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CENTER FOR INTERNATIONAL SCIENTIFIC PUBLICATIONS
JOURNAL OF LANGUAGE AND LIGUISTICS
ISSN(Online): 2984-7109
SJIF Impact Factor |(2023): 5.2|
Volume-6, Issue-5, Published |20-12-2023|

ENHANCING STUDENT ENGAGEMENT IN MATHEMATICAL CONCEPTS THROUGH STORIES AND NARRATIVES: AN INVESTIGATION

https://doi.org/10.5281/zenodo.10417788

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ANNOTATION

This study explores the impact of integrating stories and narratives into the teaching of mathematical concepts, with a goal of enhancing student engagement. Results highlight the efficacy of this approach in promoting a deeper understanding of complex mathematical concepts, along with an increased interest and engagement levels in math lessons. The research includes analysis of classroom observations, interviews with educators, and student performance data. This paper emphasizes the crucial role narratives play in contextualizing mathematical concepts, making it more appealing and accessible for students.

keywords

Student Engagement; Mathematical Concepts; Narrative-based Learning; Storytelling in Math; Mathematics Education; Active Learning; Education Strategies; Teaching Methods.

Introduction

Mathematics is a subject that repetitively tests the cognitive ability of a student. For some learners, mastering abstract mathematical formulas and complex reasoning can sometimes be quite demanding. However, employing the use of stories and narratives in explaining mathematical concepts has the potential to enhance the understanding of these concepts, consequently leading to improved student engagement. This article investigates how the use of stories and narratives can enhance student engagement in learning mathematical concepts.

In recent studies, it has been discovered that narrative-based learning acts as a bridge, connecting abstract mathematical concepts with real-life experiences. From Pythagoras to Galileo, history is replete with stories of mathematicians who transferred their revolutionary ideas through narratives. Hence, the idea of integrating stories into mathematics lessons isn't entirely novel but instead is a return to our pedagogical roots.

There's indeed a popular story that concerns Pythagoras and his theorem, which forms the basis of geometry studies and is at the heart of a right-angled triangle.

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Pythagoras of Samos is an ancient Ionian Greek philosopher and the eponymous founder of the Pythagoreanism movement. His political and religious teachings were well-known in Magna Graecia and influenced the philosophies of Plato, Aristotle, and, through them, Western philosophy.

Perhaps, Pythagoras's most significant contribution to mathematics is the Pythagorean Theorem, which states that "In a right-angled triangle, the square of the length of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the lengths of the other two sides." This can be written as a^2 + b^2 = c^2.

Now, there's an anecdote regarding his response to the theorem's discovery. In his joy at discovering the theorem, Pythagoras is reported to have sacrificed oxen— or possibly even an entire hecatomb, a sacrifice of 100 oxen— to the gods. However, readers should note that the ancient anecdote is unproven, and it might be a later attribution, as Pythagoras was famously vegetarian.

Pythagoras's Theorem is a fundamental principle used in many areas of mathematics and physics; it's applied in various fields ranging from computer graphics to architecture. However, like many ancient scholars, Pythagoras's contributions were combined with those of his followers, and it's often difficult to determine his actual achievements. The theorem that bears his name was likely known and previously used by the Babylonians and Indians, but he, his students, or one of his colleagues may have been the first to prove it.

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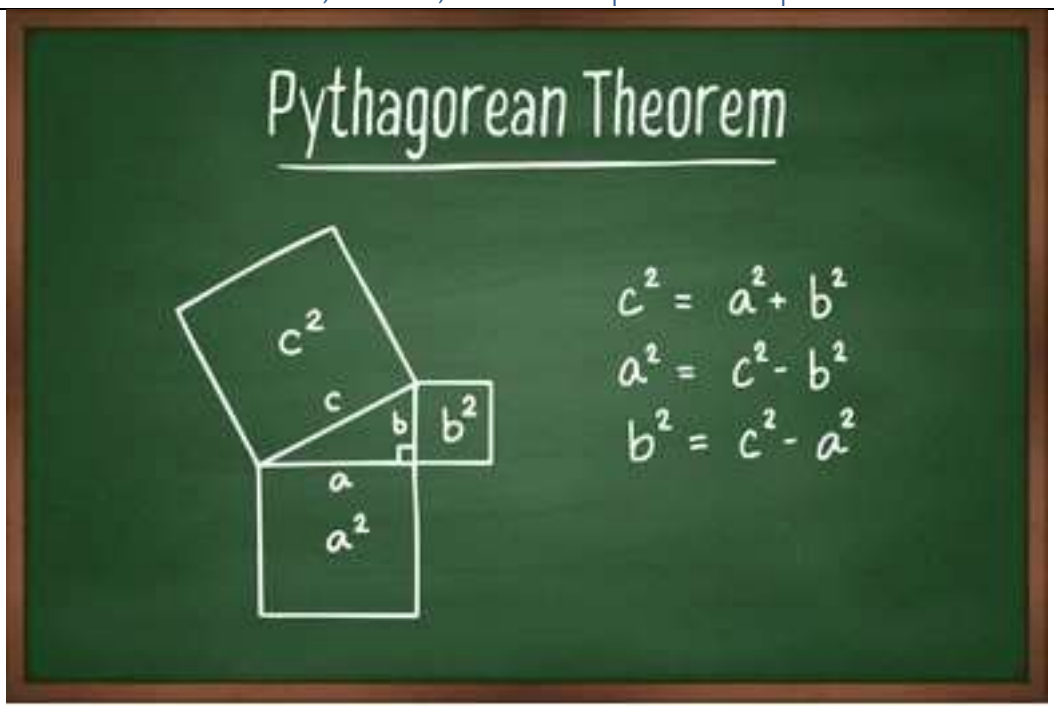

Mixing Mathematics with Narratives

The narrative form of content delivery is fundamentally around creating a coherent and logical progression of ideas. This pattern aligns seamlessly with Mathematics, which involves a systematic way of resolving problems. For example, let's consider the quadratic formula, which is typically represented as:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For a learner not used to abstract symbols and equations, this might appear like a jumble of random characters. However, by using a narrative, we can transform this concept into something more understandable.

We could frame the quadratic formula as a little adventurous story between "a", "b" and "c" where they are constant companions on a journey to find the value of "x". "b" sometimes takes the role of a villain — its negative form influencing the entire journey. But no matter how b tries to sway the course, together, they always find "x" in the end. This strategy builds an emotional connection to the characters, making the formula easier to memorize and understand.

et's delve into more examples of mixing mathematics with narratives to enhance student comprehension and engagement.

Example 1: Exponent Rule

Understanding the laws of exponents can be quite intimidating for students. But when we infuse a narrative into the concept, it becomes more intuitive.

Take "$a^3 \cdot a^2 = a^5$" for instance. This could be presented as a story: "An adventurer known as 'a' finds a magical artifact that grants him power. Each artifact he finds grants him more power. If he first finds 3 artifacts (a^3) and then 2 more artifacts (a^2), he will have the power of 5 artifacts (a^5)."

Example 2: Pythagorean Theorem

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The Pythagorean theorem stated as $a^2 + b^2 = c^2$ is a central concept in geometry, specifically in relation to right-angled triangles. A narrative could go:

"Imagine Alice and Bob live in houses placed at the two ends of a park, with a pond positioned exactly between their houses. The paths from their houses to the pond form a right-angle. Alice's path to the pond (a) is 3 miles long and Bob's path (b) is 4 miles. Now, they decide to build a direct path between their houses. How long will this new path (c) be?"

The solution involves the Pythagorean theorem, where the diagonal (c) equals the square root of (a^2+b^2). Hence, $c = \sqrt{(3^2 + 4^2)} = 5$ miles.

Example 3: Logarithms

Logarithms often prove to be a difficult area for many students. However, creating a narrative can help make it more understandable. Take $\log_2 8 = 3$ as an example.

Present it as a story involving timely personal growth: "Once upon a time, in the world of binary, a single digit (1) longed to accommodate colossal values, specifically the number 8. It was only after it could triple its size (3) that it could accommodate the number 8."

Here, it should be noted that the storyline pertains to how many times we multiply a number by itself to get another number. This story would teach students that 2 has been cubed to get 8, hence $\log_2 8 = 3$.

In conclusion, merging mathematics with narratives can be a game-changer in teaching methods. It makes the learning process engaging, enjoyable, and aids in fostering a clear understanding of complex mathematical concepts. These story-inspired ideas not only help students conquer math anxiety but also enhance their creative thinking capacities.

Translating Abstract Concepts

Storytelling feeds human's natural affinity for narratives, which in turn can invoke coded cognitive response that promotes quicker and deeper understanding. By framing abstract formulas into dynamic narratives, students can visualize these forms in a more meaningful way.

For example, let's take this simple mathematical equation:

$$3x + 5 = 14$$

In most case, it is taught by showing the mathematical steps to isolate "x." But suppose we introduce this equation in the form of a story. We might say, "Imagine your friend X rode his bike to the park, which was 3 miles away. On his way back, he stopped to buy ice cream, which added another 5 miles to his total journey. In all, he traveled a distance of 14 miles. How long was his actual ride without the ice cream detour?"

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To solve this story problem, students would have to apply the same equation, subtracting 5 from both sides of the equation to get 3x = 9 and then dividing both sides by 3 to solve for X. Here, x = 3 miles.

Example 1: Fractions

Fractions can be a challenging concept for many students to grasp. However, the use of a story or narrative can simplify the concept, making it more digestible. Consider the fractional notation ¾. This can be explained with a story such as:

"Ana is visiting a farmer's market to buy apples. She bought a bag of apples that had 4 apples, and she ate 1 before reaching home. What fraction of apples does she have left?"

In this narrative, students will work out themselves that Ana has three out of four apples, or 3/4.

Example 2: Area and Perimeter

The context of area and perimeter can also be elucidated through narratives. Consider the example:

"Charlie has a rectangular garden that he wants to fence. The length of the garden is 8 meters, and it is 3 meters wide. How much fence will he need? Also, Charlie wants to plant roses in half the garden. How much area will the roses cover?"

The first question addresses perimeter (adding all sides), allowing students to find the answer by calculating 2*(3+8) = 22 meters. The second question addresses the concept of area (lengthwidth) and fractions simultaneously, calculated as (83)/2 = 12 square meters.

Example 3: Trigonometry

For trigonometry, consider the story:

“Katy, who is 5 foot tall, wants to know how far away is a 20-foot tall statue is from where she is standing if she is looking at the top of the statue at an angle of 45 degrees."

Here, narratives provide the conceptual framework for students to apply the tangent function (opposite/adjacent sides) in trigonometry. By finding the tan of the angle, they can determine the distance which would be the height of the statue minus Katy’s height divided by the tangent of the angle. Therefore, tan(45) = (20–5)/Distance. Hence, Distance = (20–5) / tan(45) = 15 feet.

In all these examples, narratives make the mathematical concepts relatable and engaging, helping students process the information more holistically and intuitively. By applying this approach, mathematical literacy can be significantly enhanced, providing a concrete

Lets examine two examples:

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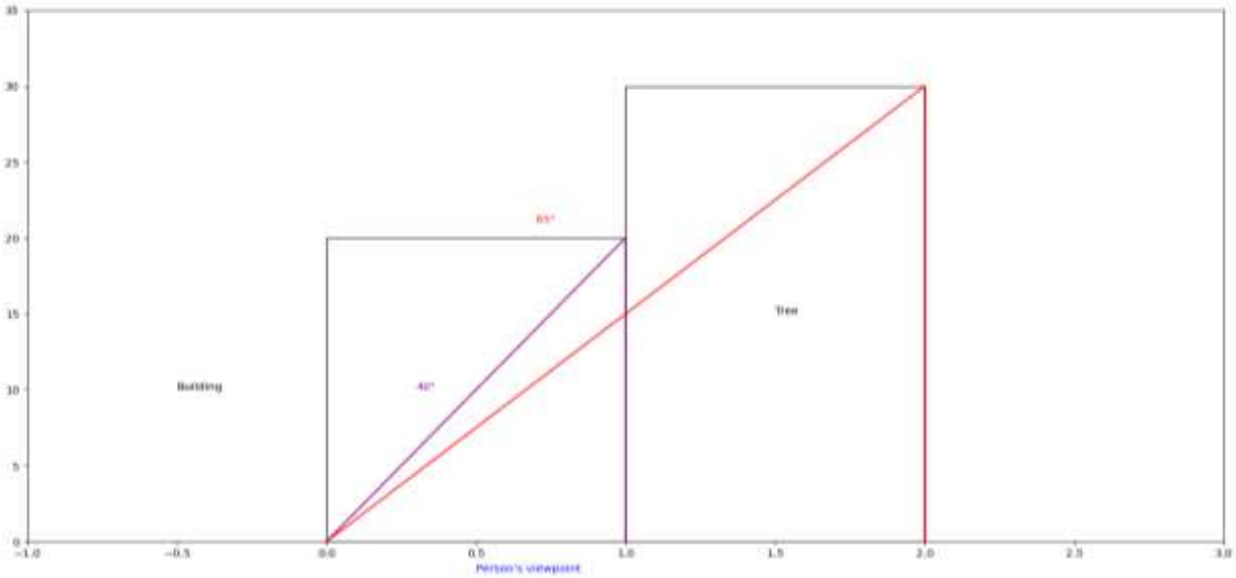
Example 1: Finding the Height of a Tree

Imagine a tall tree next to a building with a known height of 20 meters. A person looks up at the top of the tree from a point right next to the building. That person's line of sight to the top of the tree makes an angle of 65 degrees with the ground, and the angle to the top of the building is 40 degrees. How tall is the tree?



This problem can be solved using trigonometric tan function utilizing the known angles and the height of the building. We begin by finding the distance (d) from the person to the building:

tan(40) = 20 / d => d = 20 / tan(40)

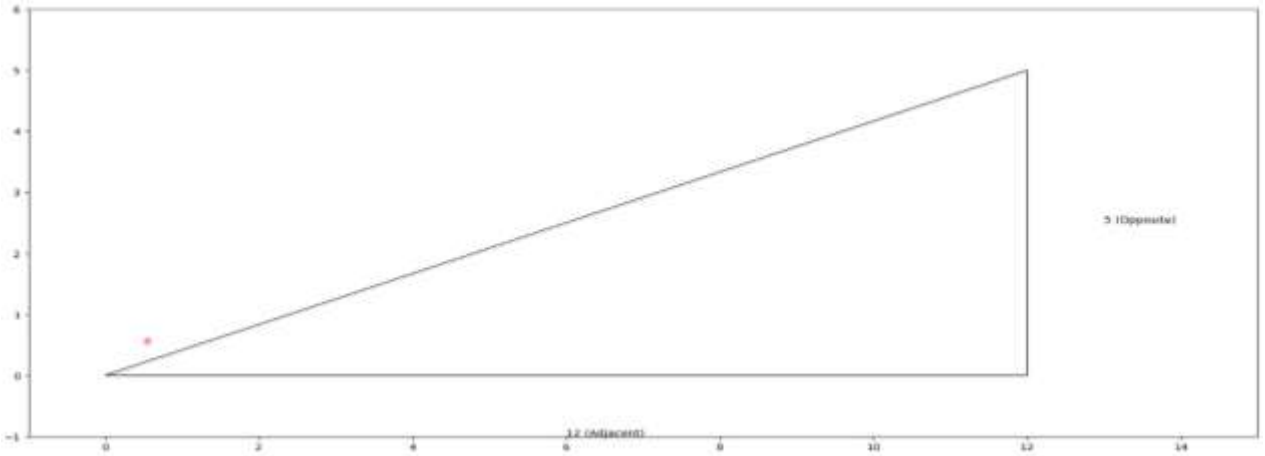
Then calculate the total height (h) of the tree using the distance (d):

tan(65) = h / d => h = d * tan(65)

Upon finding the respective values from a calculator, and making the calculations, you would get the height of the tree.

Example 2: Solving for an Unknown Angle

Picture a right triangle where the opposite side measures 5 and the adjacent side measures 12. You're asked to find the angle at the base of the triangle (θ).



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This problem is a textbook example for using tan function again. The formula would look like:

$$tan(\theta) = \frac{opposite}{adjacent} \Rightarrow \theta = arctan\left(\frac{opposite}{adjacent}\right) = arctan\left(\frac{5}{12}\right)$$

Using a scientific calculator to find the arctan (also referred to as tan inverse), you would have the measure of the angle θ.

Draw these examples out on paper as detailed above, and use your calculator to find the numerical solutions. The use of geometry software could also be helpful if the concepts are hard to picture mentally!

Conclusion

Stories and narratives possess the ability to transform abstract mathematical concepts into relatable experiences, easing students' comprehension and driving engagement. By fostering connections between mathematical ideas and real-world situations, we can demystify these daunting equations. This fusion of storytelling and mathematics brings forth a creatively unique approach which impacts not only how math is taught, but also how students perceive and engaging math.

Future studies into how to most effectively blend stories and narrations into mathematical instructions are required - with the ultimate aim of developing pedagogical strategies to help students fall in love with mathematics, a subject foundational to almost every aspect of life.

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