do. Mathematics is inherently natural.

As humans we tend to be curious and creative, we can express these desires and interests through the exploration of mathematics. Mathematics knows no race, gender, religion, or nationality. Mathematics does not discriminate, and it provides a platform for people of all different kinds to work together to gather more and more understanding.

The language of reasoning is universal and does not depend on social constructions. This is

why mathematics is for everyone. Unfortunately, some do not see mathematics as for them let alone for everyone. I have noticed, through teaching mathematics to others, that many people turn away from mathematics as the result of complicated words or scary-looking formulas. I have attempted to teach my family (without a formal education in mathematics) some concepts that I have learnt at university.

At first, I taught them as my lecturers taught me and within seconds it was clear that they were already not listening. I attempted a different approach, showing them many more diagrams and visual representations of what I was explaining. Without using any loaded terminology or frightening notation I was able to teach them the basics of these university concepts.

I believe people are naturally opposed to anything that looks complicated or difficult. It is natural for people to want to take a path of least resistance and as a result, typically avoid mathematics as it is taught formally. While these complex notations and scary-looking formulas are required by mathematicians to communicate and combine different concepts effectively, it is not required for most people. When teaching mathematics, avoiding these aspects that turn people away will still carry over the important ideas while ultimately making mathematics more welcoming.

Mathematics has many benefits that carry over in many aspects of our lives. When I think about how mathematics improves my everyday life I always think back to the movie "Arrival". In the movie, aliens from out of space visit Earth and remain in their spaceships.

Humans attempt to communicate with them and in doing so discover that they communicate in a very strange way. They do not use sound to communicate but instead use a form of writing with ink on glass walls. Their writing consists of circular figures that can convey single words or long complex ideas.

By slowly learning this non-linear language, the humans sent to communicate with the aliens develop a new way of thinking, that too is non-linear, allowing them to see into the future and back to the past. While mathematics might not give you the ability to time travel, it will, in a similar way, teach you a completely new way of think-
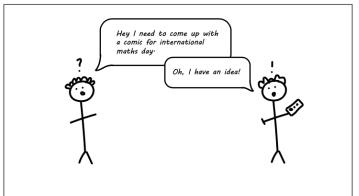
ing. I have realized through my limited study of mathematics, that the way I think, even in my everyday life, has changed dramatically. I have become more precise, calculated, and more creative. Furthermore, I have become more intrigued by the inner workings of everything from nature to machinery. Mathematics has taught me to explore the world around me and try to discover why 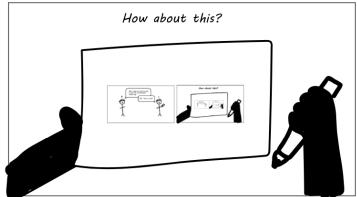things work in the way that they do. It is hard to compare my experience of life before and after mathematics. Before I still found the world around me beautiful but now I feel I have reached a new vantage point. In conclusion, mathematics is for everyone. However, it is important that everyone comes to this realization. Important changes need to be made in the education and perception of mathematics for this message to be carried across.
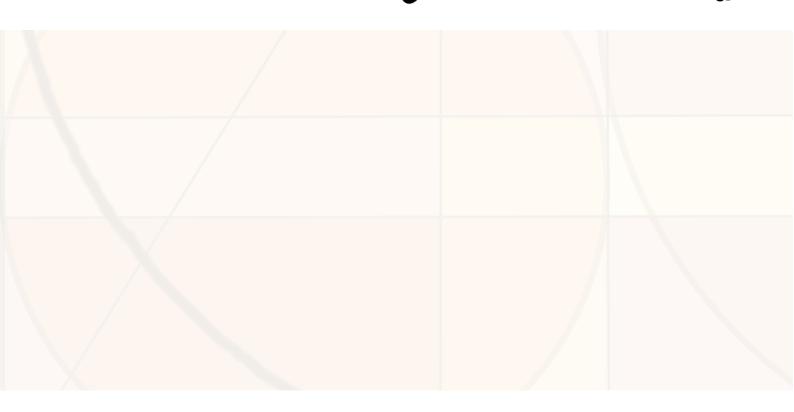
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Join us on a transformative journey through a captivating series that redefines mathematics, exploring its role in society, education, and personal development. From dismantling stigma to navigating challenges during the pandemic, these books offer invaluable insights and practical tools to empower readers in embracing the universal applicability of mathematics.

MATHEMATICS FOR EVERYONE

Mathematics for Everyone – Unlocking the Power Within
Mathematics is everywhere – in music, nature, technology, and daily life. This volume of Wisaarkhu, in partnership with NITheCS, celebrates maths as a universal language for all.

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At Wisaarkhu, our passion is to make advanced mathematics accessible and exciting for all. We are a vibrant community that values inclusivity, diversity, and global collaboration. Our mission? To ignite a love for mathematics, revealing its hidden beauty and vast potential. We understand that mathematical prowess is key to thriving in numerous life aspects, and we're dedicated to making these skills available to everyone. Join us in exploring the captivating world of mathematics through lively discussions and an inspiring book series. Each volume delves into different themes, showcasing mathematics' critical role in everyday life and across various fields. Discover with Wisaarkhu how mathematics shapes our world!

Magazine designed by Neil Mellet

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