





# MATH FAIR:

## Focus on Fractions

*A math fair in India with hands-on experiences that simplify conceptual mathematics proves to be the perfect milieu to trigger children's interest in learning mathematics.*

**M**y primary focus in teaching mathematics for the past forty-five years—to create effective mathematics environments for students while enabling them to participate in mathematical experimentation—inspired the idea to host a math fair at our school in Bombay, India.

The basic concept of a math fair is threefold: (1) to create preplanned, organized, and intentionally developed mathematical learning environments; (2) to observe students' participation in and response to various activities; and (3) to use math fair activities as teaching aids and student enrichment in day-to-day classroom instruction.

The word *fair* itself reminds me of the very spirit of Indian culture and calls to mind the colorful event held in small Indian villages as people converge to worship their favorite deity. Adults and children enjoy participating in magic tricks, activities, booths, and rides such as roller coasters, Ferris wheels, merry-go-rounds, and so forth. Fairs have many interesting activities that engage children in play. The environment is vividly colorful, enthusiastic, full of energy, and pulsating with excitement and the hustle and bustle of life. We wanted to create a learning environment that would promote similar enthusiasm for mathematics.

**By Neelima A. Mokashi**

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In two-and-a-half days, more than eight thousand people visited the math fair.

## Establishing Committees

In India the academic year commences in mid-June and ends the following April. Our math fair evolved in four distinct phases. A fair would require members' consent, so during the month of June we submitted a proposal for a math fair to our institution's managing committee. Our proposal included a basic description of the event, a proposed budget, and the fair's objectives. After the committee readily accepted this venture, I explained the idea to the four principals of the kindergarten and elementary sections of our school (one English-speaking and one Marathi-speaking, the regional language, at each level). All four principals also supported the idea.

During the first week in July, we established the organizing committee: adviser and chief coordinator (me), internal coordinators (the institution's administrator and superintendent), and coordinators of the four sections (the principals). Our working committee consisted of four supervisors for each section, four teacher representatives, and four parent representatives. Subcommittees for various tasks involved all teachers, including art, music, and physical education instructors. In mid-July, the organizing committee decided on the venue and the scope of the math fair, set the dates for January 2007, established a preliminary budget, projected a list of the resources that would be required, esti-

mated the inaugural program's duration, and identified the chief guest. We wanted our chief guest to be a school alumnus who had a strong mathematics background. The total budget was Rs. 20,000 (rupees), which is about four hundred U.S. dollars. Each section received approximately one hundred dollars to work with.

## Preparing and Planning

At the end of July, the various committees met and started the second phase. Our main objective was to trigger children's interest in learning mathematics with hands-on experiences that simplify conceptual mathematics. We had other objectives as well:

- Encourage reluctant students to become active participants in the established learning environment.
- Encourage mathematical understanding through play.
- Inspire teachers and parents to explore various methods of teaching key concepts.
- Develop simple, low-cost teaching aids that encourage class participation.

One teacher manages sixty to seventy students in classrooms in India; interacting with individual students is very difficult. The idea of a math fair with

# Our threefold math fair goal was to create preplanned, organized, intentional mathematical learning environments; to observe students' response to the activities; and to use the activities as future teaching aids and student enrichment

thousands of children and parents simultaneously interacting at a single event appealed to many teachers, and they were willing to put in extensive time, effort, and preparation to make it happen. As much as possible, we wanted to highlight the entire mathematics curriculum from kindergarten to grade 4. With the help of parents and students, I distributed a list of related topics among all the teachers who were willing to put in the extra hours of work.

At the end of August, we again held a joint meeting of the organizing and working committees to refine two major components that needed extensive preparation: the entertainment programs and the exhibits.

## Entertainment programs

We agreed that entertainment programs performed by students on the school auditorium stage would launch the inaugural event. Mathematical operations and signs were to provide the basis of the performances. The programs' duration was only half an hour in total. Hence, every section had only five to eight minutes on stage.

## Exhibits

After extensive brainstorming sessions, we finalized our selection of specific activities and games as well as the resources needed to create them. Each section received printed instructions outlining needed preparation for specific topics in relation to the mathematics curriculum (to be covered in both English and Marathi).

Although preparations for the entertainment programs and exhibits were completed by the end of September, we still did not have a clear picture of the expenses. However, by the end of October, we had formulated a detailed budget. (Unfortunately, we overlooked the expense of snacks and lunches for the volunteers.) At this time, fairly late in the game, someone suggested the idea of sponsors.

The school year's first term ended in late October, followed by Diwali (the Festival of Light) and a three-week "vacation," during which the whole team steadily continued to prepare activities. During our

one-week Christmas break in December, we made final touches, and the countdown began. Our next step was to collect all the prepared exhibits (activities and games). Storage proved to be a problem; we resorted to using some of the classrooms.

## Math Fair in Action

On January 11, 2007, our math fair began with great enthusiasm. Using the fair's inauguration date, we decorated the main entrance to the exhibition hall with a poster of a magic square, cells of which equaled the same total for each row, column, and diagonal. We also displayed an artistic image of Lord Ganesh, the Hindu god of knowledge, drawn solely using numbers. Right



**Figure 1**

Children were introduced to fraction symbols and then looked at posters and manipulatives that illustrated those symbols.



This is a picture of a cake. One-fourth has been removed. Three fourths remains. The fraction is written as

$$\frac{3}{4}$$

$\xrightarrow{\hspace{1cm}}$  Numerator (N)  
 $\xrightarrow{\hspace{1cm}}$  Denominator (D)

Figure	Total No. Shaded Rectangles	Total No. Rectangles in Figure	N (up) $\uparrow$	D (down) $\downarrow$	Fraction Shaded	In Words
	1	4	1	4	1/4	One-fourth
	2	4	2	4	2/4	Two-fourths
	3	4	3	4	3/4	Three-fourths
	4	4	4	4	4/4	Whole

away, the inauguration ceremony perfectly set the mood of the fair with the publication of manuscripts by the chief guests and with children's performances that featured mathematical concepts:

- One action song was called "Train of Numbers."
- A fancy fashion show correlated mathematics with language. Students wore animal costumes to represent each letter of the word *mathematics*. The *M* was a monkey; the *A* was an antelope; the *T* was a tiger, and so forth.
- A skit told the story of *A Mouse with Ten Tails*.
- Physical activities included a flash card drill with mathematical signs.

During the following two-and-a-half days, more than eight thousand people visited the various booths lining the main exhibition hall. Hosted by teachers and student volunteers, most of the exhibits were hands-on games and puzzles, which instantly captured youngsters' attention. Each booth was devoted to one fundamental mathematical concept, such as prime numbers, multiplication, division, or fractions.

We certainly met our objectives from the Preparing and Planning phase and accomplished our main objective of triggering children's interest in learning mathematics. Students were involved in copying articles, drawing figures in manuscripts, and decorating the rooms. They acted as magicians, showing simple mathematical tricks to spectators. Some explained to visitors how the games and activities worked. Younger children participated in entertainment programs. It was an exciting learning environment for the whole crowd, as was evident from the visitors' active participation and their comments in the feedback book.

### Focus on Fractions

The math fair addressed such a wide variety of mathematical concepts at once that it is difficult to communicate the complete details of every activity in one article. I will relate some of our fraction activities and exhibits, although only about one-tenth of the event addressed the subject of fractions.

We distributed fraction activities and games into

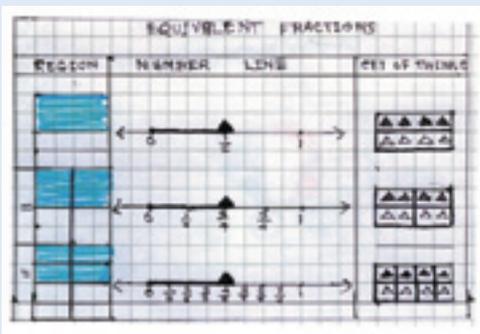
**Figure 2**

Posters illustrated the meaning of *fraction* and types of fractions.

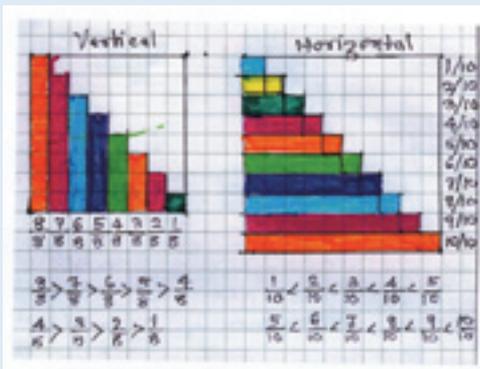
(a) comparing fractions



(b) equivalent fractions



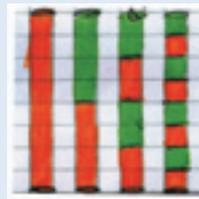
(c) like fractions



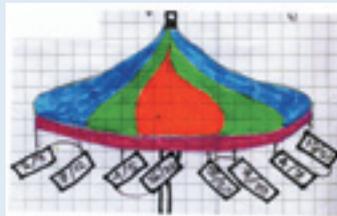
**Figure 3**

Hands-on manipulatives augmented these equivalent fractions posters.

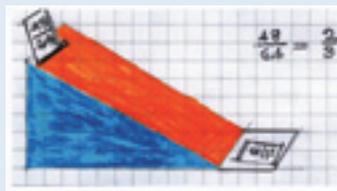
(a) cylinders (or Legos)



(b) merry-go-round



(c) magic slide



(d) distributing pizza



(e) poster



seven major categories according to the mathematics curriculum from kindergarten through grade 4: geometric patterns, distribution of a set of objects in equal parts, measurement problems, fraction symbols, fraction families, addition and subtraction of fractions, and comparison of fractional values. (See **table 1** for the objectives of some categories and their related activities.)

After children learned the symbols for fractions (see **fig. 1**), they looked at posters illustrating the meaning of the word *fraction* and various types of fractions, such as *unlike*, *proper* and *improper*, *mixed*, and *equivalent* (see **fig. 2**).

In addition to posters to illustrate families of equivalent fractions (see **fig. 3**), we used three-dimensional models such as cylinders; Legos® would work, too. In

**Table 1****Selection of Fraction Activities and Games**

	Objectives	Activity or Game
<b>Geometric Patterns</b>		
1.	Recognize basic fractions (one-half, one-fourth, three-fourths).	Simple folding techniques (origami for third- and fourth-grade standards) Rangoli (a word used in India for joining dots to create a design using colored powder) Quilt and tile patterns (see <b>fig. 4</b> )
2.	Develop understanding of fractions as equal parts of unit wholes.	Cylinders (see <b>fig. 3a</b> ) Circles: Divide models of pizza into two, three, and four equal parts (see <b>fig. 3d</b> ). Rectangles: a chocolate bar Poster (see <b>fig. 3e</b> )
3.	Build skills in recognizing fractional numbers as equal parts of a whole.	Join the pieces to create a complete square.
<b>Distribution of a Set of Objects in Equal Parts</b>		
1.	Develop understanding of fractions as parts of a whole set or group of items. Division plays an important role.	Use ice trays, egg cartons, and pebbles; divide twelve into two, three, and four equal parts to show one-half, one-third, and one-fourth. String 12 beads (see <b>fig. 5b</b> ).
<b>Measurement Problems</b>		
1.	Understand fractions in context of length, volume, or weight.	Show one-half, one-third, and one-fourth meter of a ribbon or cloth. Use different-shaped jars of 1 liter, 1/2 liter, 1/4 liter, and 1/8 liter. Use a balance with weights of 1 kg, 1/2 kg, 200 g, and so on.
<b>Fraction Symbols</b>		
1.	Recognize, read, and write the fractions 1/2, 1/3, and 1/4 as symbols and in words.	Train of dominoes (see <b>fig. 6a</b> ) Jigsaw puzzle (see <b>fig. 6b</b> )
2.	Develop understanding of fractions on a number line.	Use a number line.
3.	Develop combined understanding of a fraction of a whole region, a number line, and a set of things.	Use graphical representation for the whole region, a number line, and a set of items on one poster (see <b>fig. 2b</b> ).
4.	Provide an opportunity to go beyond the textbook and classroom.	Are you a good “fitter”? On a grid of parallel lines, students fit triangles, rhombuses, trapeziums, and hexagons into a figure and answer questions such as, “What fraction of a hexagon is a triangle?”
5.	Provide insight into geometric figures and provide minds-on activities for fractional values.	Tangrams are another interesting tool for learning fractions.

keeping with the *fair* theme, we displayed a Ferris wheel model. Adjacent horses on a merry-go-round would also illustrate the concept. The magic slide is a wonderful teaching aid for students in kindergarten and older. Some of our more popular and interesting attractions were a magnetic board, the simple version of Cuisenaire® rods, a Dice game (also known as the I’m No. 1 game), and a Bowling game.

## Follow-Up Phase

After the event was over, we continued to use the activities and games as teaching aids in everyday class work. Collecting objective and subjective data will be a demanding, ongoing process. We have yet to establish specific goals for statistical analysis. And yet, we must carry out a solid follow-up research project in the near future to enable us to capture objective data on the precise

impact the math fair had on students, parents, and teachers.

## Conclusion

Planning for emergencies and unexpected hurdles during such a large event is necessary but nearly impossible. Of course, not everything ran smoothly:

- We dealt with shortages of time, money, and space to store the material in advance.
- Because we had waited so long, we had to search for sponsors in the month of December. We should have decided earlier, but no one had anticipated such a huge response to the fair.
- Very few teachers and parents in our school community have access to computers and Internet connections, and India has a scarcity of mathematics books, so our book exhibit was quite small.
- One of the principals had a health incident and was admitted to the hospital during the fair.
- As a retired principal of the institution, I was careful to avoid interfering in the school's day-to-day activities as we prepared for the fair. In an inauguration ceremony slide show, I demonstrated the fair's objectives and described the booths, but I depended on the high school authorities to carry out much of the program—although they were busy with many responsibilities during the month of January.

## Our comment book

The fair targeted kindergartners through fourth graders, so participants were younger children. Their general feedback was, "I had fun." One student wrote, "If these fun games come to our classroom, I won't know it is a math class; it would be fun!"

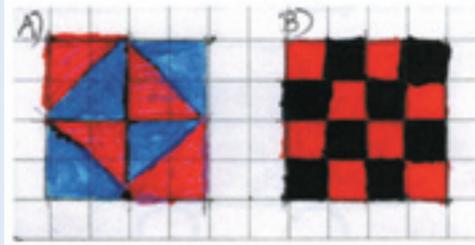
Specific comments from a parent's perspective included the following:

- We loved this; children were bubbling with energy.
- Is this really the subject of mathematics?
- If we had an opportunity to be part of something like this when we were children, maybe I would have liked math!
- This was a dreamlike fair; this should be ... mobile ... so other schools can also have a chance to experience this.

### Figure 4

Quilt and tile patterns illustrated basic fractions.

(a) geometric patterns



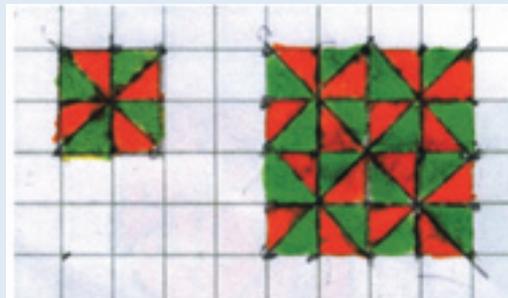
(b) coloring patterns



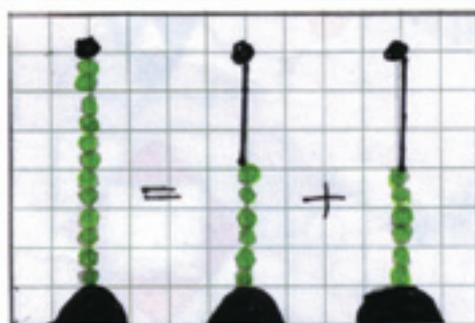
### Figure 5

Other ways that students at the fair learned to recognize fractions were by

(a) putting patterns as equal parts into a whole and



(b) distributing beads equally.



**Figure 6**

The objective of these displays was to teach children to recognize, read, and write fractions in words and in symbols.

(a) train of dominoes



(b) jigsaw puzzle



Among teachers' comments were the following:

- This should be part of a permanent hands-on exhibit at Homi Bhabha Science Center (a well-known institute promoting science and mathematics in Bombay, India).
- This should really go from the state to the national level.

One special visitor, the principal of an architectural firm in Bombay, wrote, "Can we borrow some of these ideas for our computer graphics section?"

The event also proved to be a great energizer and confidence booster for teachers. Numerous low-cost teaching aids became available after the fair and will help teachers continue to daily create interesting classroom learning environments.

### A dream come true

Seeing one of my dreams of many years come true was personally satisfying. With the cooperation of our school, municipal educational officers, sponsors, media, parents, and—most important—our teachers and students, it has been my immense pleasure to

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watch young students explore mathematical concepts with teacher guidance in such a creative environment. I am eager to work on the action research to test the math fair's teaching aids in a math laboratory and to collect and analyze detailed objective data regarding the actual use of the aids in a day-to-day learning process that displays students' responses and progress in learning mathematics.

This is just the beginning. I believe that sharing such experiences of learning and creating innovative mathematics environments may trigger interest in many inquisitive minds in the international community.



Children learn to recognize fractions in different ways. At the fair, students assembled geometric parts into a whole.

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