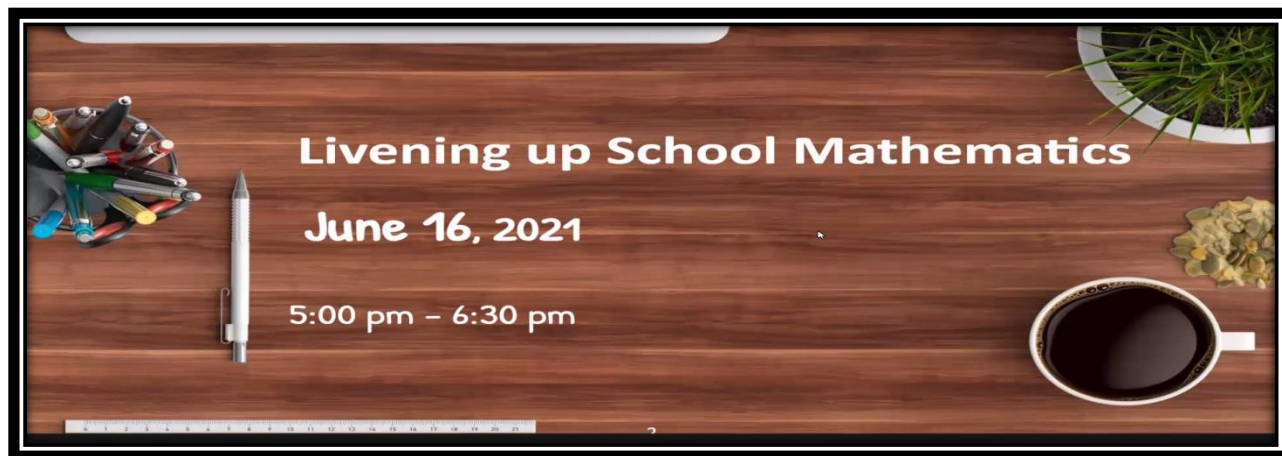


**REPORT ON**  
**'LIVENING UP SCHOOL MATHEMATICS'**  
**BY**  
**DPSS – HRDC TRAINING SESSION**



**FACILITATOR:** Prof. Dinesh S. Thakur

**ORGANISER :** Ms. Vanita Sehgal , Executive Director,  
The DPSS – HRDC

**INTRODUCTION:**

The session began with a cheerful welcome by Ms. Vanita Sehgal. She introduced the topic by a quotation,

*“It is the supreme art of the teacher to awaken joy in creative expression and knowledge.”*

*By Albert Einstein*

She expressed her feelings by saying, that ‘A successful math teacher has an extensive knowledge of mathematics. Not all students like math, but a good math teacher has the power to change that. A good math teacher can help students who have traditionally

Mathematics is not about  
numbers, equations,  
computations, or algorithms:  
it is about  
**UNDERSTANDING**

-William Paul Thurston

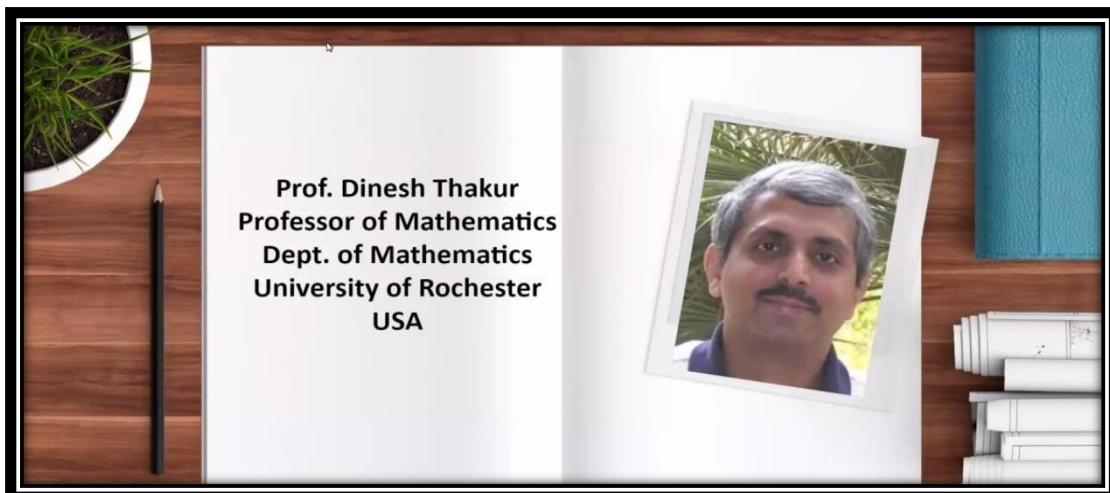
struggled with arithmetic begin to build confidence in their skills. For students who are usually bored with numbers, a good math teacher can breathe new life into the subject. A good math teacher makes her class a place where students want to be.'

She said, "I would be fortunate enough if I could have such an amazing Math's teacher.....".

Then she gave introduction about Prof. Dinesh Thakur as....



**Dinesh S. Thakur** is a [mathematician](#) and a professor of mathematics at [University of Rochester](#). Born in Mumbai, Before moving to Rochester, Thakur was a professor at [University of Arizona](#). His main research interest is [number theory](#).



He joined University of Rochester in July 2013. Thakur wrote a research monograph *Function Field Arithmetic*. Thakur has been serving on the editorial boards of *Journal of Number Theory*, *International Journal of Number Theory*, and *P-adic Numbers, Ultrametric Analysis and Applications*. Thakur is a founding member of-and for 15 years a participant in-the NSF-funded Southwest Center for Arithmetic Geometry and the Arizona Winter School.

He was elected as a member of the 2017 class of Fellows of the American Mathematical Society "for contributions to the arithmetic of function fields, exposition, and service to the mathematical community".

### **SHOCK TIME**

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#### **KEY WORD -- 'ALWAYS GIVE SHOCK TO YOUR CHILDREN'**

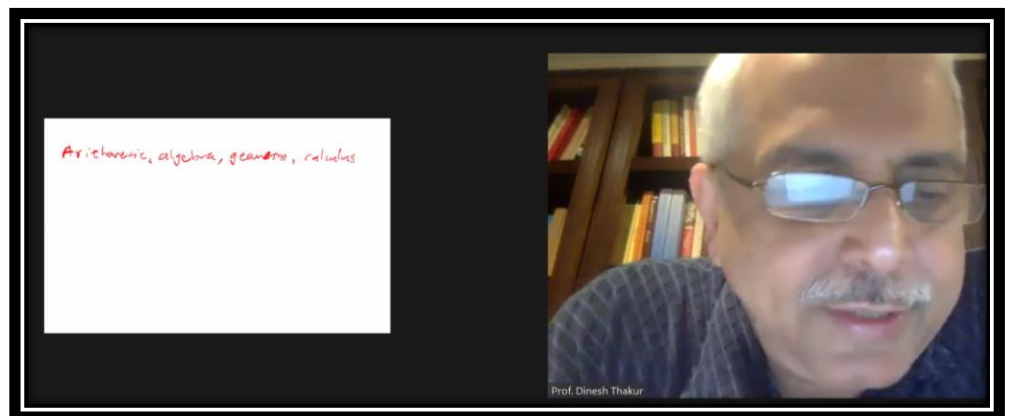
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Mr. Thakur reflected his profound knowledge about Mathematics and began the session with a brainstorming set of questions.

Mostly he used white board to explain various concepts of Mathematics, taught presently and explained how exactly to be taught in a classroom to avoid confusions..... which surely leads to innovative ideas/Divergent thinking.

- ❖ According to him, Basic Topics of Mathematics in schools can be divided as follows:

- Arithmetic
- Algebra
- Geometry
- Calculus



He focused mainly on the idea to give 'shocking conclusions' to your learners that force them to think and form their own theorems and results that is exactly 'THINKING BEYOND TEXT-BOOK'.

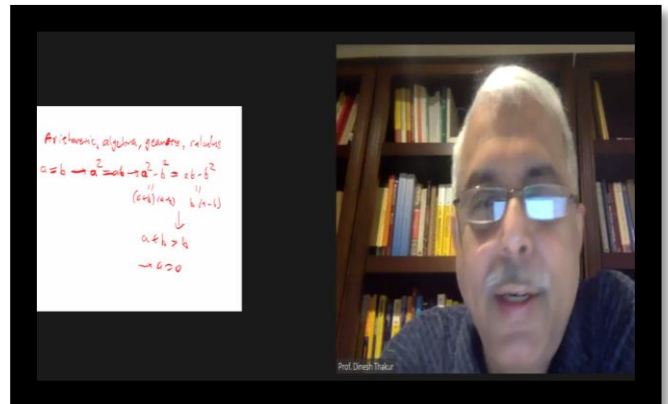
❖ Firstly he explained the concept from 'ALGEBRA' by taking an example of 'zero' that one can't divide by zero.....

- Let the students discover themselves...
- Let them start thinking.
- Discover and then develop the concepts themselves.

- Proved by taking an example,

$$'a = b'$$

By the representation of contradiction,



SHOCK TIME # 'TO THINK' #  
CONCLUSION

THINKING-----

CRITICAL  
ANALYSIS-----

EVALUATION--

## Example from 'GEOMETRY'

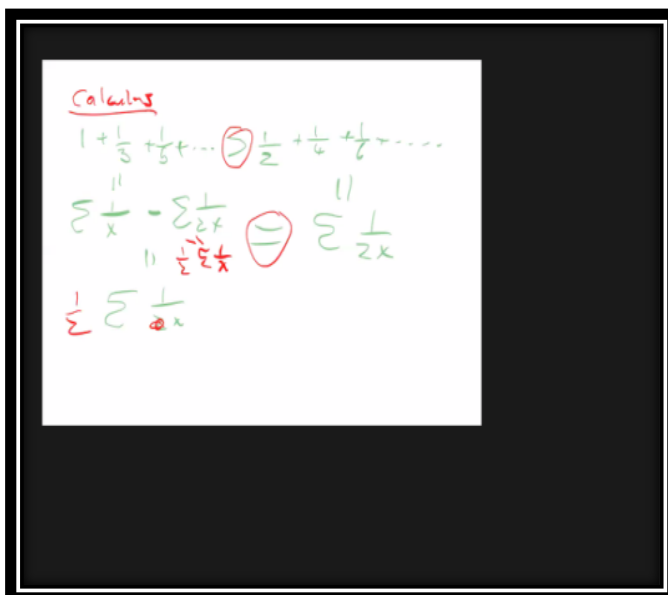
Taking an example from Geometry by drawing a triangle and by joining its perpendicular bisectors and angle bisectors.....he proved concept of

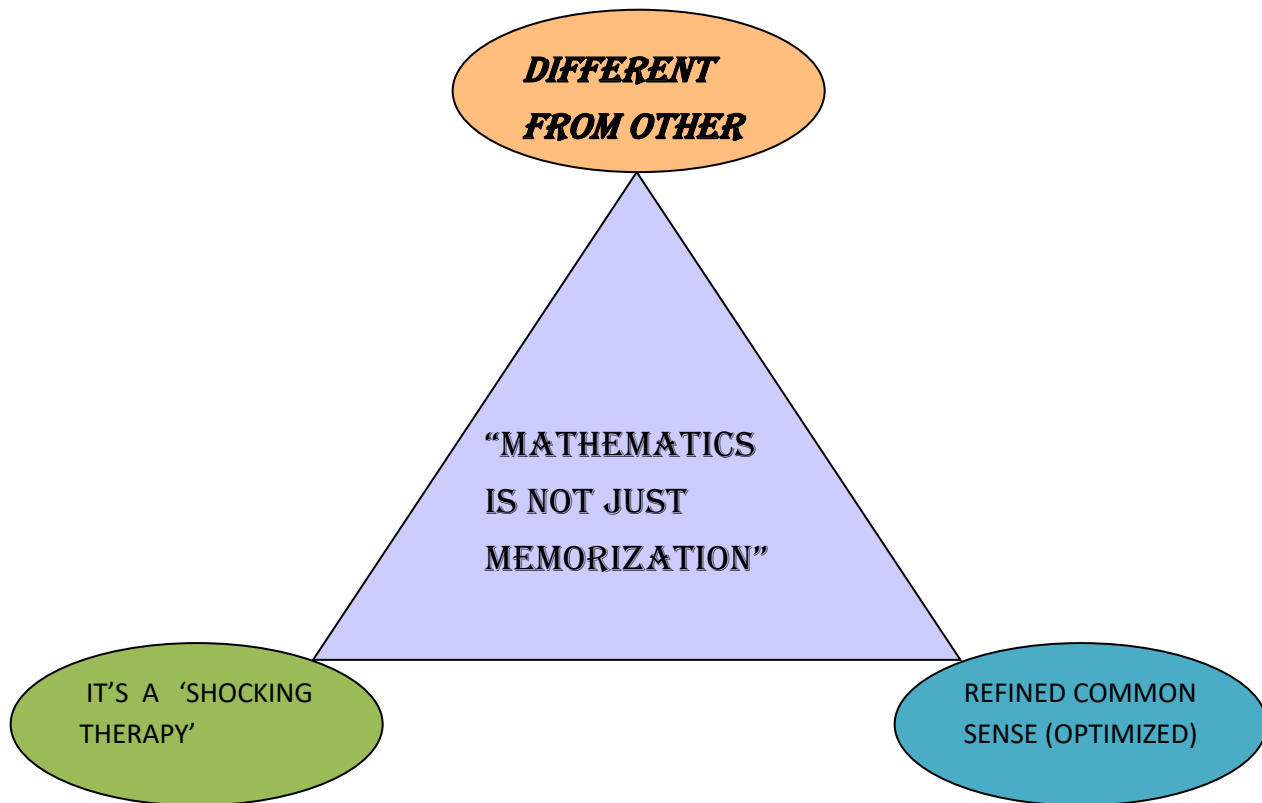


congruency of triangles.....and equality of its various sides and angles.

## ❖ Example from 'CALCULUS'

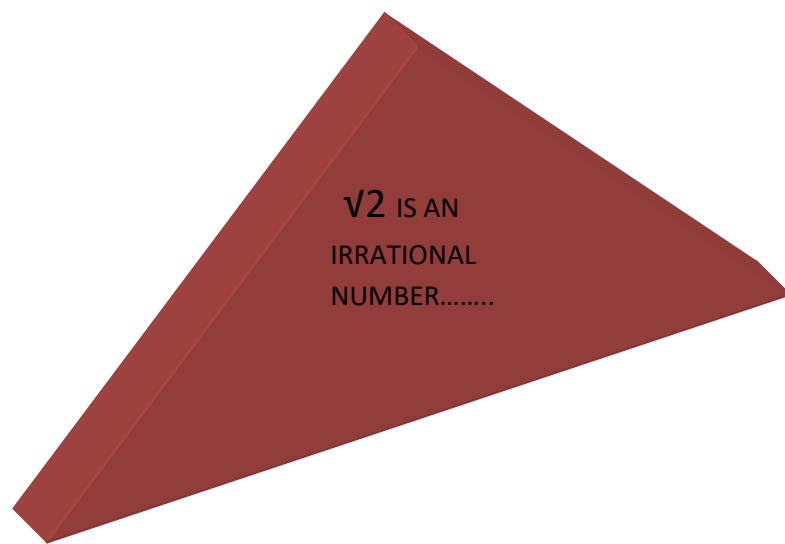
Here by representing inequality between two infinite series.....In next step by equating them Resource person asked the participants to 'THINK, RETHINK AND FIND THE EXACT CONCLUSION'.





➤ **THEOREM PROOF BY CONTRADICTION**

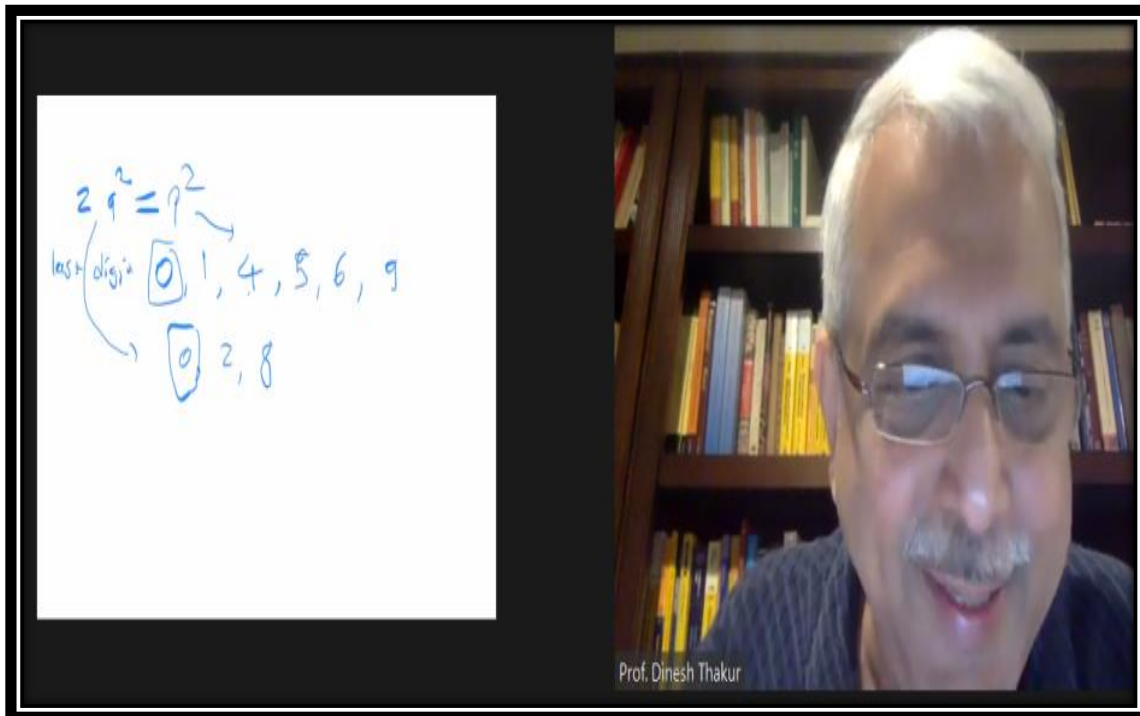
Students must be taught the correct usage of various results and this forms the basis of critical analysis and thinking beyond generalization/textbooks. One result can be retrieved by various ways.....



Zoom Webinar

$\sqrt{2}$  is irrational  
Sudhakar, 12/1  
pf:  $\sqrt{2} = \frac{p}{q} \rightarrow 2q^2 = p^2 \rightarrow p^2$  even  
 $\rightarrow p$  even  $\rightarrow q^2$  even  $\rightarrow q$  even  
 Contradiction

$2q^2 = p^2$   
 last digit  $\boxed{0}$  1, 4, 5, 6, 9  
 $\boxed{0}$  2, 8

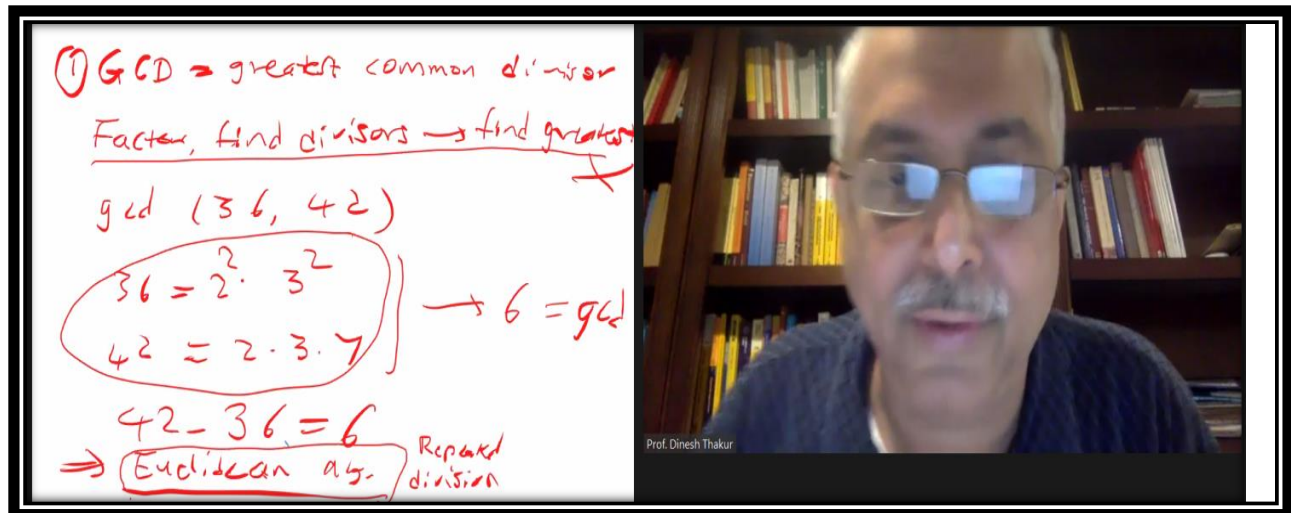


Prof. Dinesh Thakur

NOTE: 'IRRATIONAL NUMBERS ARE MORE THAN RATIONAL NUMBERS.'

### ➤ GREATEST COMMON DIVISOR

He stressed on the Reliable and Authentic methods to find the GCD.....He gave emphasis to use Euclidean Algorithm to find GCD between larger numbers.



① GCD = greatest common divisor  
Factor, find divisors → find greatest

gcd (36, 42)

$36 = 2 \cdot 3^2$   
 $42 = 2 \cdot 3 \cdot 7$  } → 6 = gcd

$42 - 36 = 6$   
⇒ Euclidean alg. Repeated division


Prof. Dinesh Thakur



Zoom Webinar

$p$  prime  $\Leftrightarrow$  no non-trivial factor  
 Try to factor  $\times$   
 Better method: If  $p$  doesn't divide  $2^{p-1} - 1 \rightarrow$  (probably) prime  
 much faster methods will always work.


Agarwal-Kagal-Saxena  
 guaranteed fast test.



Prof. Dinesh Thakur

$84 = 3 \cdot 24 + 12$   
 $24 = 2 \cdot 12 + 0$

gcd = the last non-zero remainder in repeated division.



➤ **QUERY TIME**

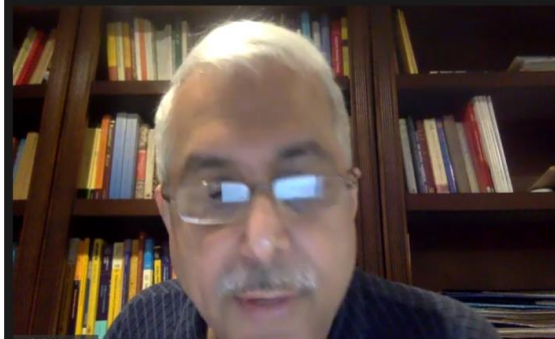
Various questions were asked by the participants.....some are as follows.

- Discussion on ways to simplify and find the number of zeros of a Polynomial having degree more than 4...

$$ax^2 + bx + c = 0$$

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

Formula of this type exists for deg.  $\leq 4$  but not for higher degree.



Prof. Dinesh Thakur

■ Another question asked by an educator from DPS SRI-NAGAR.....

“Students these days are loosing interest in the subject ....

suggest some strategies to improve their thinking and interest level.”



- TALK TO YOUR LEARNERS.
- FOLLOW ROUTINE TECHNIQUES AND DRILLING.
- USE SHOCK THERAPY.
- TRY TO RAISE THEIR CURIOSITY.
- NO ONE HAS MAGIC ANSWERS.
- LET THEM THINK BEYOND YOU TEACH.....AS MATHEMATICS IS REFINED COMMON SENSE.

Can You Relate?

**Dear Math,**  
I don't want to solve your  
problem, I have my own  
problems to solve.  
**Sincerely, students**

The enriching session ended by filling up the feedback form for the session and with warm regards from all the participants.

*Reported By,*  
*PREETI ARORA*