Maths Mela: A Unique Measurement Fair in a School

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School events such as a fair or celebration allow children to learn about matters which are more realistic and connect to daily life, in a manner which is beyond the scope of textbooks. In my learning and teaching experience, I encountered many events centred around science and other subjects but very few of mathematics. When talking about having such events in mathematics at least in the mainstream public education system, the number is almost zero. The learning experience for mathematics has not been very joyful and experiential as compared to others. When I heard about the unique concept of measurement fair, "MAPAN MELA", it quite excited me.

My first experience of this mela in a primary school was indeed amazing. Later, I read an article describing the same experience and, while it motivated me to try out such a mela, I was clueless about how to organize it. Not only were there a limited number of activities, but I also started doubting if it was appropriate for a larger age group of 10-18 years or even for teachers. Later, I encountered the IGNOU chapter on measuring units[1]. This talked not just about measuring length, weight, area, and volume, but also about the layered conceptual complexity of the units and methods. I understood that my assumptions about my students' understanding of these concepts could be unreal and that the fair could have very important objectives.

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- To encourage mathematics and mathematical thinking among students.
- To promote joyful mathematics learning experiences by connecting the concepts they had to learn to their daily life experiences.
- To encourage and nurture the approximation and estimation skills of learners using resources from their environment.

This helped me redesign and also add some activities which cover and excite children of all age groups. Now we call it both a Mathematics Fair and a Measurement Fair.

Preparation: Preparations for this fair are minimal in terms of time as well as resources. The material, which is all locally available, is listed along with the activities in the table below.

But I will explain the points which should be kept in mind for each activity. "Guessing" is at the center of all activities listed as the facilitator needs to ask the participants to guess the result for each measurement and then be allowed to check the result against the guess.

Measurement Fair - Registration Slip						
S.No.	**Name of the activities**	**Guess**				**Resources required**
1	Name					
2	Age	Years				
3	Weight		Kilos			
4	Length/Height		feet	inches	cm	tape measure
5	BMI					BMI chart and formula
6	Width		feet	inches	cm	tape measure
7	Foot length		cm	cm		tape measure
8	Palm length		cm	cm		inch tape
9	Body temperature		F	°C		thermometer or temperature gun
10	Pulse rate		bpm			stopwatch
11	Count per minute (grains)					a bowlful of pulses or cereals
12	Count in one breath					Count down from 1001
13	Breath-holding capacity		s			stopwatch
14	Water drops on a coin		Estimate		Actual	coin, dropper, a glass of water
15	Volume of a solid object		Estimate	ml	ml	measuring jar, beaker, putter, or any solid object
16	Change of Volume (Volume equivalence)		a bucket	how many mugs	how many glasses	glass, mug, cup
17	Palm area measurement		sq. cm			graph paper, pencil, colour
18	Footstep		first bottle	second bottle	third bottle	any three different solid objects such as bottles
19	Side measurement of Table/Black Board.		how many Bitta/palm length			
20	Weighing of 1 breath out of gas		g			Balloons, Small Weighing Machine

- **Measuring length and breadth of the body:** It is good to mark a scale (generally, of 100cm to 180 cm) on the wall with the help of a pencil or pen. While measuring the height, participants should remove footwear. A small ruler (scale) should be used to press down the hair before the height is marked on the scale on the wall. It's good to go with the centimetre scale but the facilitator should know the foot and inch scale along with metre and centimetre. While measuring the width of the body, make sure the hands are fully open up to the middle finger and in a straight line with the shoulders. For accuracy, it's good to mark finger-tip to finger-tip on the wall and then measure the breadth of the participants. This avoids the curved path and the false increase when the tape is wrapped around the body.
- **Measuring weight:** Always measure without shoes and overclothes (sweater, coat, shawl etc.). This helps to get a precise value.
- **BMI Index:** Calculating Body Mass Index (BMI) using the measured weight and height. It is an indicator of good health and the right proportion of weight as per height. It's good for the facilitator to know how BMI gets calculated (BMI = Weight/Height^2). The normal range is 18.5-25. Below 18.5, the person is underweight, those more than 25, the person is overweight, and those with BMI above 30 are considered obese. Facilitators should read more about BMI and know its limitations. As per current thought, BMI does not measure body fat directly, it should not be used as a diagnostic tool. Instead, BMI should be used as a measure to track weight status in populations and as a screening tool to identify potential weight problems in individuals [5].
- **Measuring body temperature:** This is also very easily done with temperature guns, but facilitators should discuss the unit of measurement and the conversion from Fahrenheit to Celsius and vice-versa. This is appropriate to discuss with 8-10 grade students.
- **Measuring palm and foot length:** It's good to mark the scale on a piece of chart paper and paste it on the ground or bench. Participants can measure the palm and foot length by putting them over it.
- **Counting in one breath:** This is a fun activity along with counting and checking number sense. Participants are asked to guess the number up to which they can count in one breath. Usually, they count from 1. After they are done, you can ask them to count from 1000, or in hundreds, or even in reverse order from a stated number.
- **Counting cereals:** This activity again checks counting and estimation skills in a fun way. There can be multiple participants who can check their answers against each other's counts.
- **Counting pulse rate:** First, the facilitator should know what is pulse rate and how it is related to the heartbeat. What is the pulse rate of a normal person? Where can we easily feel the pulse? Finding the pulse is an achievement for students and I have seen the magical sparkle in their eyes the moment they get it, especially the smaller ones. Let them take time to find it. Before they measure, let them ask the 'candidate' to relax and take a deep breath at least five times. Avoid measuring when they have just come running or doing heavy work of any kind. For a timer, a wall clock or hand/smartwatch, or mobile can be used. It is good to take the best of three measurements.
- **Holding the breath:** It is another health exercise that participants take as a challenge and that's fun. They do enjoy doing this. The result can be taken out of the best three. Good to use a mobile stopwatch or smartwatch. The facilitator is advised to do this test separately for each child and ensure that this does not turn into a dangerous competition.
- **Counting the water drops on a coin:** These are some of the exercises which overlap with science but here we focus on the mathematical part. As this activity is not so common, participants see a significant difference between

their guess and the actual number, and that amazes them. The use of multiple droppers and different coins is suggested when working with a larger group of participants. It's good to put this stall in a corner and restrict the number of visitors, otherwise, the guesses get influenced.

- **Measuring the volume of a solid object:** The apparatus is specific - a measuring jar or beaker. The solid object could be anything but a paperweight or any small pebble which could be submerged easily in a mug or measuring beaker is preferred. This activity starts with giving the apparatus to participants after they guess the volume. If they have no idea about how to find the volume, leading questions and some instructions can be used to scaffold the measurement. If all else fails, a demonstration can be done in two ways: Fill a mug placed on a container (to catch the overflow) with water. Drop the solid object (whose volume needs to be found out) gently into the mug. Let it settle and then collect the water which has overflowed into the container. Pour it into the measuring cylinder and read the scale. That will be the approximate volume of the solid.

  Another way is taking water into a measuring beaker and marking its level on the scale printed. Drop the solid so that it gets submerged fully and the water level rises. Read this new scale level. Subtract the previous reading from the second one. This gives the volume of the solid object.

- **Transformation of volume equivalence:** This concept is related to volume transfer from one vessel to another. This adventure also starts with the question of how much or many of the small vessels will be equivalent to a large vessel. Let them guess and then let them check for themselves. This could be done with a bucket and mug or even a mug with small tea cups.

- **Measuring the area of the palm or any irregular 2D shape:** The object should be outlined over graph paper. (The palm could be dipped in watercolours and the print taken over graph paper.) Count the square boxes which are completely or more than half inside the print area. Omit the squares which have more than half uncovered. The total count will give the approximate area of the palm in square units.

- **Measuring in footsteps:** This activity uses footsteps to measure lengths. This is one of the common local units to communicate the measurements of a piece of land in many cultures. In this activity, 2 -3 bottles may be kept as markers (or an "X" with chalk on the floor could be marked) at three points A, B and C. Participants first guess the distance in footsteps and then measure to verify.

- **Measuring with Palm:** This is another common method used in the villages. In this task, participants are asked to first guess the length of the table or window and then measure it. Facilitators should try to measure the lengths of different objects for different candidates.

- **Weighing the gas of one breath:** This is a task to measure the weight of gas breathed out at one time. This could be collected in a balloon. Do measure the weight of the empty balloon first by using a digital or conventional lightweight scale to which the balloon is tied with a string. After exhaling into the balloon, measure the weight again.

The list of activities can go long and we have many activities which certainly engage children and provide a learning opportunity, to think about, create and add to the list. The core idea remains the same, i.e., the activity is simple, very low-cost material is used and there is space for speculation and mathematical exploration. Activities from other subjects may be used but we explore the mathematical part of it. Here, the activities were centered around measurement but many other fun yet challenging tasks/games/puzzles like a picture puzzle, mind game reader, card game, fun with matchsticks, mathematical treasure hunts and many local popular games may be included as well. This ensures a good day-long activity and mathematics fair.

Do's and Don'ts during the fair preparation:

1. It's good if the facilitators practise the activities among themselves for a day or two and also read and discuss the basic facts behind each of the activities.
2. Facilitators in each stall can be given logistical support.
3. Stalls should be spaced out so that students do not form a crowd.
4. Avoid crowding a stall so that students do not get influenced by other participants' estimates and answers.
5. It is good to have a couple of sets for each activity if the participant number is large.
6. A clear map with stall locations is needed at the entrance. Also, each stall should be labelled with bold letters.
7. The attached registration slip is mandatory for all participants to attend the fair. If not available, participants can use plain paper to note down their guesses and results for each activity.
8. To fill the response in the registration slip, a sketch pen or pencil may be used, with different colours for different stalls. A whitener might also be required to correct responses.
9. The registration slip is good to go with two prints per page. (Try back-back prints to save paper.)
10. Facilitators should be conscious of mentioning the unit while giving the final result to the participants.

Pre- and post-talk are very necessary and helpful to see how much they enjoyed and if they have come across any findings during this experience. Like length and breadth being almost the same and palm and foot length as well. As we practise and become aware, our capacity for counting increases. As a facilitator, I found this fair an opportunity to start discussions about measurement on an interesting note. In the conventional method, this part has been confusing and too focused on facts and calculations. My focus was on the identification of local and standard units to measure different physical quantities and the conversion of units to their subunits. But this could provide a dialogic platform to explore questions such as the need for measurement. Why are standard measures used? Why are there sub-units of measurements and why are different units used for different objects and quantities? Starting from the concept of measuring length, areas, volume, capacity, mass, quantity, current, etc., may be explored based on the level of students. I found all of it very appropriate for all school students up to grade 12 along with teachers and parents as this all together helps to nurture the measuring skill and ability to choose appropriate measuring units based on the need of measuring a physical quantity. I also see that there is a lot of scope to go further and explore more with more advanced measuring tools such as vernier calliper, screw gauge, multimeter, sextant, etc.

The facilitators as per the capacity and scope of space and time may extend most of the activities into making a pool of data to understand data handling which would include representation and interpretation of data. They may, in a manner appropriate to the age and grade of the students, calculate central tendencies such as mean, mode, and median and their significance along with dispersion and deviations. All of these activities inside and outside provide interesting and contextual data to interact and learn important data concepts without going much into the textbooks or external data. But this has to be precisely planned with cues and questions to lead students into much more complex concepts in a more relatable and contextual manner. Findings may be put up near the stall itself and will be certainly interesting to the viewer.

Thus a math mela, while certainly a break from the routine of classroom mathematics, has extensive scope for learner engagement, introduction and teaching of more complex concepts. If the student will not come willingly to the math classroom, then why not take mathematics to the student?

References:

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[5] (Read more here: https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html, as on 25/04/23).

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