



Group	Subject	Topics
G3: Class 6, 7 & 8	Maths	Values in Mathematics

Values integration will help the students get life lessons through mathematics. Associating values with mathematical concepts can serve as a source of motivation for the students. If the students find a learning material engaging and meaningful, then they ask for more (since curiosity will start to kick in). Curiosity is the force behind lifelong learning!

The ideas presented here suggest some ways in which teachers can explore the integration of values education into the mathematics lessons.

A Value is:	A standard; A thing regarded to have worth; A principle by which we live/act; A standard by which we judge what is important; Something we aim for; Qualities to which we confirm
Mathematical Values:	Rationalism; Objectivism; Control; Progress; Mystery; Openness
Mathematics Educational Values	Accuracy; Clarity; Conjecturing (Estimating; guessing; assuming); Consistency; Creativity; Effective organisation; Efficient working; Enjoyment; Flexibility; Open mindedness; Persistence; Systematic working

The world is interconnected. Everyday mathematics shows these connections and possibilities. We need to bring these concepts into the class room discussions. The earlier our young learners are put into these practices, the more likely we can have more innovation in our society and economy.

Example: Algebra can explain how quickly water becomes contaminated and how many people in our country drinking that water might become sickened on a yearly basis. A study of geometry can explain the science behind architecture throughout the world. Statistics and probability can estimate death tolls from earthquakes, conflicts and other calamities around the world. It can also predict profits, how ideas spread, and how previously endangered animals might repopulate. Math is a powerful tool for global understanding and communication. Using it, students can make sense of the world and solve complex and real problems. Rethinking

Illustration 1

content that makes the math itself more applicable and meaningful for students.

1. Order of Operations:

To perform Arithmetic Operations, we follow the rule of BODMAS. If this rule is not followed, then the calculations will yield different results. To get consistency, uniformity we follow rules.

Just like how BODMAS, a rule is used to get the consistent, uniform and accurate results from the mathematical operations, we, human beings to follow our own set of principles consistently we need to be systematic and follow the rules as applicable to place and time.

Relate this lesson to the importance of obeying rules/order for self-management and doing things one step at a time.

Teacher can ask the following questions to students and discuss briefly.

1. Why are rules important?
2. What aspect of obeying rules did you find quite challenging in the past?
3. What step-by-step process do you follow in solving for problems?

Illustration 2

2. Zero:

Zero is most important in every one's everyday life. This secures value when the other number comes along with this.

We are like zero in this world. We get value when someone in the form of another digit comes along with us. This is like, when parents, friends, family members, teachers or any other are with us we get value and we value them as well.

Illustration 3

3. Zero and Infinity:

What is ZERO? What is INFINITY? 3. Can ZERO and INFINITY be same?

We all think that we know the answers and we generally reply as following:

ZERO means nothing;

INFINITY means a number greater than any countable number;

ZERO and INFINITY are opposite and they can never be same.

But,

The concept of infinity can be understood in a very interesting way -

Imagine that there is an illiterate shepherd who can count only up to 20.

Now, if the number of sheep he has less than 20 and you ask him how many sheep he has, he can tell you the precise number (like 3, 5 14 etc.).

However, if the number is more than 20, he is likely to say "TOO MANY".

In science infinity means 'too many' (and not uncountable) and in the same way zero means 'too few' (and not nothing)

As an example, if we take the diameter of the Earth as compared to distance between Earth and Sun, the diameter of earth can be said to zero since it is too small.

However, when we compare the same diameter of earth with the size of a grain, diameter of earth can be said to be infinite.

The same thing can be ZERO and INFINITE at the same time, depending on the context, or your matrix of comparison.

The relationship between richness and poverty is similar to the relationship between infinity and zero.

It all depends on the scale of comparison with your wants.

If your income is more than your wants, you are rich.

If your wants are more than your income, you are poor.

Anyone can consider oneself rich, provided their wants are far less than their income.

People do not become rich by acquiring lots of money, but by progressively reducing their wants. If you can reduce your wants, you too can become rich at this very moment.

Illustration 4

4. Place Value:

Each number has got some value by default, and this default value changes according to the place. For example, 'zero'. Just the number 'zero' as such is used as nil. But, depending on where the number 'zero' is placed in the number, its value of the number varies.

For example, in the number 5190, 'zero' is in its unit place where as in 5019, 'zero' is in its hundred's place. Similarly, the placement of 'zero' before the decimal point or after the decimal point will change its value. For example, 43.04 and 40.43.

The change in place of 'zero' increases or decreases the value of these numbers.

Similarly, in life we all take different roles and responsibilities depending on the situation and place. A person is a 'father' to his children, manager in the office, a driver while driving the vehicle, a passenger while travelling etc. Similarly, a lady is a 'mother' to her children, a teacher in school, a wife to her husband etc. ...

Depending on the role, our responsibilities vary. Our priorities also depend on the responsibilities. Priorities are similar to the placement, and based on the placement the value increases or decreases like the number 'zero'.

Illustration 5

5. Equal fractions:

Observe the fractions $\frac{1}{2}$, $\frac{2}{4}$, $\frac{8}{16}$, $\frac{32}{64}$etc.... All these fractions have different numbers. But they all get simplified as $\frac{1}{2}$, even though it has different numerator and different denominator. In the first fraction $\frac{1}{2}$, the value of 1 and 2 are different from all the other numbers given in the set of fractions. But, when each of these fractions are simplified they all give the same result which is $\frac{1}{2}$.

This can be compared with the diversity we have around us. Like, we may speak different languages, have different skin colour, look differently, have different talents and abilities, a set of similar features block together and exhibit the same human values and qualities.

Notice that despite the differences in form, color, ethnicity, gender, faith, socioeconomic status, mental health condition, etc. our life is worth the same and worth saving. We are born equal, but not the same.

Story 1 - Equal Fractions:

Let us analyze the values in the following story -

Narration of the story:

There are 5 people A, B, C, D and E earning Rs 100, Rs 500, Rs 1000, Rs 2000 and Rs 10000 per day. An NGO doing a lot of social work approaches A, B, C, D and E to donate for their noble cause. Person 'A' donates Rs 50, 'B' donates Rs 250, 'C' donates Rs 500, 'D' donates Rs 1000, and 'E' donates Rs 5000. Mathematically, each of these five donate 50% of their daily earning.

Analyze who has contributed more? Obviously, E. But if we analyze the story all A, B, C, D and E donated 50% of their earnings. They are all in a way equal. At the same time, a person earning 100 donating 50 is more

valuable than others. So, qualitative analysis and quantitative analysis provide more insight about the transactions.

Story 2 : Fractions

Narration of the story:

It was in early 1900, when an interesting incident happened between 2 friends Shyama and Rama. Rama and Shyama decided to on a long ride on their bicycle. On the way, it started raining heavily so they took shelter in one of the mantaps on the way. Meanwhile, one more person Soma joins them. All the three watching the rain and having good fun. It was quite a time, Soma said that he is feeling very hungry. Rama and Shyama both said we have brought lunch, let us share equally. When they opened the box, Rama had 5 roties in his box and Shyama had 3 roties in his box.

They thought how to share 8 roties among 3 persons equally?

Teacher asks students, can you tell me how can we share 8 roties equally among 3 persons?

After, children answering for this question.....

Soma was very good at maths, he suggested to make each roti into 3 pieces. Now $8 \times 3 = 24$ pieces. Now, each one took 8 pieces and ate.

Pleased with the generous behaviour of both Rama and Shyama, Soma gave them 8 coins and told them to share and left the place. Rama gave 3 coins to Shyama and kept 5 coins for himself. But Shyama disagreed. According to Shyama, both should get 4 coins.

When both were arguing, they thought they should not fight for coins and loose friendship. So, they decided to go to the village head to resolve this issue.

Teacher pauses and asks a few questions

1. If you were in the place of the Soma, how much money would you give Shyama and Rama?
2. Was Rama justified to keep 5 coins?

The story continues...

The village head heard what had happened and concluded that Rama should get only 7 coins and Shyama should get the remaining 1 coin.

The village head declared that his solution was based on how much both had shared.

3. Justify the final judgement given by the village head.

(Solution: There were 8 chapatis and 3 people to eat. Each chapati was divided in 3 parts. Hence, there were 24 pieces, each of them should get 8 pieces. Since Shyama had brought 3 chapati's, they were divided in 9 pieces. So, he had kept 8 pieces to himself and shared only 1. Whereas Rama had brought 5 chapatis, which were divided into 15 pieces. He kept 8 to himself and had shared 7 pieces. Hence, Rama gets 7 coins whereas Shyama gets 1 coin.)

4. Teacher, asks for the feedback from students and the value they learnt from this story.

Illustration 6

6. Addition and Subtraction of Fractions:

Relate this to the idea that most of us tend to be attracted to people who are similar to us.

1. What are the qualities would you like your friends to have? Do you also possess these qualities?
2. Reflect on the saying: "Opposites attract". Do you believe in this saying?
3. Should you listen to the opinion of a person that is not like this saying?

Fractions that are dissimilar can still be combined. You just have to do some modification to the denominators to make the similar. Just like in real life, you live in a very diverse world. Even if tow people are different (in faith, gender, faith, socioeconomic status, etc.), they can still work harmoniously.

A key value that you need to develop is modifying your attitude and genuinely respecting other people.

Illustration 7

7. Polygons:

As we know, in geometry, a polygon can be defined as a flat or plane, two-dimensional closed shape bounded with straight sides. It does not have curved sides. The sides of a polygon are also called its edges. The points where two sides meet are the vertices (or corners) of a polygon. The simplest polygons are triangles (three sides), quadrilaterals (four sides), and pentagons (five sides), this goes on as the number of sides increases, the polygon changes the shape.

In life we too like a polygon, keep on adding values and develop our personality.

Let the students reflect on this.

What is the SHAPE of your life right now?

Spiritual gifts (What are the blessings that you received?)

Hindrances (What are the problems that you encountered?)

Abilities (What are the lessons that you understand? do not understand?)

Persons (Who inspires you? Who makes you feel sad?)

Experiences (How have your past experiences helped you grow as a student?)

Geometry (Triangles)

Relate this lesson to the rigidity of triangles. Other polygons can be easily deformed. If you make a rectangle or a square from metal wires with hinges at the corners, you will find that it does not stay in the orientation. It can be transformed into an ordinary parallelogram, in a triangle, each edge is supported by the other two edges. This characteristic makes a triangle stable. You have to act like triangles, and you have to make sure that you have a strong support group.

Illustration 8

8. Whole Numbers:

Connect the lesson to the concept of “ Wholeness”- comprising the full quantity, the start of forming a complete and harmonious whole, and the state of being unbroken and undamaged. 1.What were your experiences in

the past that make you feel “whole” or “complete”? 2. Bullying can make a person’s heart break/not whole. Cite a specific event in the past in which you or your classmates have experienced bullying (in any form). How did you respond to the situation? What can you do to stand up against persons who break or damage people’s heart?

Illustration 9

9. Factors and Multiples:

Associate this with the idea of organizing things.

You group all items that have a common factor together.

1. What are some benefits of being organized?
2. How do you deal with people who are having a hard time organizing things?

Illustration 10

10. Problem-solving:

Mathematical problem solving can contribute to the following values:

- perseverance
- thoughtfulness
- self-reliance
- resourcefulness
- common sense
- appreciation of social issues

Use a problem-solving approach to teach a standard mathematics topic, and observe the extent to which the students show signs of these values. Discuss your findings with your students.

Presenting a problem and developing the skills needed to solve that problem is more motivational than teaching the skills without a context. It allows the students to see a reason for learning the mathematics, and hence to become more deeply involved in learning it. Teaching through problem solving can enhance logical reasoning, helping people to be able to decide

what rule, if any, a situation requires, or if necessary to develop their own rules in a situation where an existing rule cannot be applied directly.

There are three types of problems to which students should be exposed:

1. Word problems, where the concept is embedded in a real-world situation and the student is required to recognize and apply the appropriate algorithm/rule (preparing students for the challenges of life)

Examples:

- 7 children went collecting old clothes and decided to share the work of distributing the same to the needy. They picked 245 number of clothes. How will they find out how many they will get each for distribution?
- Raghu helps his elderly neighbour for $\frac{1}{4}$ of an hour every week night and for $\frac{1}{2}$ an hour at the weekend. How much time does he spend helping her in 1 week?
- Recently it was discovered that a clean engine uses less fuel. An aeroplane used 4700 litres of fuel. After it was cleaned it was found to use 4630 litres for the same trip. If fuel cost Rs.100 a litre, how much economical is the clean plane?

2. Non-routine problems which require a higher degree of interpretation and organisation of the information in the problem, rather than just the recognition and application of an algorithm (encouraging the development of general knowledge and common sense), Non-routine problems can be used to encourage logical thinking, reinforce or extend pupils' understanding of concepts, and to develop problem-solving strategies which can be applied to other situations.

The following is an example of a non-routine problem:

What is my mystery number?

If I divide it by 3 the remainder is 1.

If I divide it by 4 the remainder is 2.

If I divide it by 5 the remainder is 3.

If I divide it by 6 the remainder is 4.

3. “real” problems, concerned with investigating a problem which is real to the students, does not necessarily have a fixed solution, and uses mathematics as a tool to find a solution (engaging students in service to society). Sometimes it is important to give problems which contain too much information, so the pupils need to select what is appropriate and relevant:

Example:

Last week I travelled on a train for a distance of 1093 kilometres. I left at 8 a.m. and averaged 86 km/hour for the first four hours of the journey. The train stopped at a station for 1 1/2 hours and then travelled for another three hours at an average speed of 78 km/hour before stopping at another station. How far had I travelled?

To be able to solve these problems, the students cannot just use the bookish knowledge which they have been taught. They also need to apply general knowledge and common sense.

Another type of problem, which will encourage students to be resourceful, is that which does not give enough information. These problems are often called Fermi problems, named after the mathematician who made them popular. When people first see a Fermi problem they immediately think they need more information to solve it. Basically though, common sense and experience can allow for reasonable solutions. The solution of these problems relies totally on knowledge and experience which the students already have. They are problems which are non-threatening, and can be solved in a co-operative environment.

These problems can be related to social issues, for example:

1. How many litres of petrol are consumed in your town in a day?
2. How much money would the average person in your town save in a year by walking instead of driving or taking public transport?
3. How much food is wasted by an average family in a week?

അലക്ഷ്യം