Virtual Labs for Mathematics with special reference to their pedagogical usage

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Background

Laboratory a key component

School education in India faces many challenges

- Lack of infrastructure including labs.
- *Students come out with little practical knowledge of the concepts they learn.*

Approach – Virtual Labs

Not meant to replace physical labs!

But augment and amplify them.

Virtual labs address deficiencies of physical labs.

Infinite repetitions at no cost.

It provides the ease and convenience of conducting experiments over the internet.

Aimed to bridge the constraints of geographical distances and time.

Technology can expand the boundaries of a physical Lab

Salient Features

Aligned to CBSE curriculum

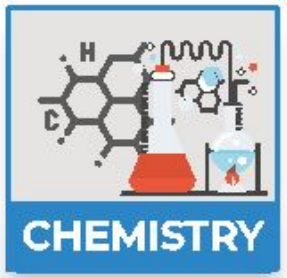
Interactive 2D/3D simulations

Simulations model real life environment

Authentic content

Intuitive feedback and guidance

Labs available in subjects



Labs available in languages

Eco-system

Theory relevant to the lab

Understanding of the process and its implications

The core simulator

Auxiliary requirements: plot, measurement and recording, etc

Review questions, references

Effective usage of Virtual Labs (Math) in your school

Minimally, use it for demonstration in class

To prepare students for the physical lab

To reflect on the activities performed in the lab

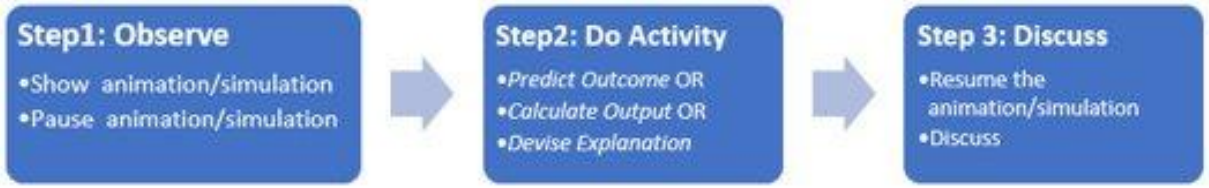
Can get more by ensuring students are actively involved in the activity.

Active learning strategies can be interleaved with usual lecture

As Homework – Give inquiry-based activities

Encourage self-evaluation using “Viva-Voce” section of each lab.

Proposed Active Learning Strategy for Virtual Labs (Math)



- Recommended time: 5-15 min
- *Predict Outcome* - Ask students to make prediction: "What will happen if …"
- *Calculate Output* - Ask students to calculate next step or output.
- *Devise explanation* - Ask students to devise reason for process
- **Choose activity based on pedagogical purpose and learning objective of the Lab**

Using Virtual Labs (Math) : Scenario

- **Teachers (In the classroom/Lab)**
  - Explain labs before performing the practical/lab session
  - Explain a procedure
  - Demonstrate a phenomenon
  - Set expectation about a lab
  - Can frame review questions with the lab as the backdrop (after Lab Session)

Creative teachers and students can come up with many more innovative uses!

Usage Virtual Labs (Math)

Students

- Familiarize with the Lab before physical lab session
- Try variations available in the lab
- Do revision
- Use Lab to reinforce the concepts, answer question they may have, etc.

Mathematics Labs – Salient Features

- 3D representation for select labs
- Facilitates drawing geometric figures on workbench with given dimensions
- Tools provided relevant to lab
  - Show Scale
  - Cut triangle/rectangle
  - Rotate Clockwise
  - Rotate Anticlockwise
  - Drag/Drop
  - Superimpose

Mathematics Labs – Salient Features

Instructions provided on each step

Actions taken by student/system in ‘Workbench”, displayed in “Observations”.

Details inference and conclusion after completion of Lab. Also relevant illustration on workbench.

List of Labs

Class 6 –8 : 90+ labs

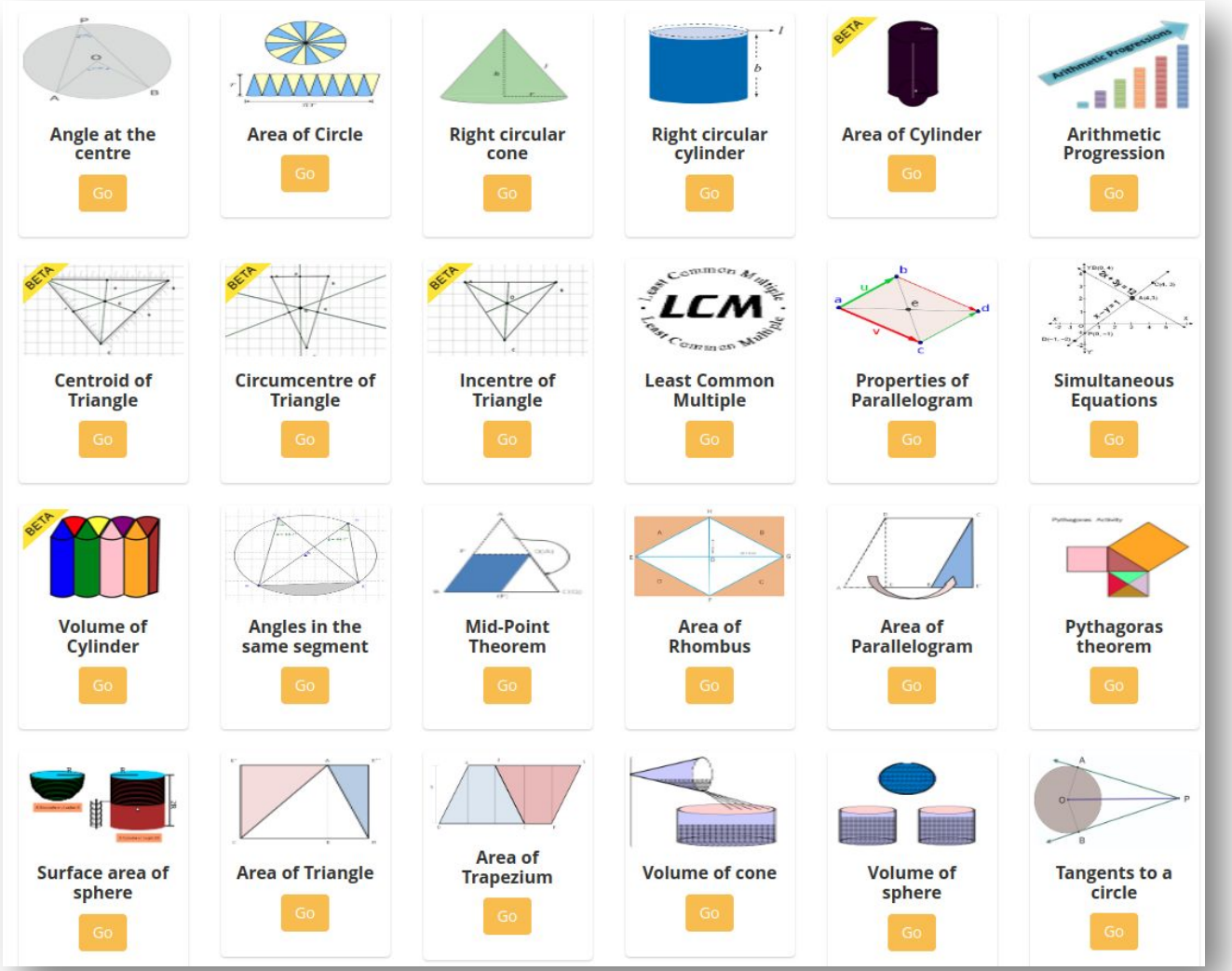
Class IX : 40+ Labs

Class IX : 40+ Labs

Class IX : 30+ Labs

Class IX : 25+ Labs

Screenshots

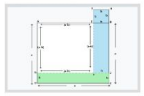


OLabs Phase II

Screenshots

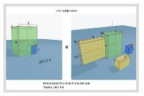
- **OLabs NextG**

Factorization Of Polynomial

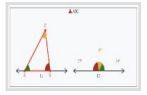


Algebraic Identity $(a - b)^2$

Factorization of Polynomial $2x^2 + 4x$

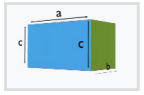


Algebraic Identity $(a^3 - b^3)$

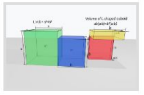


Angle sum property of triangle

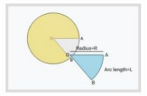
Cube and its surface area



Cuboid and its total surface area



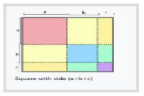
Algebraic Identity (a^3+b^3)



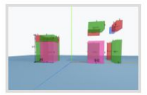
Frustom of a cone

Algebraic Identity $(a-b)^3$

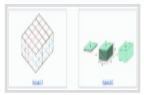
Surface area and volume of cone



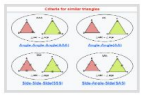
Algebraic Identity $(a+b+c)^2$



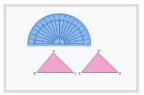
Algebraic Identity $(a + b)^3$



Volume of a cuboid

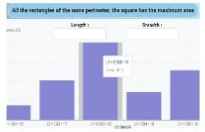


Similarity of two triangles

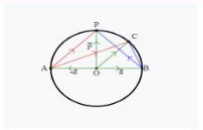


Congruence of triangles

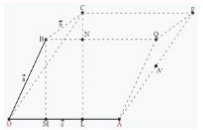
Class 12



Perimeter of rectangle and area of square

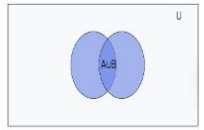


Angle in a semicircle

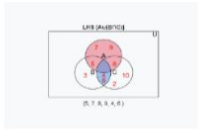


Distributive vector multiplication

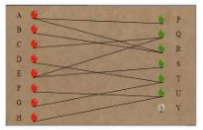
Class 11



Set theoretic operations using Venn diagrams



Set Theory: A ∪ (B ∩ C) = (A ∪ B) ∩ (A ∪ C)



Relation and Function

https://diksha.gov.in/virtuallabs.html

Demonstration of Mathematics Labs

List of Labs for Demo

3D Labs

- Volume of Cylinder
- Cube and Cuboids

Geometry

- Cyclic Quadrilateral
- Area of Circle

Algebra

- Algebraic Identity
- Polynomials
- Fractions

Virtual Labs Ahead!

Yes, we are now on to add another 500+ labs to the pool.

Classes 6-12, and more subjects including languages, social science, etc.

120+ Math labs to be added for classes 6-12

Many improvements in light of the challenges mentioned earlier.

Learner tracking and analytics
Guidance in the lab
AR/VR capability
Richer simulation – variety within limits.

Help us help you….

1

Share the information to all fellow teachers…

2

Share your feedback on whatever you have explored in this regard.

3

Let us know if there are some concepts/topics on which you would like such a lab to be available.

Thank You

- ***For any information, please write to us at:***
  - **Educational Technology Unit, C-DAC Mumbai**
  - **support[at]olabs[dot]co[dot]in**

For more details

- Email id: etu@cdac.in, vidyakashetu@gmail.com
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