The Power of Stories in Math Class

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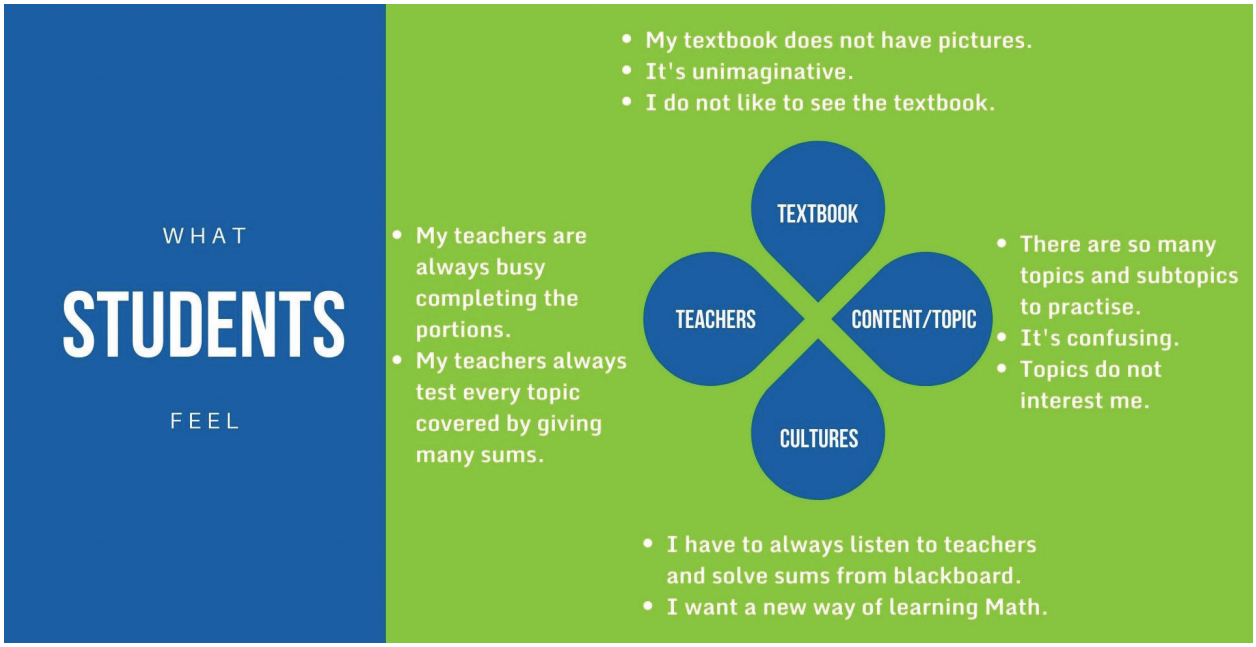
Math is beautiful. But sometimes, this can be hard to see, and even harder to teach students who don't – *yet* – share the passion.

Though the pedagogy of mathematics has evolved over the years, it is still considered a tough subject. It is a known fact that when we ask students about their favourite subject at the elementary level most students choose math but when the same question is asked in middle and high school, the students' response is that math does not interest them anymore. There could be many reasons; it could be the unimaginative black and white textbook that only has numbers and symbols which do not help the students to visualize the abstract concepts that they are studying. Or it could be the pedagogy (students are not encouraged to think), or the relentless drill and practice with the sole end goal of getting better scores in assessment. Their learning is not connected with life and, in addition to this, the cultural inheritance of fear associated with the subject does not help the students.

To create interest in students towards the subject while catering to a heterogeneous group of learners is quite challenging.

Keywords: mathematics, math-phobia, pedagogy, stories



Mathematics is essential for everyone. Then how can we overcome student bias, improve pedagogy, and create interest in Mathematics?

One such strategy initiated 3 years ago by the Department of Mathematics, Delhi World Public School, Bangalore is *Math story writing. We have discovered that using stories and storytelling to teach mathematics can foster love for the subject.* Students enjoy listening to stories and reading stories. Stories are built upon human problems, conflicts and capabilities. Many times, the problems can be solved by mathematical thinking. Stories organically lead to discussions in the classroom. They can help to *humanize* mathematics, visualize Math concepts and create relatability. Then why not use stories and storytelling to develop critical thinking skills, problem solving and literacy skills amongst children.

Origin of stories

Stories are not new in Indian culture and history. For instance, in the Ramayana, Dasharatha distributes the divine payasam that he received from Lord Agni-this can be related to fractions. The story 'The Greedy Brahmin's Dream,' from Panchatantra in which the Brahmin gets a pot of flour and dreams of selling it for profit, and trading relates to money and estimation. Arjuna's archery can be used to illustrate Pythagoras theorem, area, perimeter, and coordinate geometry.

We used these as well as several books that are based on Math such as 'Mathematwist: Number Tales from Around The World,' by T.V. Padma, 'Tales from the history of Mathematics' written by Archana Sarat and stories published by Pratham.

Teacher's endeavor in using story-based pedagogy

One of the practices in school was to include relevant stories while introducing a math concept. The in-house publication 'Assignment Booklet' includes math stories for students to read. This story writing was not forced to fit into our lessons or was given to students as assignments but was planned according to the concepts taught in the classroom. The students were encouraged to weave a story using the concepts. The idea was to inculcate an intrinsic value of mathematical thinking that is required to solve the problem in the story.

After the first attempt of math story writing, we Math teachers could observe that our students were able to connect the concepts to their daily life and were using math concepts along with the required key vocabulary. But the stories lacked mathematical thinking. When we discussed this with our English department, the teachers suggested that the story must have a conflict and solution; this would lead to mathematical thinking. This discussion gave math teachers a clear understanding of how we could help students to further improve the math story writing process.

This strategy also helped the students to relate math stories with their English language writing and grammar. The children were able to identify the elements of story writing, such as the characters, setting, problems, situations, actions, and climax.

From listening to stories to writing stories - shift in pedagogy, advantages

We initially started narrating stories in the classroom related to the concept. We read the book *Sir Cumference and the Dragon of PI* written by *Cindy Neuschwander* and illustrated by *Wayne Geehan.* After reading the story in the class, we discussed the different story elements in the class through questionnaires. Later the students were given the *Math story analysis template* to fill in.

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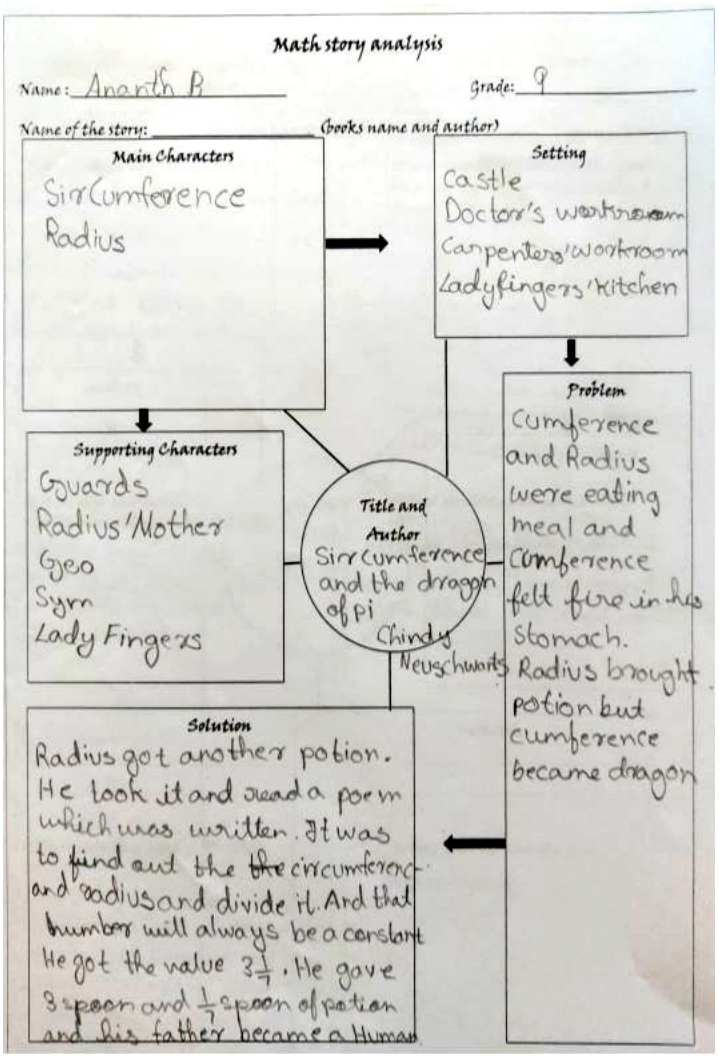

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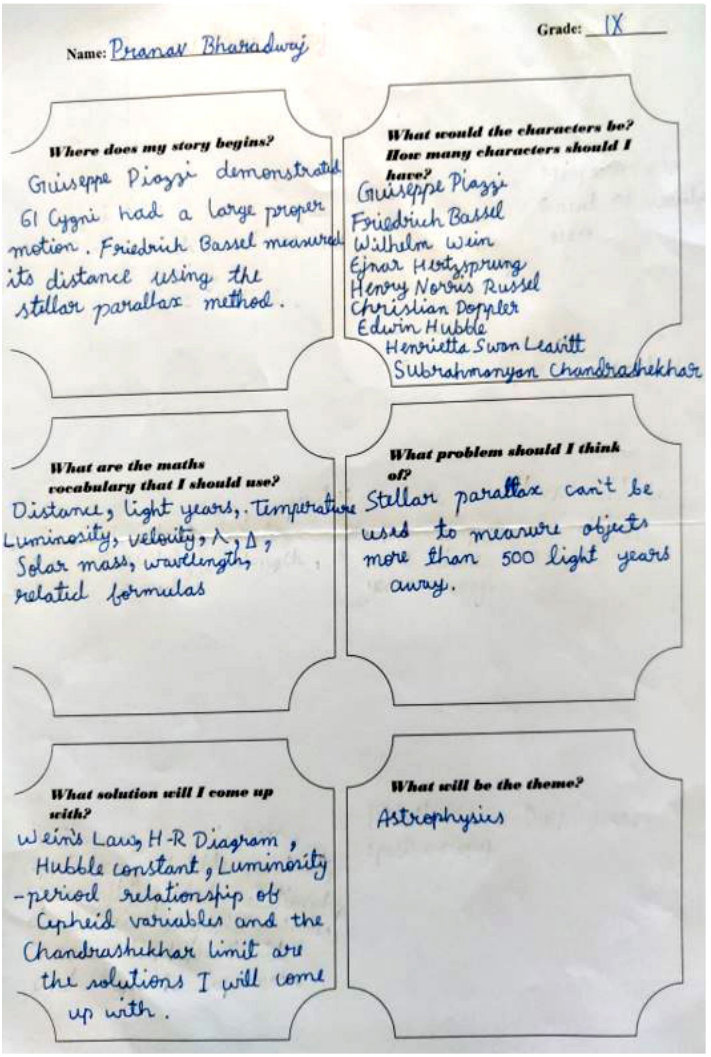
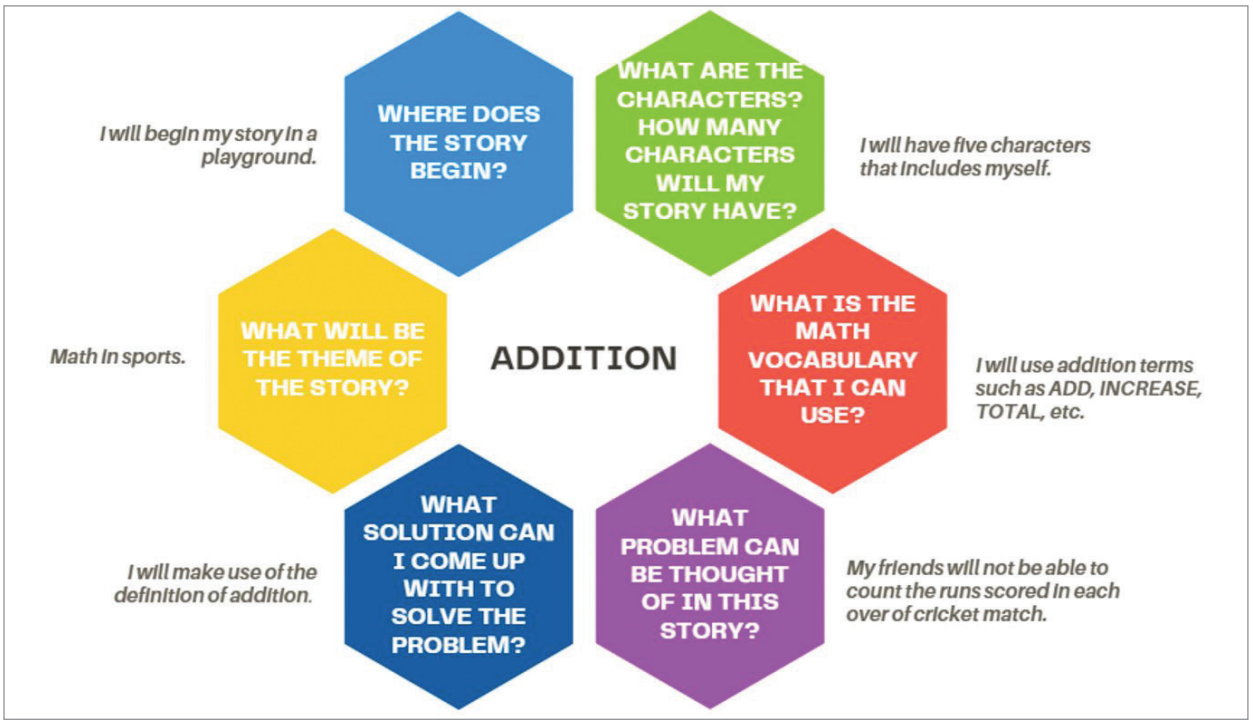


This helped the students to analyse the story. After the teachers and students read the math stories together, they discuss and fill in the template. This helps the students to understand the various story elements that are present in a story. This is followed by another template, where the students, with the help of the math teachers, start planning about their individual story that they want to write. The process helps the students to visualize the story. After this, teachers introduced story writing activity to the whole class, later with small groups and finally, the students worked independently on writing stories as home assignments. The students were guided and mentored by the teachers to write math stories using some simple steps.

Create a mind-map – students were encouraged to create a mind map around a specific concept such as addition, fraction, multiplication, etc.



Come up with character, setting, problem & solution – students were encouraged to think about introduction, names of the characters, setting, problems and solutions.

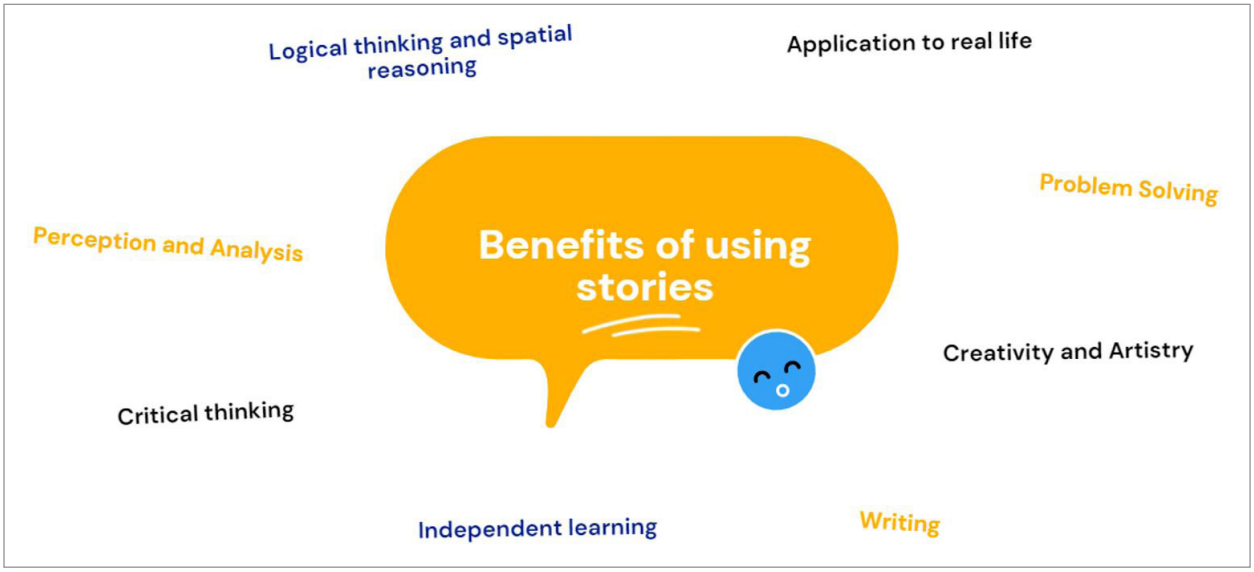
Read the story - Once they had drafted the story, students were encouraged to read the story aloud in the class for the other students to listen to and provide feedback. The feedback activity was done from Grade VI to VIII in the age group between 9 to 12 years.

Feedback and mentoring by the teachers – The next step would be giving feedback to students. The students shared their write up of the story with the teachers who offered constructive feedback to improvise. Math teachers focused on the mathematical thinking and math vocabulary. We also kept a check on their grammar and sentence structure, as it was a multidisciplinary project. Teachers encouraged the students to observe and include logical, critical thinking and mathematical thinking in the stories that were being read and written.

In the month of November each class was given a list of topics based on the concepts that they had learned over the academic year. For example, grade 1 would write stories using shapes, grade 2 would write on addition, grade 6 would write on ratios and proportions, etc. Each child is encouraged to write one story.

Students who were slow learners or not interested in learning are slowly beginning to show progress. Most of the students are now able to visualize the problems by drawing pictures and coming up with solutions. They have started gaining confidence in solving math problems. They draw cartoon characters and write the formula. The students are happy to see their classwork not just filled with problems. The usage of visual representation, character and colours has made math a fun subject for the students.

We have been practising math through stories for the past 3 years and we have seen how it has led to the development of various skills such as (see mind map below):



Samir, a student of Grade VII, always had been mechanical in his presentation of math projects. He assumed Math is all about solving the sums from the textbook by following the steps and formulas. *Through this activity he was able to connect math with real life situations like connecting geometry to patterns in nature; he drew many pictures of flowers, shells, etc., connected with art during his art classes. I recollect an anecdote when a child came up to me and said that he was able to relate integers while using the elevator. There was another student who was fascinated about architecture and was able to connect architecture with math while learning practical geometry.* His way of looking at Math has changed and now he relates math with real-life problems.

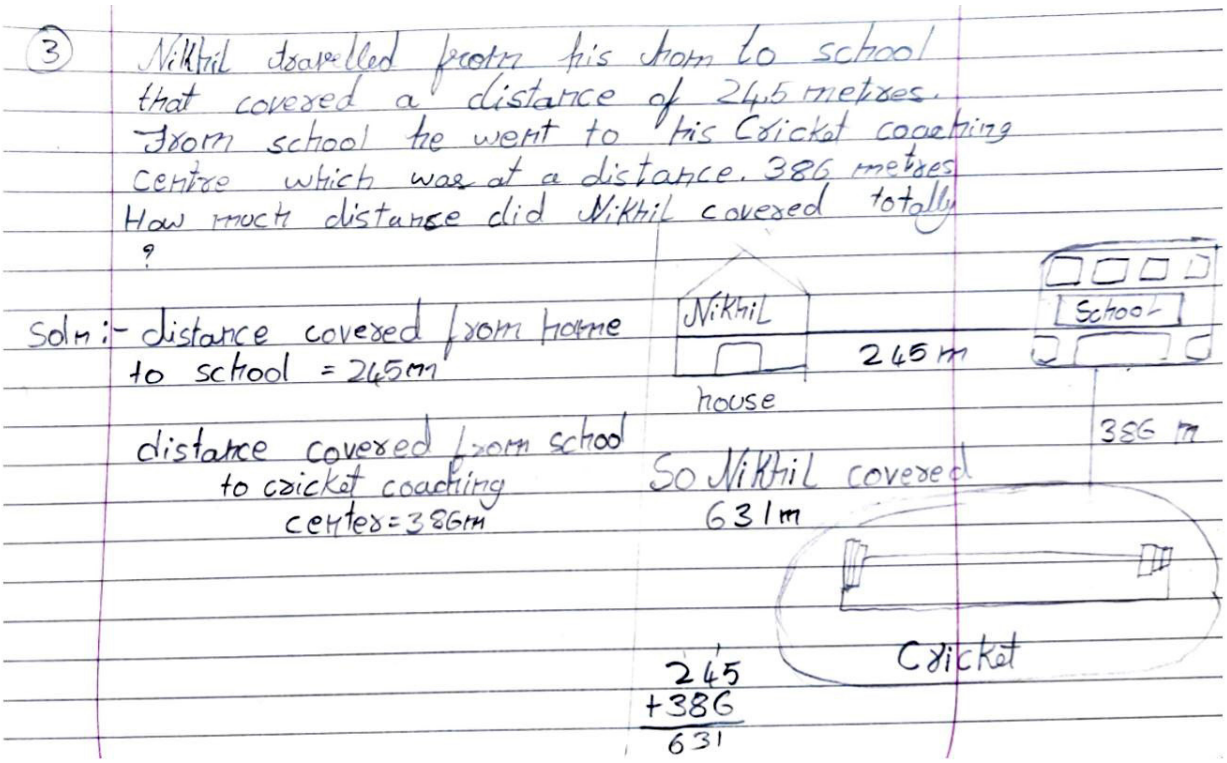
It is more important to apply mathematical thinking to real life, than to apply real life to textbook mathematics. The focus is now gradually shifting to life, not a subject or examination.

Amith, a student of Grade III, was not interested in the subject. He avoided interacting in the classroom during the Math classes. When stories were introduced slowly the child started to participate in the classroom. *Now the child interacts in the class by asking questions like what exactly are addends? Why is there no end to numbers? Can I ever find an end to counting numbers? Why are shapes given specific names? He has started learning math by drawing simple drawings and completing the word problems with appropriate statements.*

Earlier we used to solve all the problems on the blackboard giving very little time for the students to think and come up with the key terms in the problem or formula used to solve the problems. But through the introduction of story writing, students are now developing confidence to read the questions and analyse the problems before solving them. They draw the shapes if they have to solve area-based problems or they draw small pictures considering them as characters and keeping them in real life situations and solving the problem.

When I was teaching addition word problems to Grade III, one of the children in the class drew a small picture and named himself as one of the characters in the picture in the rough column and wrote the statements required to solve the problem.

This is one of the student's exercises. The word problem actually began as Sam travelled…



Let's take a sneak peek into some of the stories written by our students and see how they have used their imagination to relate mathematical concepts to their daily life.

Reema is an 8-year-old who lives in Bangalore with her parents. She is full of energy and enjoys playing with her friends. She is an inquisitive child & has always been full of questions about everything that she observes around her. She has always been interested in numbers & learnt to count from 1 to 20 at the age of five, from her father. Since then she counts everything she sees around her…. like the number of flowers that bloom in her garden each day, the number of butterflies that come to visit the flowers, the number of ants that crawl around fallen bread crumbs, etc. Her father, being an engineer himself, encouraged Reema's interest in numbers. Reema's mother, on the other hand, was trying to be cautious & always worried about Reema wandering off engrossed in her world of numbers.

Every year Reema & her parents travel to their native place in Kerala to celebrate Onam festival with her grandparents & cousins. Reema loved these trips and always waited eagerly for August so that she could enjoy the road trip, see new sights, eat different food, etc. This year also Reema is traveling along with her parents to Kerala. They left home by car at 5 a.m. Reema was very excited, but sleepy too. She dozed off!! After some time, when she woke up, she heard her mother asking her father where they had reached.

Her father replied, "We have covered 50 Kilometres." Reema asked, "Daddy how many kilometres more do we have to travel to reach Kerala?" Dad replied, "Reema we have just covered 50 kilometres of the journey, we still have 6 times the distance to cover!" On hearing this, Reema started thinking.

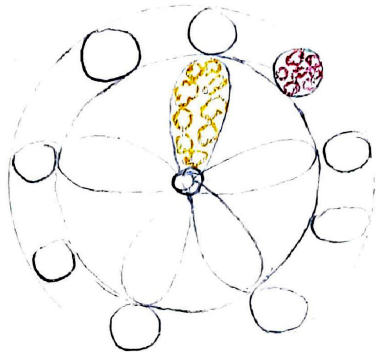
Reema asked, "Daddy, so that means we have to travel 300 kilometres more! Am I right?"

Dad: "Absolutely correct !"

After some time, Reema saw mangoes being sold. They stopped the car to buy some mangoes for relatives and for themselves. Reema's mother said that they must buy mangoes for four families. Mom decided to buy 12 mangoes for each family. Reema again started calculating the number of mangoes they needed to buy in total: 4 × 12 = 48.

Soon it was lunchtime and Reema was very hungry. They stopped at a restaurant and ordered Thalis for all three of them. After lunch, Reema's dad went to the washroom. The waiter came with the bill and said that each thali costs ₹120/-. Reema quickly calculated the bill 120 x 3 = 360 before her father returned. When her father came, she asked for ₹360 and paid the bill. Her dad was proud to see Reema apply the math she learnt at school, in her daily life.

Finally, they reached home by 5 p.m. Reema was tired after the long journey. She met her grandparents and cousins. They had fun for some time. She had an early dinner and slept soundly.

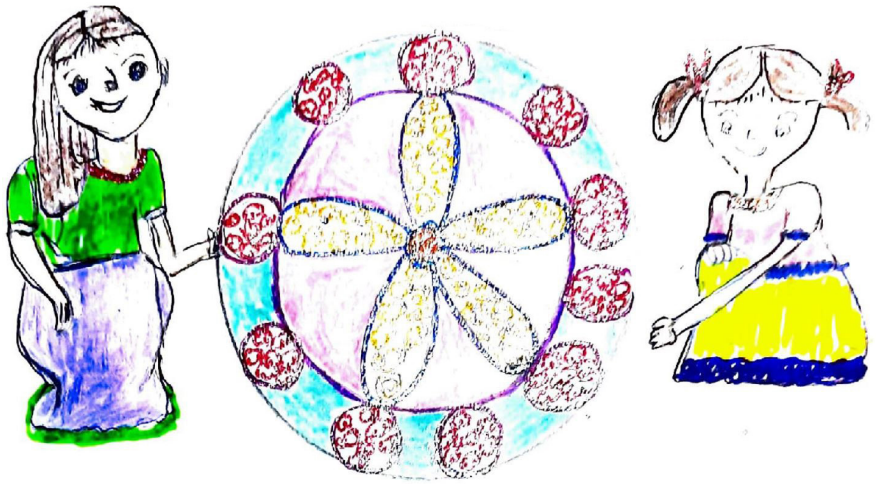


Next morning, Reema woke up to a flutter of activities in the house and saw her grandmother and mother worriedly rushing about in the kitchen. She asked her father and got to know that relatives called in the morning saying they would be visiting their house. So, grandmother and mom were busy making snacks and sweets for them. Reema felt bad to see her grandma so worried. She went to her cousins who were busy playing and told them, "Let's do something interesting this time. Shall we try and make the Pookalam? We have seen grandma doing it every year...let us try to do it this year. I will ask Amma for the design, then we can collect the flowers from the garden." All the kids were excited at the thought of making the pookalam all by themselves and immediately rushed to the garden. Reema went and told grandma and amma about their plan. Grandma was very pleased to know that Reema and her cousins were offering to help, understanding the difficult situation at home and happily gave her the design she had chosen. Reema took bath and wore her new "Pattu Pavada" for Onam celebrations and went down to see all her cousins in elegant traditional dresses, ready to make the pookalam.

They drew a design with 5 petal shapes and 10 small circular shapes inside a circle. Reema asked her cousins, "Simi, how many yellow flowers did you fill in one petal shape?"

"Nine yellow flowers," replied Simi. Reema calculated, "so for 5 petal shapes, we will need 9 × 5 = 45 yellow flowers!"

"Shall we fill the small circles with red flowers, Reema?" asked Simi. "OK Simi, how many flowers do we need to fill one circle?" asked Reema. Simi filled one circle with red flowers and counted. "We need 7 red flowers for 1 circle and there are 10 circles. So, in total we need 10 × 7 = 70 red flowers."



The Pookalam looked beautiful when they completed it. Everybody at home appreciated Reema and her cousins for the beautiful work they had done. Reema on the other hand spoke about shapes she had learnt in school and was fascinated to learn from her mother about rangolis and mandala art works.

All were hungry and tired and ready for the delicious feast prepared by Reema's mom, aunt and grandma. Lunch was served on a banana leaf. Mom asked Reema to serve three banana chips in each of the banana leaves. So Reema counted again! There were 8 members for lunch, so 8 x 3 = 24 chips. Reema took 24 chips in a bowl and served it equally on banana leaves.

After the delicious food, everyone took rest. In the evening, Reema, her cousins, and her parents went to the beach. Reema's father bought kites for them and they all flew their kites high in the sky. Reema enjoyed her Onam vacations!

My name is Maanasya Mirjith. I am studying in Grade III at Delhi World Public School, Bangalore. I love watching cartoons and playing with my friends. I have written this math story based on my Onam experiences. My parents helped me complete this story well. A big thanks to them and to my teacher Sowmya ma'am for encouraging me to think and apply the mathematical concepts in a fun way.

Maanasya has always found math interesting and ever since we started using stories, she also started to relate math with herself. And this is how she came up with this story, as she finds the mathematical operations quite easy.

She has beautifully described her family trip to Kerala using the 'Multiplication concept.' In the story, Maanasya has incorporated descriptive writing and applied the skills learned in the English language. She has explained the meaning and concept of multiplication in different situations such as calculating the kilometres travelled, while buying mangoes, while serving food and calculating the restaurant bill, and she has correlated multiplication with pookalam, a rangoli design made with flowers.

Every year, Delhi World Public School celebrates Math week and during this week we plan various activities such as making Math models, enacting math stories, integrating art with math etc. The students enacted maths plays referring to the book "Tales from the history of Mathematics' written by Archana Sarat. Our idea of writing stories was inspired from this activity. We wanted to do something different out of the box and that's where the idea flashed through to include story writing. This entire process happened over a period of about 3 months from November to January. Students from grade I to VIII wrote stories.

After the story is submitted, teachers review the stories in the class and individual feedback is given to the students. In the academic year 2019-20, stories were exhibited during the Math week and in the academic year 2020-21, the stories were published as an eBook. The link for the book is https://issuu.com/delhiworldpublicschool/docs/math_through_stories_37e547e733fb03

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