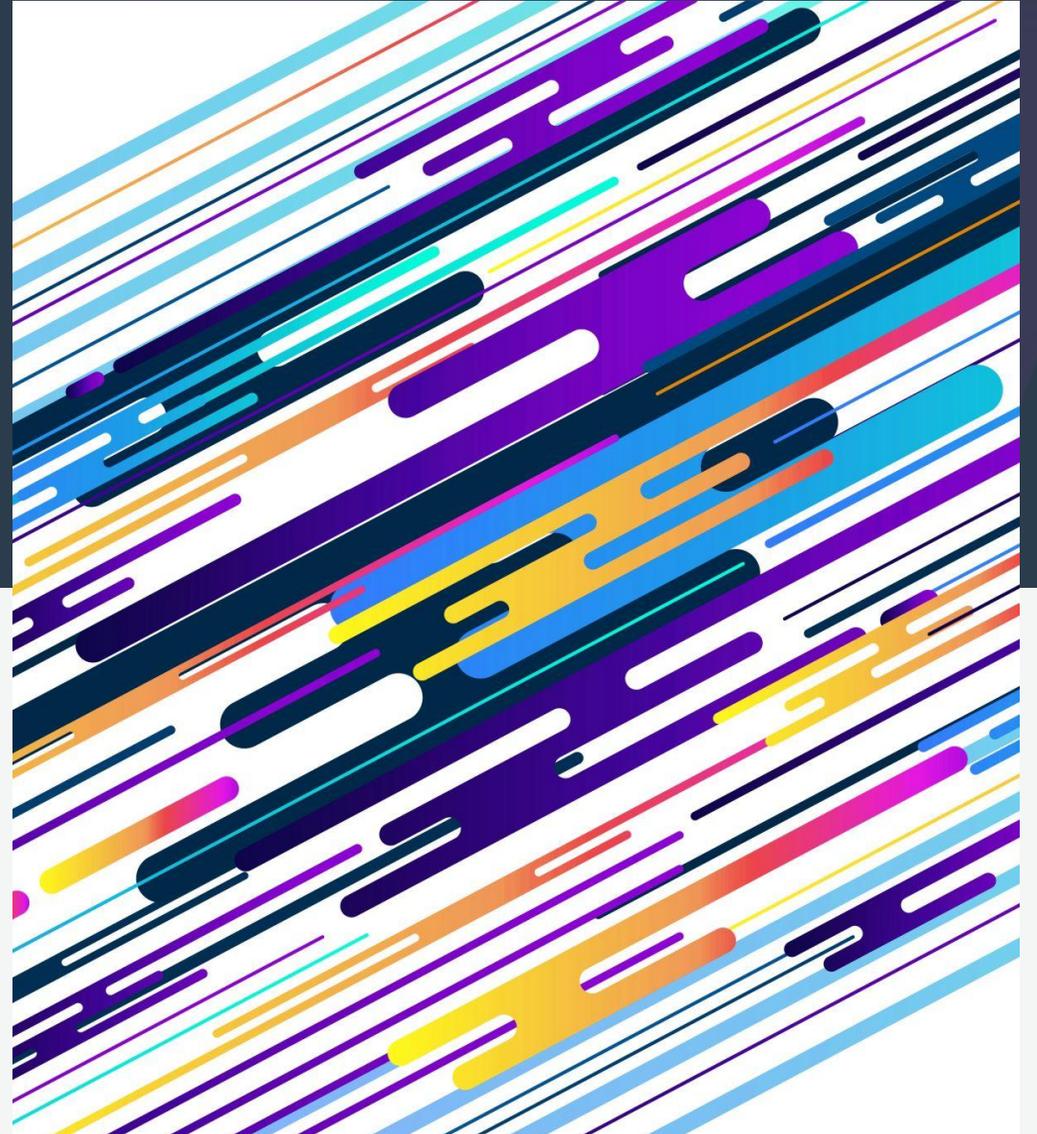


Virtual labs: Lessons from *the O Labs* *experience.*

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OLabs – virtual labs for schools

- The OLabs project, supported by Meity, has produced over 170 virtual labs covering Science, Maths and English for school students.
- Freely accessible on the web (olabs.edu.in).
- A 10-plus year long journey till date.
- Coming: A suite of about 700 more in the next couple of years.

Physics
Chemistry
Biology
Mathematics
English

Olabs.edu.in
--- Now available under
Diksha

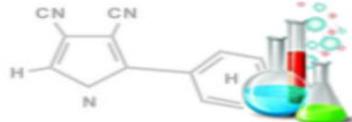
OLabs at present

Experiment/Lab Details



Physics

54



Chemistry

46



Biology

36



Mathematics

25



English

12

Total Experiments : 173

Classes:

- IX
- X
- XI
- XII

Plus 30 more recently added, and growing steadily

Available in

- English
- हिंदी
- മലയാളം
- मराठी

Landing page of OLabs

On Diksha, the labs will also be linked to the subject/topic directly.

The screenshot shows the OLabs website landing page. At the top left is the OLabs logo, featuring the Indian national emblem and the text "OLABS", "Funded by MeitY", and "Ministry of Electronics and Information Technology". At the top right are logos for "AMRITA VISHWA VIDYAPEETHAM" and "सी डेक CDAC". A navigation menu includes "Home", "About", "In the news", "Workshops", "Training", "Registration", "Contact us", "Login", and "Languages". The main banner features a photograph of two young girls in a lab setting with beakers and flasks. To the right of the photo is a graphic of laboratory glassware and the text "Experience REAL LAB LEARNING". Below the banner are five subject category buttons: "PHYSICS" (orange), "CHEMISTRY" (blue), "BIOLOGY" (green), "MATHS" (red), and "ENGLISH" (yellow), each with a representative icon. Below the subject buttons is a section for "Olabs Training Registration Form" with a "Featured Simulation" titled "Pythagoras theorem". To the right of this section is a text block titled "OLabs" explaining the platform's purpose, accompanied by a video player showing a student at a computer with a "PLAY" button.

Labs in education...

- Laboratories recognized as important devices in the learning process:
 - Hands on feel of the lessons learned.
 - Connecting the theory to the real-life.
 - Focus on experiment as a key paradigm in science.
 - Better internalization of the content
 - Tell me, I will forget;
 - Show me, I may remember;
 - Involve me, I will understand.

Active
Learning

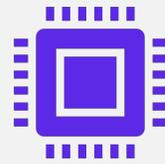
But....

- Cost and space requirements for physical infrastructure and equipments.
- Cost of raw material.
- Limited access, that too often in group mode.
- Support for divyang students?
- Not all activities amenable to physical labs:
 - *Pendulum with gravity change*
 - *Dangerous reactions*
 - *Time-taking tasks and very fast paced phenomena*

Virtual labs



Virtual labs and remote labs to the rescue?...



Virtual labs: simulation labs. Usually computer simulation of important aspects of the lab.

One of the recommendations in the NEP 2020



Remote labs: expensive equipments can be manipulated remotely; enables sharing of such resources.

Virtual labs

- Aka simulation labs (e.g. OLabs).
- Unconstrained availability; trivial cost once developed.
 - Development cost can be high!
- Simulations **attempt to** mimic the reality – but not actually the reality
 - There are boundaries ignored (spring's linearity region)
 - Simplifications introduced
 - Can manipulate the timescale (slow down very fast reactions, speed up the very slow)
 - There are also new opportunities (pendulum in Moon or Jupiter)

Can be a very
powerful
instructional
device

How effective..

- Many believe them to be education enablers...
 - Particularly in cases where education infrastructure is not adequate.
- But there are also those who believe these can be inhibitors.
 - Real-life experiences are important for a complete picture!
 - See as amplifiers, not replacements!
- Meanwhile, there is a lot we can do to make it a positive experience....

.... Such as....

1

Provide a comprehensive eco-system to reduce time to use.

2

Understand the pedagogical aspects and adopt relevant usage pattern.

3

Provide rich set of affordances and guidance.

4

Integrate into the curriculum.

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

OLabs: A view of a lab

you are here-> home-> physics-> class 12-> ohm's law and resistance

Ohm's law and resistance



Theory



Procedure



Animation



Simulator



Video



Viva Voce



Resources



Feedback

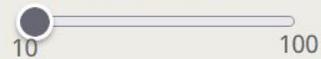
Ohm's Law

HELP

Select the metal:

Silver

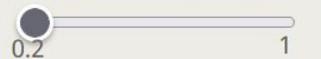
Length of the wire: 10cm



10

100

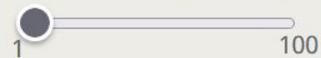
Diameter of the wire: 0.2mm



0.2

1

Resistance of the rheostat: 1



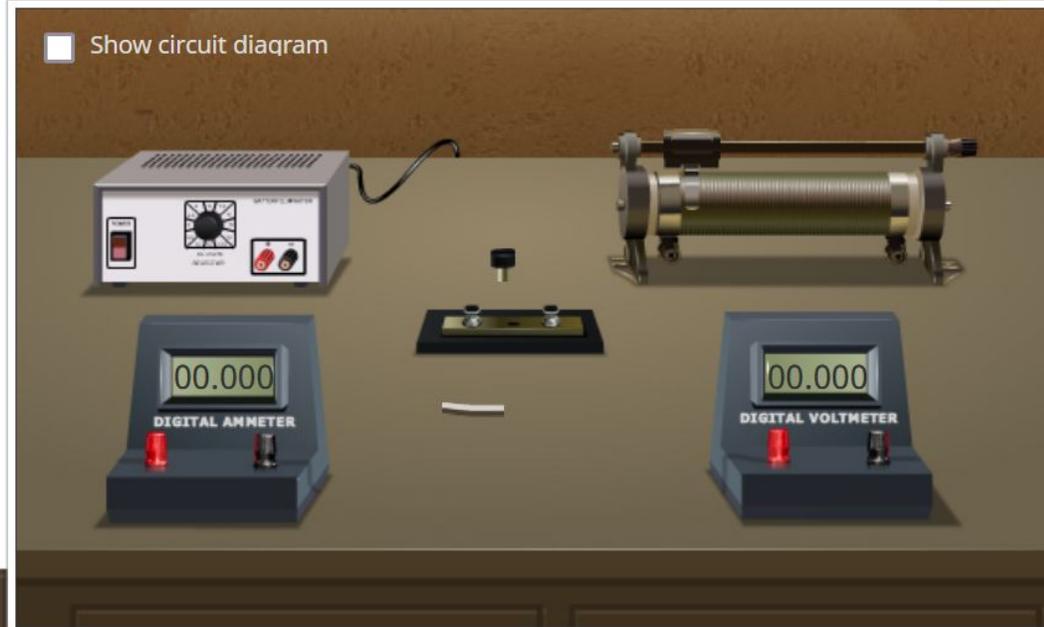
1

100

Show result

Reset

Show circuit diagram



Affordances

OLabs Ready to Use

- Compared to the many simulators available online, Olabs provide a complete eco-system for the lab.
- Consistency in terminology across the tabs.
- Compliance with the NCERT curriculum.
- Content reviewed and approved by CBSE teachers.
- High degree of interactivity for the learner and multiple affordances.

Usage mode-1

- Before the physical lab....
- Usually students have no idea of what to expect in the lab, till they reach there.
- Being prepared will help to use the limited lab time more effectively.
- OLabs mimics the experimental setup with high fidelity.
- Use the virtual lab as a preparatory ground before the lab.

Usage mode-2

- After the physical lab
- Physical labs provide limited options to explore..
 - due to resource constraints
 - and time constraints.
- In the lab environment, adequate time to reflect may not be there.
- Ask the learner to explore the virtual lab in more detail and try out more scenarios.
- Use reflection in the class, with specific scenarios.

Usage mode-3

- As an instructional device....
- Explaining concepts like hooks law, focus length of a lens, etc hard without a lab setup.
- Olabs can function as a replica of lab setup for this purpose.
- Demonstrate the intended behaviour using Olabs.
- Use affordances provided to try select use cases.
- Encourage the learners to try them out on their own.

Usage mode-4

- For active learning strategies...
- Active learning strategies like flipped classroom require mechanisms to engage a class without lectures.
- A lab setup replicated in the classroom can provide a fertile ground...
- Stop the experiment arbitrarily and ask learners to predict what happens?
 - What happens if a weight of 25Kg is put on the spring in Hook's law?
 - What happens to image, as the candle moves closer to the focal point of a lens?
- Deepens learning and encourages reflection.

Usage mode-5

- When there is no physical lab – e.g. pandemic, lack of infra.
- Can also function as replacement of physical lab in
 - Performing the activities envisaged.
 - Maintain lab records.
 - Getting a feel of the lab activities
 - Only appearance and activities though.

Lab specific affordances

- In each lab, a set of affordances are provided.
- These are chosen based on the expectation and requirements of the lab.
- For simple pendulum, you can change
 - The wire length, value of 'g', material of bulb, etc.
- For tense conversion, you can choose
 - The source and target tenses.
 - List of words provided to minimize typing overhead and errors.
- Tables to record data, where there is multiple iterations of the experiment is required.
- Plotting provision where applicable.
- Click to perform, where fine grained mouse control may be difficult.
 - Connectors in electric circuits.

Challenges

- Evaluation of labs
 - No accepted standards yet for this. Can do cost effectively with Olabs.
- Proper and timely guidance in the lab
- Collaboration
- Immersive experience
- Retaining interest
- Non-science subjects

These are being explored in Olabs NG!

Guidance in the lab

- Modelling labs for automated guidance is hard.
- Having a physical teacher around is expensive, not feasible.
- Need to look at
 - Guided lab (an agent advising appropriately depending on student activity)
 - Peer lab (two or more students in the lab at the same time, with provision to converse)
- Currently in Olabs, we have a procedure tab and animation tab for help.

Improved user(age) experience

- Mouse to manipulate everything in the lab...
 - Provide more realistic and natural manipulators?
- Gesture: turn the knob of the burner.
- Speech
- Haptic devices – two-way user interface
 - can help feel pressure, etc.

Retaining interest

- Gamification is a known technique to bring elements of a game to non-game environments.
- Help maintain a degree of 'flow' for the user.
- Gamify virtual labs
 - Structural
 - Content
- Provide a competitive environment for students to compete in scoring points and badges.
- Accumulate records over time to build a portfolio.

Non-science subjects

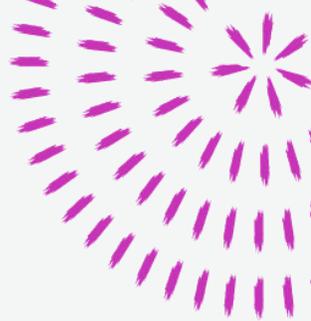
- Mathematics
- Languages
- Social sciences

- No real concept of a lab in these.
- Creating a lab environment could be useful.

Language labs?

- Can we use the same idea for languages -- English, Hindi?
- Four aspects to language: Reading, Writing, Listening, Speaking.
- Two components to consider: grammar and pronunciation.
- At higher level: coherence, organization, style
- Pronunciation required good quality ASR and TTS with Indian accent -- so deferred.
- For grammar:
 - Voice conversion, tense conversion, proposition, etc
 - Already part of Olabs.

Looking ahead



A very satisfying experience so far. CBSE and NCERT and schools happy and looking for more.

Further work required in more classes and subjects.

And more innovations to improve effectiveness.?

Olabs 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.
 - Comprehensive coverage of science and maths from 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....

M Sasikumar, CDAC Mumbai

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Access OLabs at
www.olabs.edu.in

Access OLabs page at
<https://www.facebook.com/onlinelabs/>

Did Olabs work?

To some extent -- tool was appreciated in training and workshops – till 2019!

But organic adoption was low.

And then the pandemic struck....

Demand and usage shoots up; NCERT and CBSE intervenes to step up efforts to train teachers.

Immersive experience

- Now lab is in the screen only.
- A lab environment can be provided by putting the student in a virtual world and navigating.
- Or a virtual reality headset to provide a more immersive experience...
 - Sense the direction of view to simulate a 3-D perspective.

2011-12: 30
labs phase I;
CBSE endorses
quality

2013-16: 170+
labs; CBSE
review;
NKN hosting

2015-20: Launch
of rollout, 40000
teachers trained
across India

2020: Pandemic
enhances
demand
manifold.

2021: Olabs
NG commencing
With 500 new
labs

OLabs: The journey so far

