



**Report on  
Capacity Building in Virtual Labs for Teachers and  
Teacher Educators of Maldives  
February 1<sup>st</sup> – 3<sup>rd</sup>, 2021**

Organized by

**Commonwealth Educational Media  
Centre for Asia, New Delhi**

Report Submitted  
by

**Mr. Saneesh P F**  
Project Manager  
Virtual Labs  
Amrita Vishwa  
Vidyapeetham

## Introduction

Amrita Online labs (OLabs) is an educational initiative pioneered by Amrita CREATE (Center for Research in Advanced Technologies for Education) at Amrita Vishwa Vidyapeetham in partnership with CDAC, Mumbai, under a research grant from the Ministry of Electronics and Information Technology, Government of India. This initiative provides an opportunity for all students from classes 9 to 12 to understand and perform online laboratory experimentation free of cost. The aim is to provide high quality laboratory access in Science, Mathematics and English disciplines for students and faculty members. The lab hosts virtual experiments in Physics, Chemistry, and Biology developed by Amrita CREATE for students from classes 9 to 12 with content aligned to NCERT/CBSE and State Board Syllabus. The Mathematics and English labs are developed by CDAC Mumbai.

Main website: <http://www.olabs.edu.in/>

The development of OLabs includes the study and use of mathematical techniques to demonstrate various complex functions in diverse areas of science. This makes use of complex user-interactive simulations and detailed animations. OLabs combine technology resources, automation, along with tried and true training concepts. These are richly featured platforms meant to provide a compelling and personalized experience for learners, one that goes beyond just looking at content or interacting with simulations. They enable hands-on training whenever and wherever needed.

Laboratory experiments are an integral component of science and engineering education. However, access to lab equipment is often limited due to geographical distances and resource constraints. Virtual or online labs provide an alternative to physical hands-on labs where such labs are not present or augment existing access to experiments. Further, virtual labs, as innovative interactive multimedia platforms for online and blended learning, can enhance the teaching and learning experience and outcomes. There is, therefore, an urgent need for effective deployment, use, and integration of virtual labs into curricula. Recognizing this need, the Commonwealth Educational Media Centre for Asia (CEMCA), in partnership with the National Institute of Education (NIE) Maldives, facilitated a capacity building programme in the use of virtual labs for teachers and teacher educators of Maldives.

## Aim

This programme aimed to create awareness about virtual labs for internet-based experimentation and to enable teachers and teacher educators to use virtual labs and to integrate them effectively in teaching practice.

## Objectives

Participants would be able to:

- Demonstrate awareness about virtual labs
- Use virtual labs for performing experiments
- Integrate virtual labs into teaching and learning practice

## Invitation

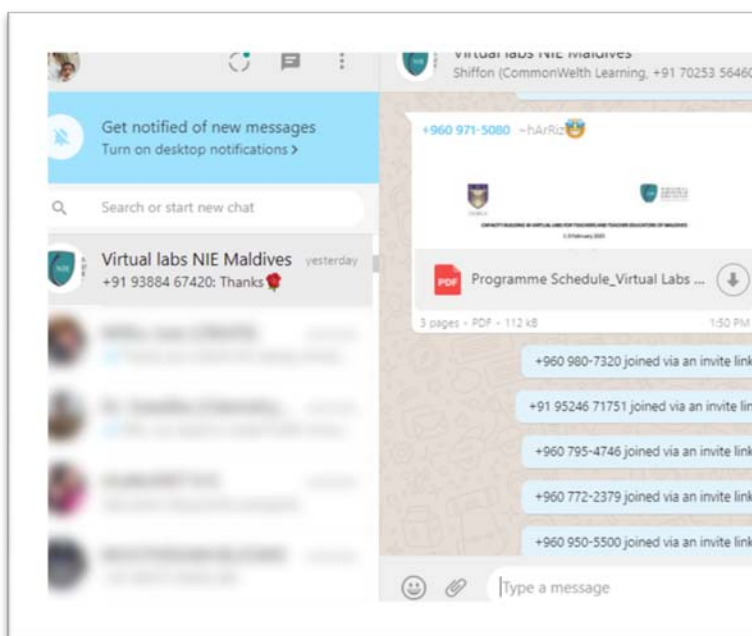
CEMCA, New Delhi invited Amrita OLABs to conduct a three-day online workshop on 1<sup>st</sup> to 3<sup>rd</sup> February 2021 for teachers and teacher educators of Maldives.

## Participants

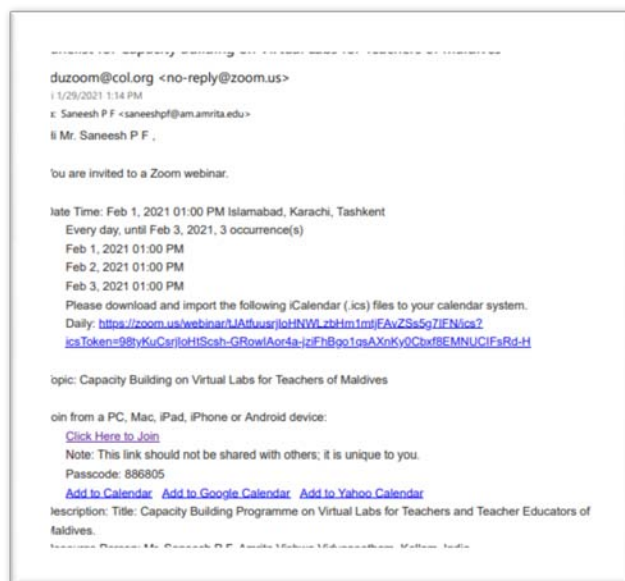
One hundred and ninety-four participants from various schools of Maldives attended the online workshop. List of participants is placed in Appendix 1.

## Methodology

The capacity building workshop was conducted online through the virtual platform ZOOM. The methodology used was live demonstration of Virtual Lab experiments from university website [olabs.edu](http://olabs.edu). followed by hands-on practice by participants using the assignment questions provided by the resource person. The organizing team shared a WhatsApp group to interact asynchronously, share information, answer queries and submit feedback.



*WhatsApp Group screenshot*



*Zoom link sent to the participants and experts*

**Dates:** The workshop was for three days - February 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> 2021 from 01:30PM to 3:00PM (IST)

**Venue:** The workshop was conducted online through the virtual platform ZOOM.

## Workshop Schedule

Day 1: February 1 <sup>st</sup> 2021 (Monday), 1.30 pm to 3.00 pm (IST)		
Time	Activity Session	Key persons
1:30PM – 2:10PM	Inaugural function	<p>Prof. Madhu Parhar Director, CEMCA</p> <p>Mr. Hussain Majid Education Support Unit National Institute of Education Maldives</p> <p>Fathimath Naseer Hon'ble Minister of State for Education Maldives</p> <p>Prof. Prema Nedungadi Director, AmritaCREATE Amrita Vishwa Vidyapeetham India</p> <p>Shri Anil Kumar Pipal, Scientist F &amp; HoD (HRD) eLearning Divisions Ministry of Electronics and Information Technology Government of India</p>
2:10PM – 2:50PM	Introduction to Virtual Labs	Mr. Saneesh P F
2:50PM – 3:00PM	Q&A session	
Feedback and assignment		
Day 2: February 2 <sup>nd</sup> 2021 (Tuesday), 1.30 pm to 3.00 pm (IST)		
1:30PM – 1:45PM	Introduction to Online Labs for School Experiments	Prof. MethilKrish Amrita Vishwa Vidyapeetham
1:45PM – 2:30PM	Experiment demonstration	Mr. Saneesh P F
2:30PM – 2:45PM	Hands-on activities	Mr. Saneesh P F
2:45PM – 3:00PM	Q&A Session	
Feedback and assignment		
Day 3: February 3 <sup>rd</sup> 2021 (Wednesday), 1.30 pm to 3.00 pm (IST)		
1:30PM – 1:45PM	Impact of online laboratories & blended learning	Mr. Saneesh P F
1:45PM - 2:00PM	Experiment demonstration based on assignments	Mr. Saneesh P F
2:00PM - 2:30PM	Hands-on activities & Interactive session	Mr. Saneesh P F
2:30PM – 3:00PM	Closing session	<p>Prof. Madhu Parhar Director, CEMCA</p> <p>Mr. Hussain Majid Education Support Unit National Institute of Education Maldives</p> <p>Mr. Zaidulla Mohamed GN Atoll Education Centre (On behalf of participants)</p>

## Day 1 - Inauguration: February 1<sup>st</sup> 2021

Inauguration was graced by the presence of Fathimath Naseer, Hon'ble Minister of State for Education, Maldives; Mr. Hussain Majid, Education Support Unit, National Institute of Education, Maldives; Prof. MadhuParhar, Director, CEMCA; Prof. PremaNedungadi, Director, Amrita CREATE, Amrita VishwaVidyapeetham; Shri Anil Kumar Pipal, Scientist F & HoD (HRD), eLearning Divisions, Ministry of Electronics and Information Technology, Government of India.

Prof. MadhuPraharwelcomed all the participants and gave an overview of the program. She mentioned the need for creating virtual labs so that all students have equal access to quality practical and hands-on experiment based learning. She pointed out that when students construct their own understanding, learning can be better sustained. Mr. Hussain Majid, NIE Maldives addressed the audience and mentioned that for students who do not have access to the equipment or have difficulty in understanding the experiments, this is an opportunity for them to explore science experiments. Hon'ble Minister of State Education, Maldives, Fathima Naseer, spoke of how Maldives is a nation with geographical challenges and few resources such as laboratories in schools. She emphasised that this was a golden opportunity to get access to virtual labs for performing experiments. She stressed on the importance of the workshop for teachers because through this training, ultimately students would benefit as they could get access to virtual labs and perform hands on activities. She expressed her gratitude to CEMCA for organizing this workshop. Dr. Prema Nedungadi, Amrita Vishwa Vidyapeetham spoke of how OLABS could be used as a supplementary resource for schools that have labs, as well as a primary resource in rural areas. It is hosted on India's National Knowledge Network and is hosted free of cost.

Shri Anil Kumar Pipal, HoD (HRD), Ministry of Electronics and Information Technology, Govt. of India expressed the view that virtual labs will help students to understand Physics, Chemistry, Mathematics and Biology lab experiments with full capability.

Mr. Saneesh P F served as a resource person of the workshop. He demonstrated various experiments from Physics, Chemistry, Biology, Math and English. He delivered talk on how to transform the teaching using virtual labs and shared few research findings regarding how virtual labs are effective for students and faculty members.

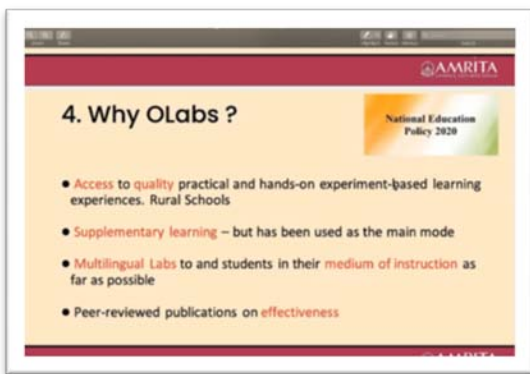




*Prof. Madhu Parhar delivering inaugural address*



*Fathimath Naseer, Hon'ble Minister of State for Education, Maldives addressing the audience*



*Prof. Prema Nedungadi delivering the keynote address*



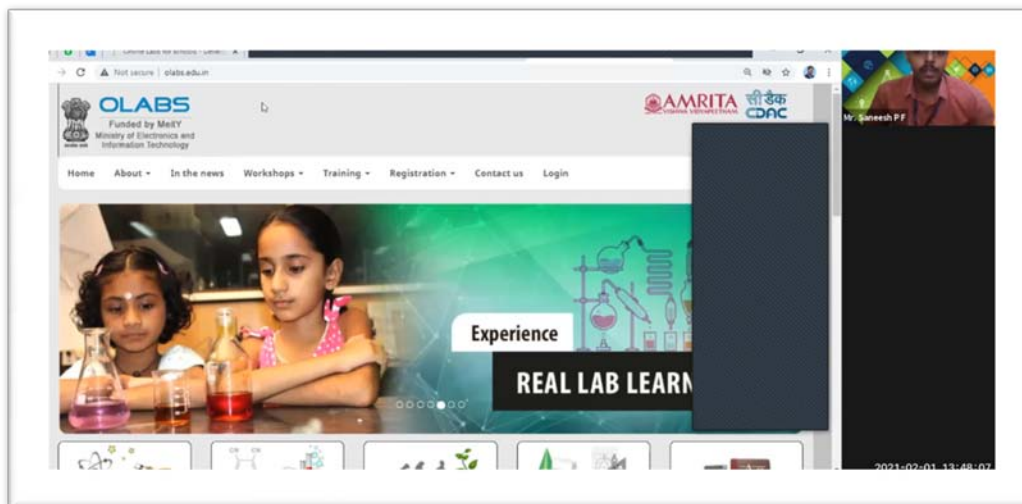
*Mr. Hussain Majid, NIE Maldives, addressing the audience*



*Shri Anil Kumar Pipl from MeitY addressing the audience*

## Session details from 2:10PM to 2:40PM

*Introduction to online laboratory:* Mr. Saneesh presented the overview of the experiments and he demonstrated experiments (list given below) from [olabs.edu.in](http://olabs.edu.in). In between the sessions he asked several questions to the audience through polls. Audience submitted their answers through polls so that the presenter could have a good interaction with the audience.



*Mr. Saneesh P F demonstrating virtual lab experiments*

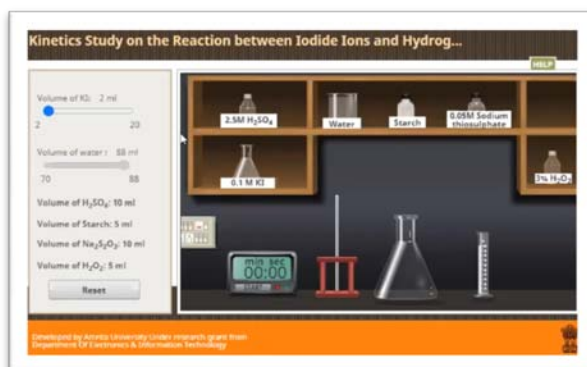
## Virtual Lab Experiment Demonstration



*Simple pendulum*

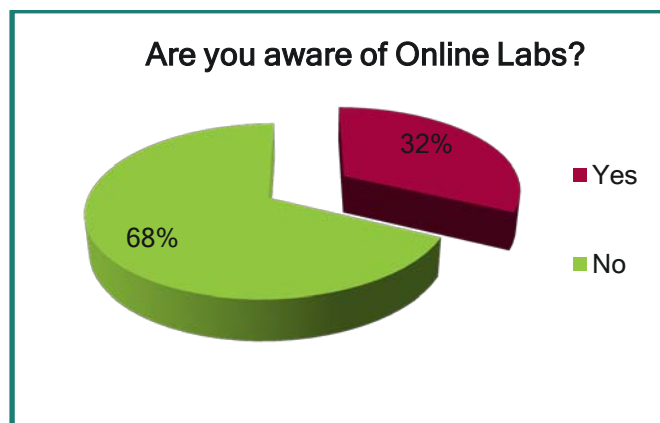


*Ohm's Law*



*Kinetic study on the reaction between iodide ion and hydrogen peroxide*

## Poll question responses



## Assignments for Day 1

For practicing virtual lab experimentation, a set of assignments were provided to the participants.

### Capacity building virtual labs for teachers

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**Assignment 1**  
Website link: <http://www.olabs.edu.in/>

**Physics**

- What will be the resistivity of the aluminum wire of length 30cm, diameter 0.44mm.  
Link: <http://amrita.olabs.edu.in/?sub=1&brch=6&sim=22&cnt=1>

**Chemistry**

- Identify the time taken to complete the reaction between Iodide ion of volume 4ml and Hydrogen Peroxide of volume 5ml.  
Link: <http://amrita.olabs.edu.in/?sub=73&brch=8&sim=117&cnt=1>

### Assignment 1

Website link: <http://www.olabs.edu.in/>

#### Physics

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#### Chemistry

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Link: <http://amrita.olabs.edu.in/?sub=73&brch=8&sim=117&cnt=1>



## Biology

Identify the pH value of the river water.

Link: <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=29&cnt=1>

## Mathematics

Prove the formula for the volume of a right circular cone.

Link:

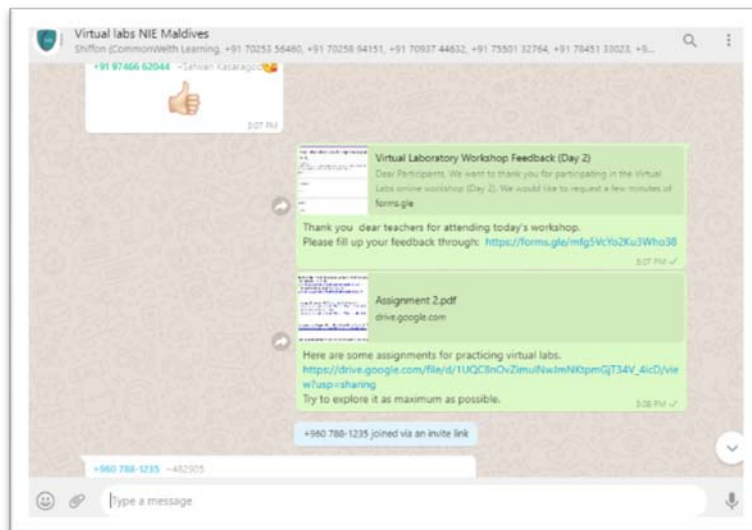
<http://cdac.olabs.edu.in/?sub=80&brch=20&sim=164&cnt=1>

## English

Which preposition is used to express a surface of something.

Link:

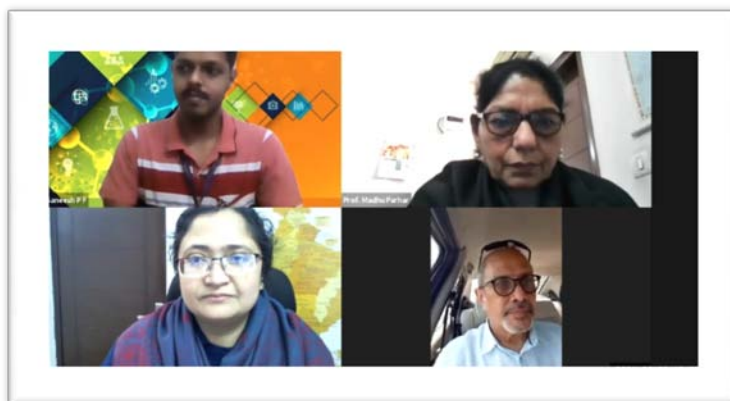
<http://cdac.olabs.edu.in/?sub=84&brch=22&sim=188&cnt=1>



Assignment and feedback form shared in the WhatsApp group

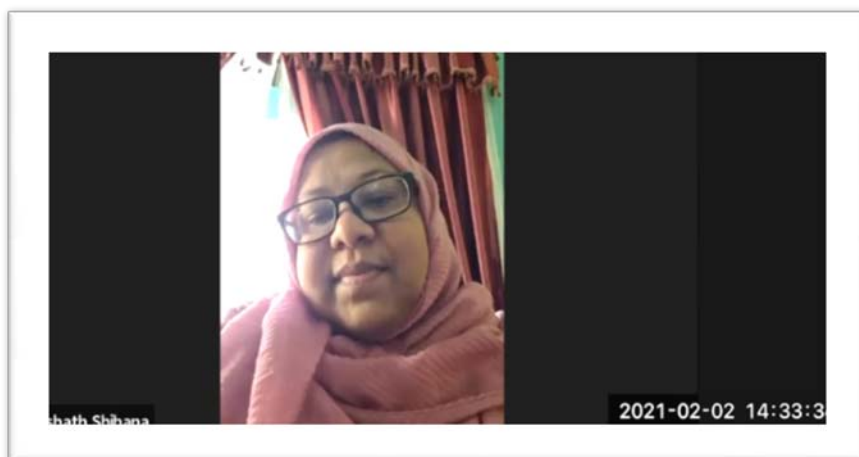
## Day 2 –February 2<sup>nd</sup> 2021

Dr. ShiffonChatterjee, Senior Programme Officer, CEMCA, welcomed the dignitaries during the second day of the workshop. Prof. MadhuParhar delivered the welcome address. After the welcome address, Prof. MethilKrish, Chairman, Career Competency Development, Amrita Vishwa Vidyapeetham presented the importance of laboratory education especially in the COVID-19 pandemic situation. He



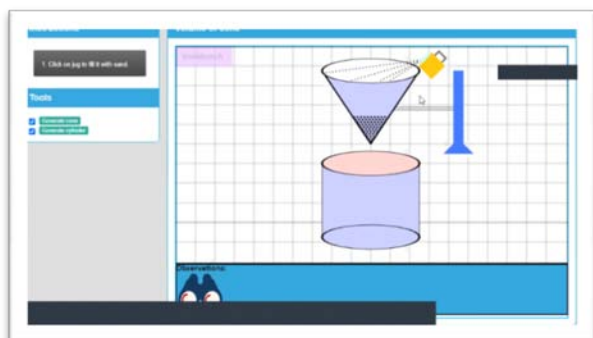
congratulated all the teachers for their efforts to continue teaching using available technologies. Mr. Saneesh demonstrated virtual lab experiments from Mathematics, Biology, Physics, Chemistry and English disciplines. Mr. Saneesh provided several tasks to the participants so that hands-on experience of virtual laboratories could be obtained. All the participants very

actively engaged with the hands-on session and interacted with the recourse person. After the demonstration of the experiments and hands-on session, Dr. Shibana, Education Development Officer, NIE Maldives, concluded the second day of the workshop.



Dr. Aishath Shibana, Education Development Officer, NIE Maldives concluding Day-2 of the workshop

## Virtual Lab Experiment demonstration



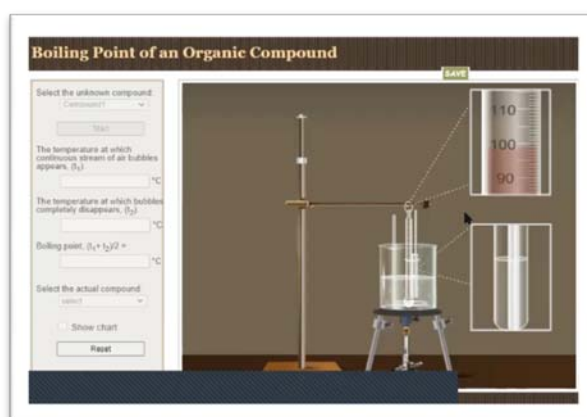
Mathematics: Volume of cone



Biology: Study of Microbial presence in water



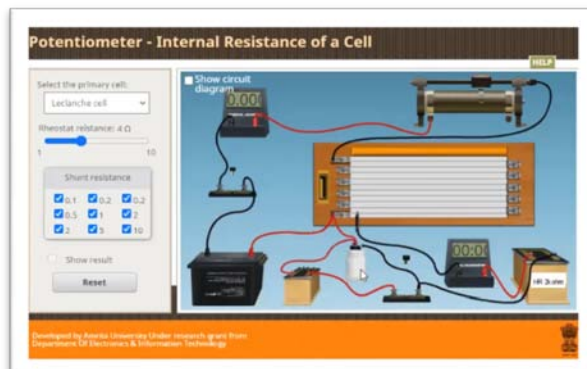
Biology: Study of physical properties of soil



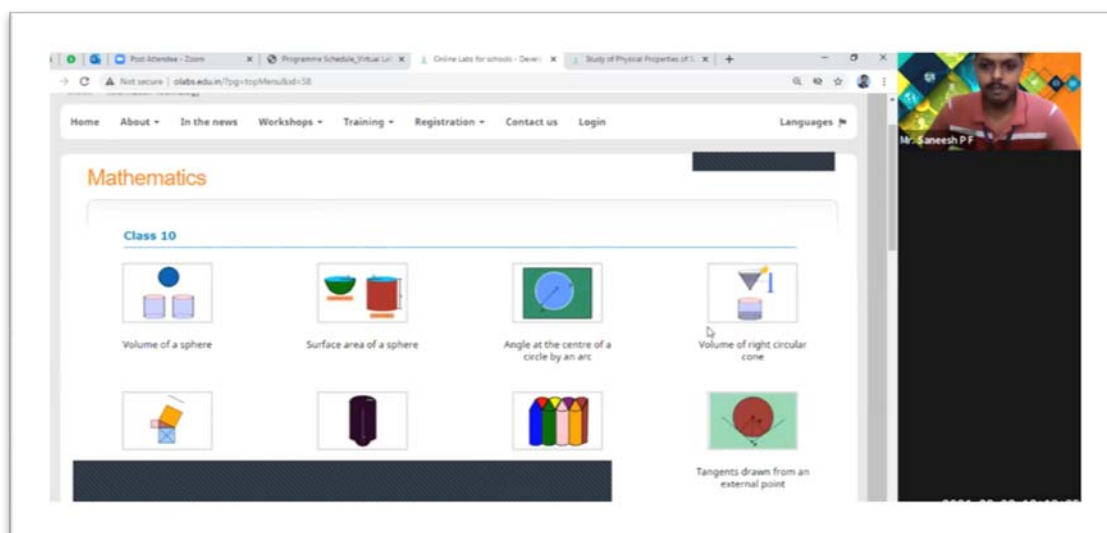
Chemistry: Boiling point of Organic solvent



Physics: Focal length of Convex Mirror

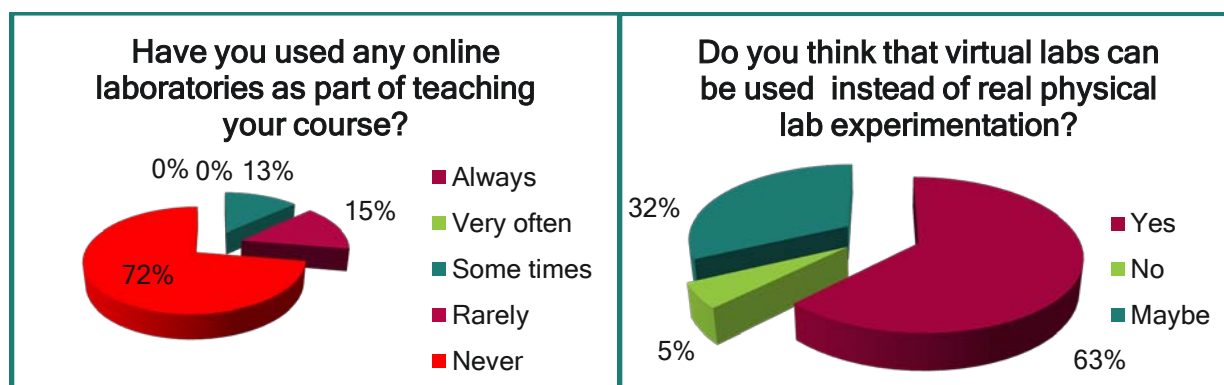


Physics: Potentiometer- Internal resistance of a cell



Mr. Saneesh demonstrating mathematics simulations

### Poll question responses



### Hands-on task result

As part of the workshop there were several tasks assigned to the participants to practice the virtual labs and submit the answers. Around 10 minutes were provided to complete the task and submit the answer through polls. Participants who could not submit the correct answer were encouraged to repeat the experimentation at their own pace as part of the assignment after the online session.

**Task:** Identify the focal length of a Convex Mirror-6

60% of the participants were able to identify the correct answer.

**Task:** Identify the organic compound-13 by using its boiling point

65% of the participants were able to identify the correct answer.

## Assignments for Day 2

A set of assignment questions were provided for the participants after the second day of the workshop. The assignment document was shared through WhatsApp group as well as Zoom chat box.



Screen shot of assignment questions Assignment and feedback of Day 2 shared via WhatsApp group

## Assignment 2

Day 2: 2<sup>nd</sup> February 2021

### Physics

- Calculate the internal resistance of a cell. Choose primary cell as Leclanche cell and Shunt resistance as 2 Ohm.

Link: <http://amrita.olabs.edu.in/?sub=1&brch=6&sim=147&cnt=1>

- Identify the focal length of the convex mirror-5

Link: <http://amrita.olabs.edu.in/?sub=1&brch=6&sim=243&cnt=1>

### Chemistry

- Identify the organic compound-15 by using its boiling point

Link: <http://amrita.olabs.edu.in/?sub=73&brch=7&sim=111&cnt=1>

- Identify the pH value of Tomato Juice

Link: <http://amrita.olabs.edu.in/?sub=73&brch=7&sim=144&cnt=1>

### Biology

- Study the presence of suspended particulate matter in the air at different sites.

Link: <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=240&cnt=1>

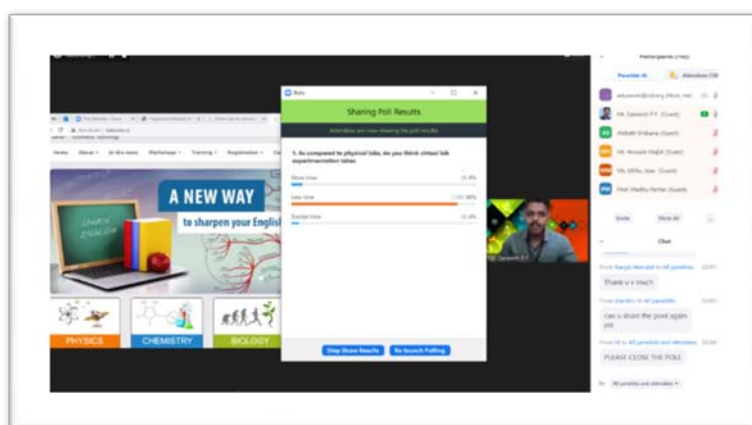
### Mathematics

- Demonstration of the formula for the volume of a sphere in terms of its radius.

Link: <http://cdac.olabs.edu.in/?sub=80&brch=20&sim=165&cnt=1>

## Day 3 – February 3<sup>rd</sup> 2021

Prof. Madhu Parhar welcomed the audience and resource person for the third day of workshop. Mr. Saneesh delivered talk on significant impact of virtual labs as well as innovative teaching using virtual labs. He shared various methods to practice virtual labs as part of curriculum and how to engage students in the laboratory learning exercises. He also discussed learning techniques such as active and cooperative learning, real-world learning, and brainstorming sessions that can be incorporated with virtual labs for enhancing students' interactivity with the platform. Throughout the session, interaction with participants was facilitated through polls.



*Interaction with participants through poll questions*



*Presentation on impact of virtual labs*

### Significant impact of virtual labs- Research studies

Amrita Virtual Lab team has conducted various research works to identify the impact of virtual labs among students and institutions. Mr. Saneesh shared some of the research findings with the participants. He presented the following research articles:

- Kolil, V. K., Muthupalani, S., & Achuthan, K. (2020). Virtual experimental platforms in chemistry laboratory education and its impact on experimental self-efficacy. *International Journal of Educational Technology in Higher Education*, 17(1), 1-22.
- Achuthan, K., Kolil, V. K., & Diwakar, S. (2018). Using virtual laboratories in chemistry classrooms as interactive tools towards modifying alternate conceptions in molecular symmetry. *Education and Information Technologies*, 23(6), 2499-2515.
- Achuthan, Krishnashree, Sayoojyam Brahmanandan, and Lakshmi S. Bose. "Cognitive Load Management in Multimedia Enhanced Interactive Virtual Laboratories." *Advances in Intelligent Informatics*. Springer, Cham, 2015. 143-155.



## Virtual Lab Experiment demonstration

*Mathematics: Area of a triangle*

Items	Result	Description	Remedy
Main Verb	✓	main verb is correct	---
Helping Verb	✓	helping verb is correct	---

*English: Tense conversion*

*Biology: Study the pH of water*

*Chemistry: Determination of pH*

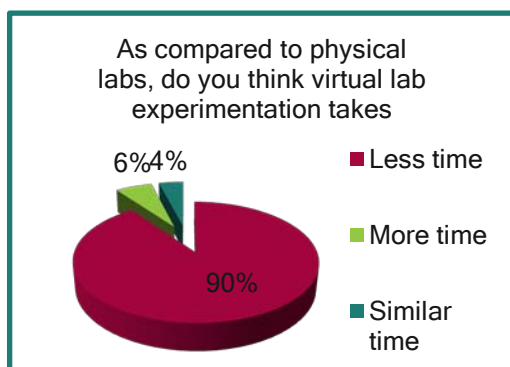
*Physics: Vernier Calipers*

*Physics: Laws of reflection of sound*

*Biology: Membrane channels*

*Mathematics: Quadratic equation grapher*

### Poll question responses

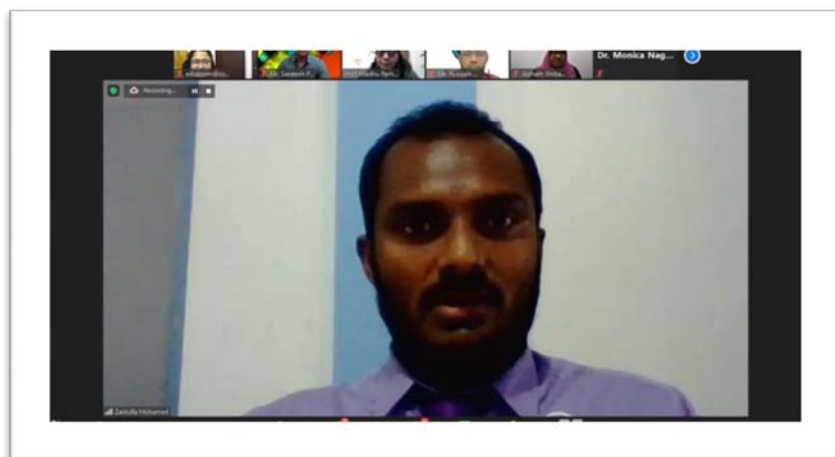


### Hands-on activities with responses submitted through polls

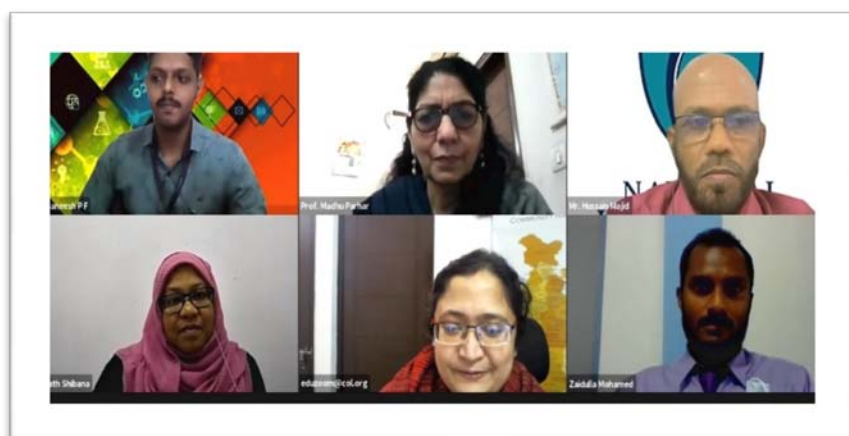
Hands-on task	% of correct responses
What is the pH value of lake water?	68%
What is the relation between volume of a cone and volume of a cylinder, both having base radius $r$ and height $h$ ?	78%
Find the area of the triangle (side one=4cm, side two=3cm, side three=5cm).	75%

### Valedictory session from 2:30PM – 3:00PM

The concluding and the valedictory session was graced by the presence of Prof. MadhuParhar; Director CEMCA; Mr. Hussain Majid, National Institute of Education Maldives; Mr. Zaidulla Mohamed, GN Atoll Education Centre; Dr. Aishath Shibana, Education Development Officer, NIE Maldives; Dr. Shiffon Chatterjee, Senior Programme Officer, CEMCA. Mr. Zaidulla Mohamed and Dr. Shibana appreciated CEMCA's initiative. They appreciated the resource person from Virtual Lab team. Mr. Hussain Majid motivated the faculty members to use virtual labs for regular sessions along with curriculum. Dr. Shibana delivered the vote of thanks and concluded the session.



*Mr. Zaidulla Mohamed, GN Atoll Education Centre, Maldives, speaking on behalf of the participants*



*Closing session*

## Feedback of the workshop

Participants were requested to fill up the feedback form. The link to this Google Form was shared via WhatsApp group and Zoom chat box at the end of each session. Feedback is used to adjust and improve current and future actions and behaviors.

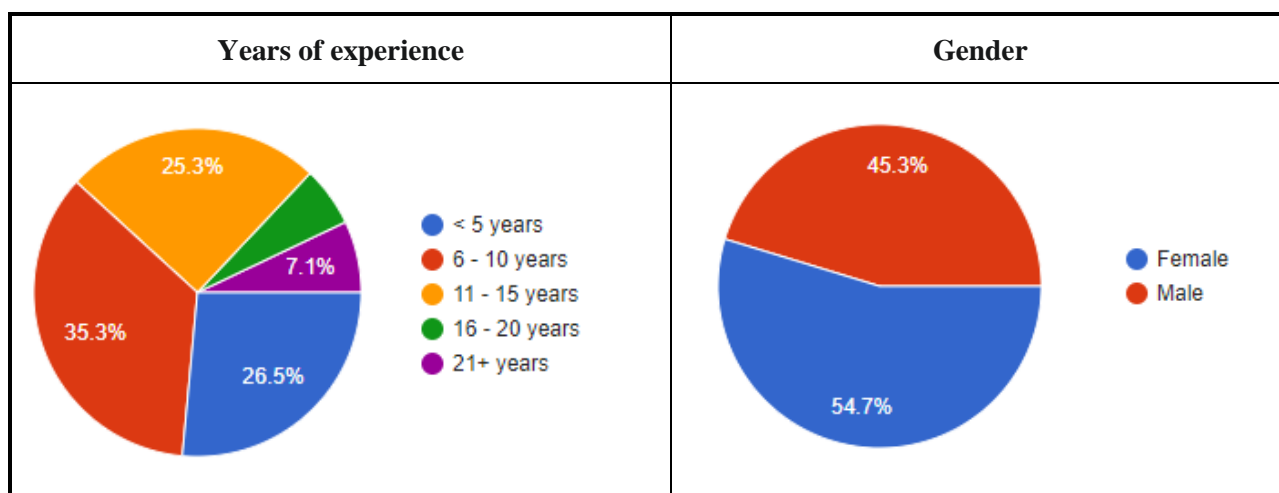
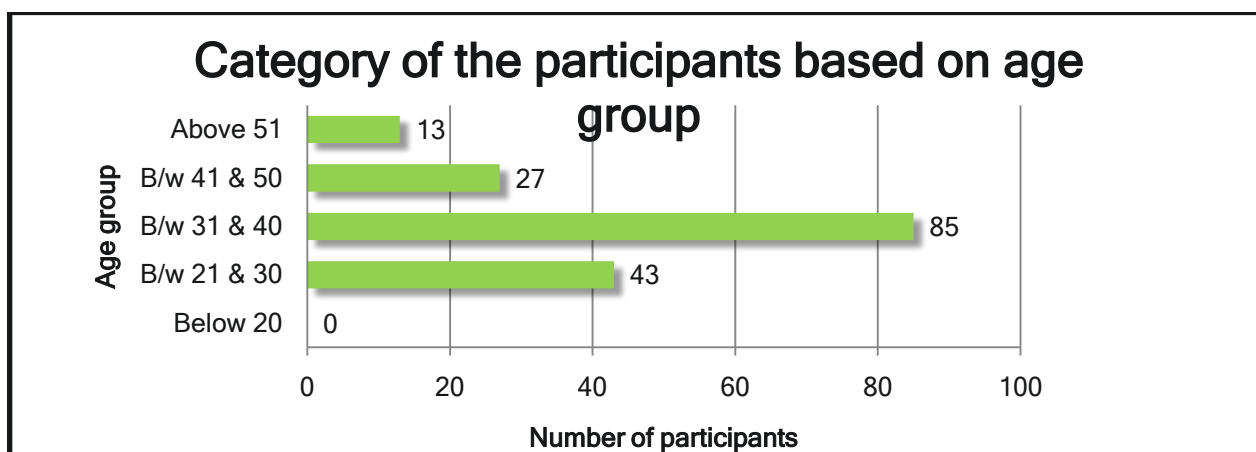
### Day 1 Feedback

### Virtual Laboratory Workshop Feedback (Day 1)

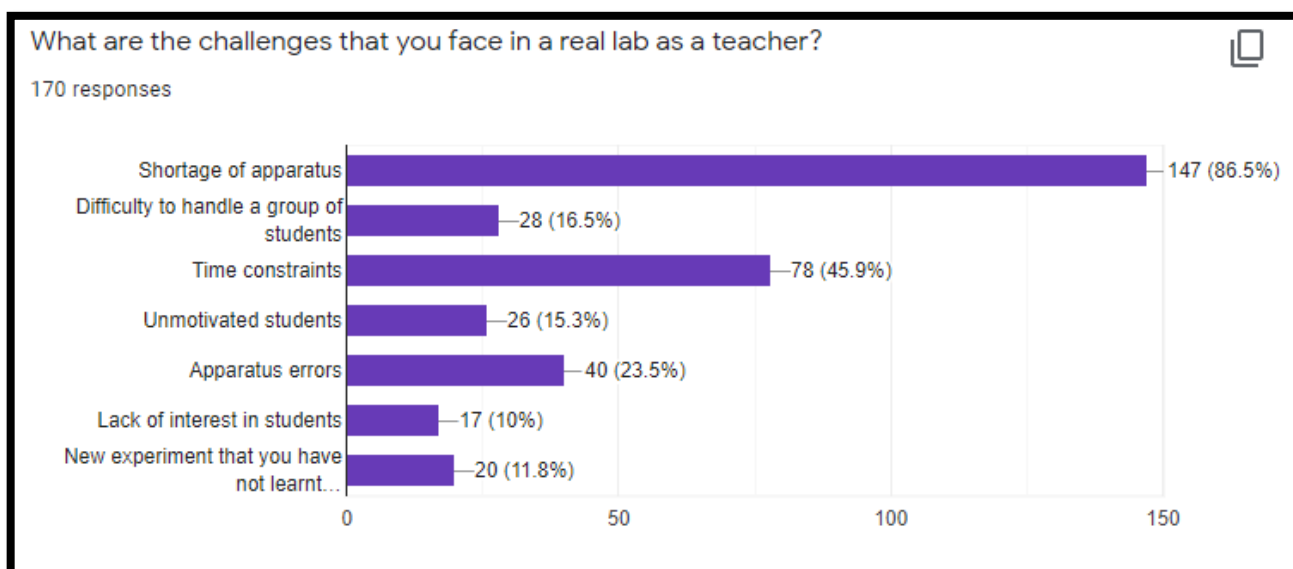
Dear Participants,  
We want to thank you for participating in the Virtual Labs workshop (Day 1). We would like to request a few minutes of your time to take this survey.

\* Required

170 responses were received on the first day of the workshop. Majority of the participants were in the age group 31 to 40 years.



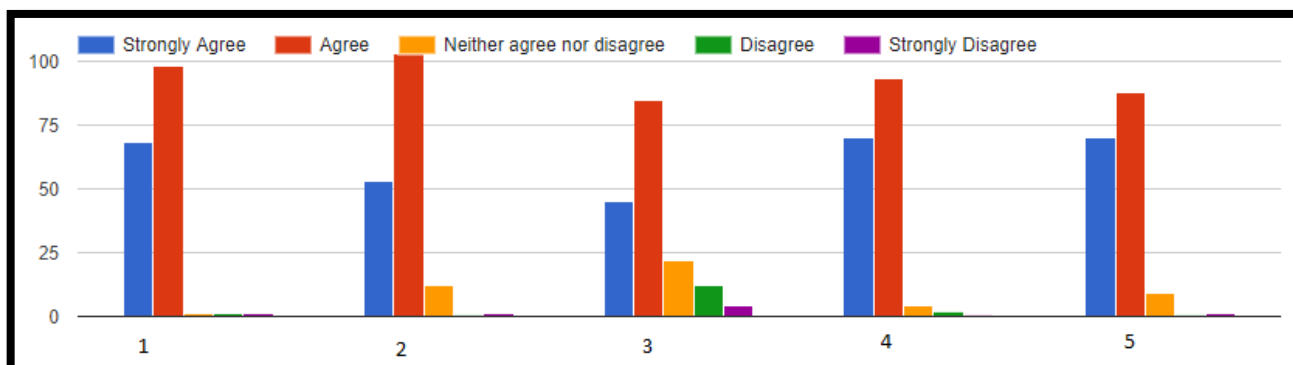
Majority of the participants have around 6-10 years of experience. 54.7% of the participants are female and 45.3% of the participants are male candidates.



The common challenges faced by teachers during laboratory teaching were analyzed. 86.5% of the participants responded that there is a shortage of apparatus in the traditional laboratory. 16.5% of the participants faced difficulty in handling groups of students. 45.9% of the participant face time constraints in the physical lab session. 15.3% of the participants responded that unmotivated students also pose a challenge in conducting laboratory sessions. 23.5% responses said that the apparatus error makes it difficult to complete the experimentation. Only 10% of the participants reported a lack of student interest to learn laboratory experiments. This indicates that most students are interested in doing laboratory experiments but cannot complete them successfully due to the above constraints. 11.8% of the participants faced difficulty in teaching new experiments to the students because teachers must learn the experiment rigorously before conducting the laboratory session.

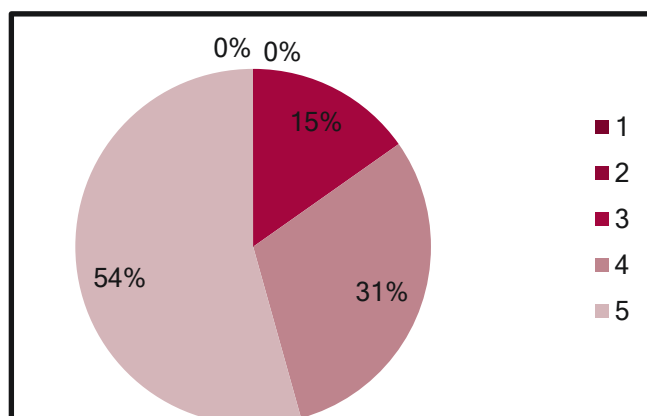
To understand the effectiveness of virtual labs, a survey was conducted. Based on the teachers' experience, we analyzed the effectiveness using the below questionnaire. Responses are reported in the graph below. Majority of the teachers either Strongly agreed or Agreed that virtual labs are effective to teach and understand laboratory experiments.

1. Students can easily understand the experiment by performing it in virtual lab
2. Performing the experiment in virtual lab increases student's confidence level to perform the same in physical laboratory environment.
3. Performing the experiment in virtual lab will decrease student's anxiety with physical lab experimentation.
4. Experiments in virtual lab are easy to understand.
5. Learning experiments through virtual lab is fun and interesting.

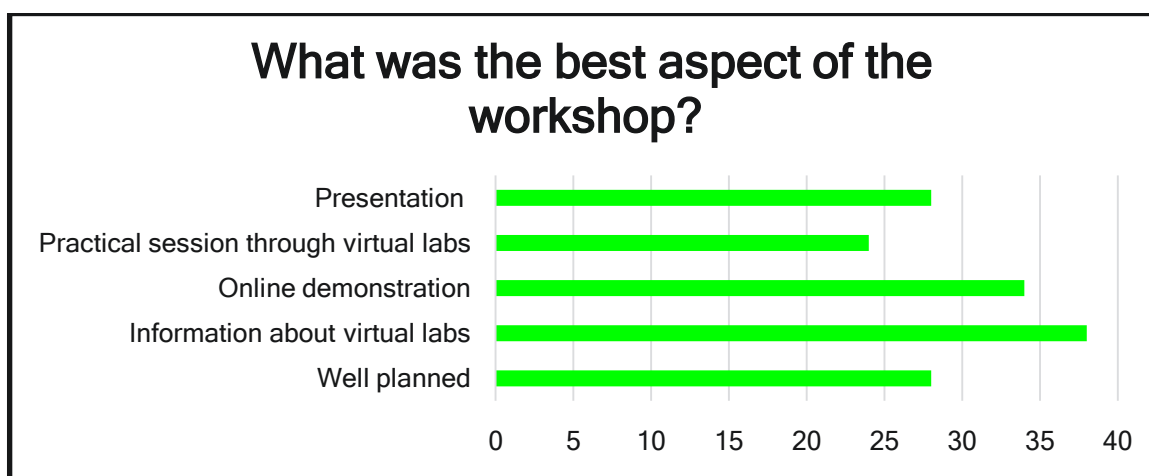


### How would you rate the workshop?

For rating the first day of the workshop, participants could choose from 1 – 5 where 1 represents poor and 5 represents excellent. 54% of the participants rated the workshop as excellent, 31% of participant's rated as 4 out of 5 and 15% of the participant's rated as 3 out of 5.



There were several questions asked to the participants to know their opinion. Their responses are represented in the following graphs.



### Day 2 – Feedback

Feedback-2 was collected during the second day of workshop. 178 participants submitted the feedback. Feedback was collected as Likert scale, 1 – 5 (1 – poor, 5 – Excellent).



## Virtual Laboratory Workshop Feedback (Day 2)

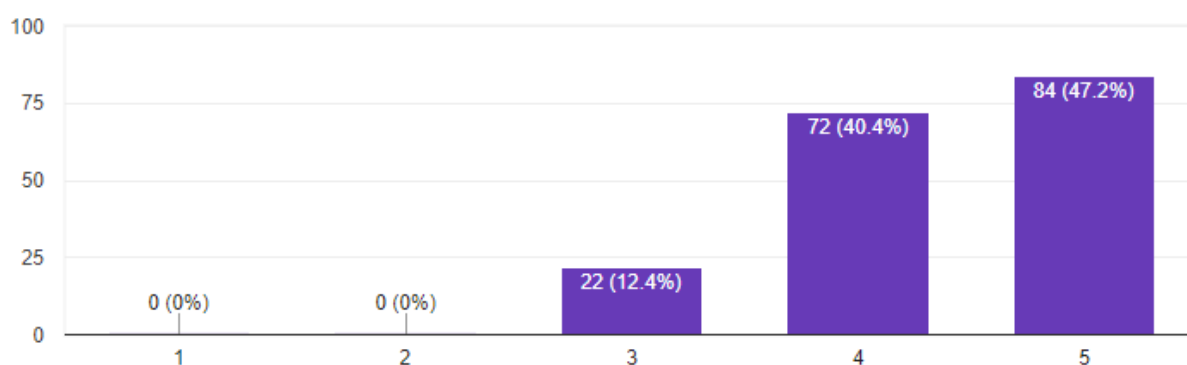
Dear Participants,  
We want to thank you for participating in the Virtual Labs online workshop (Day 2). We would like to request a few minutes of your time to take this survey.

\* Required

How would you rate the quality of the theory descriptions given in the olabs.edu.in



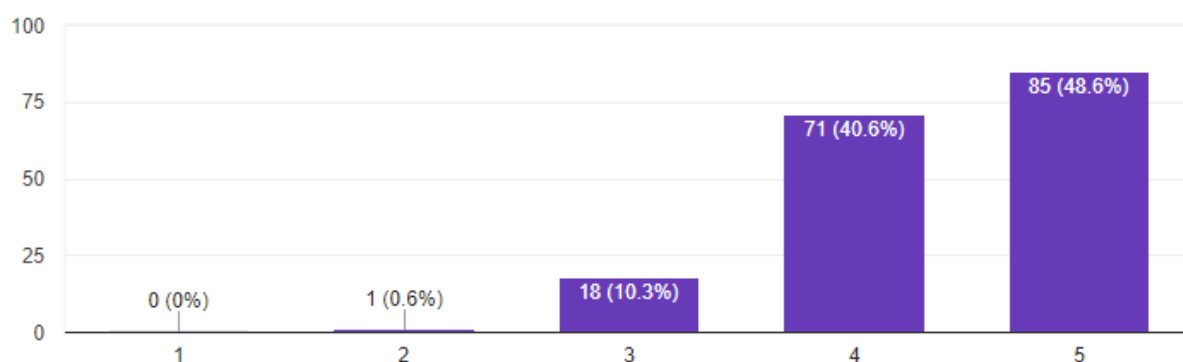
178 responses



How would you rate the quality of the simulator provided in olabs.edu.in

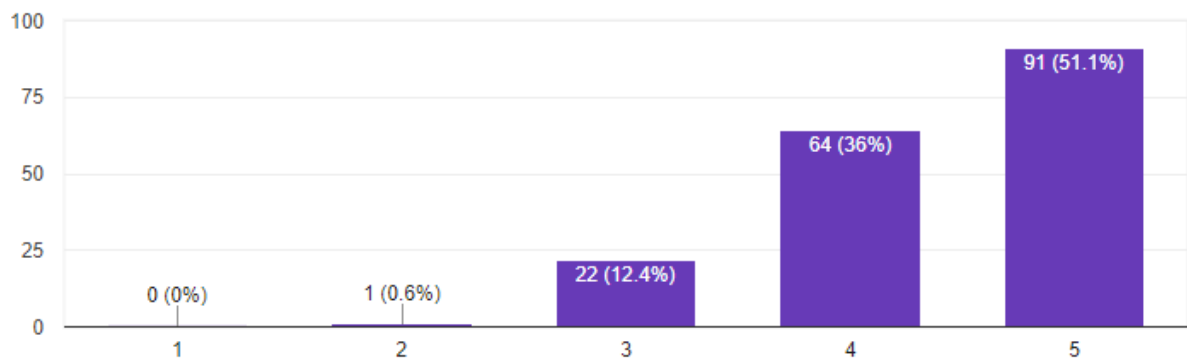


175 responses



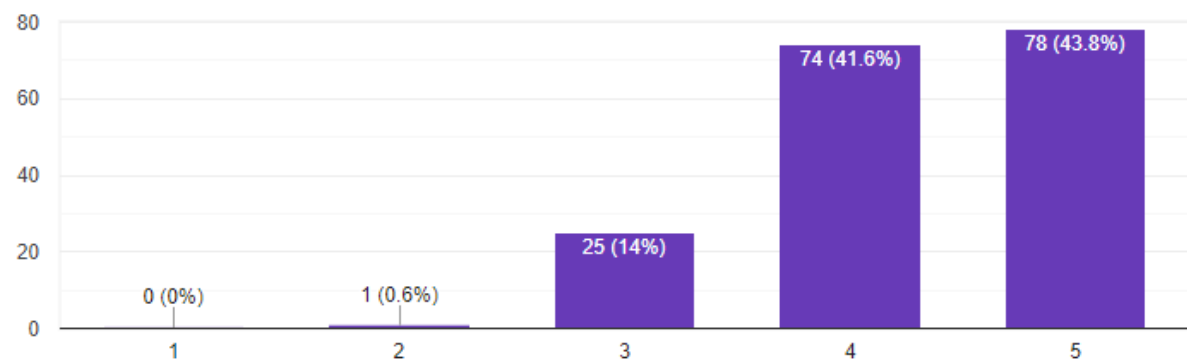
How would you rate the quality of the lab procedure given in the olabs.edu.in

178 responses



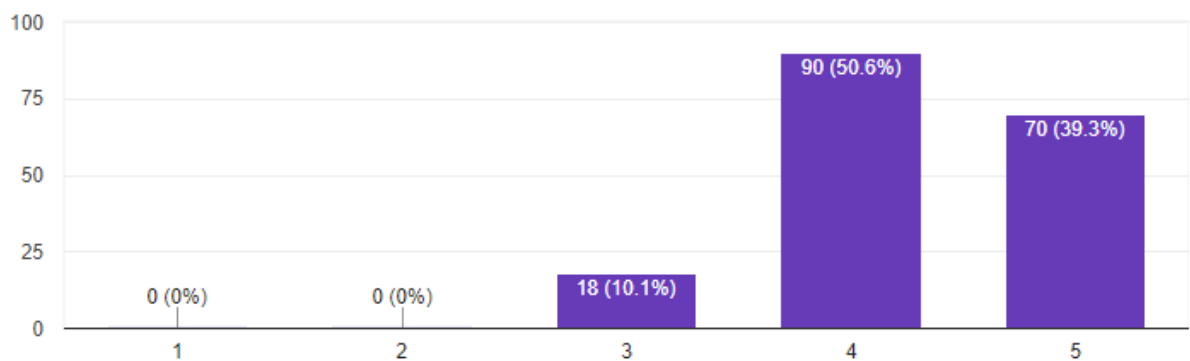
How would you rate the overall quality of the content from olabs.edu.in

178 responses



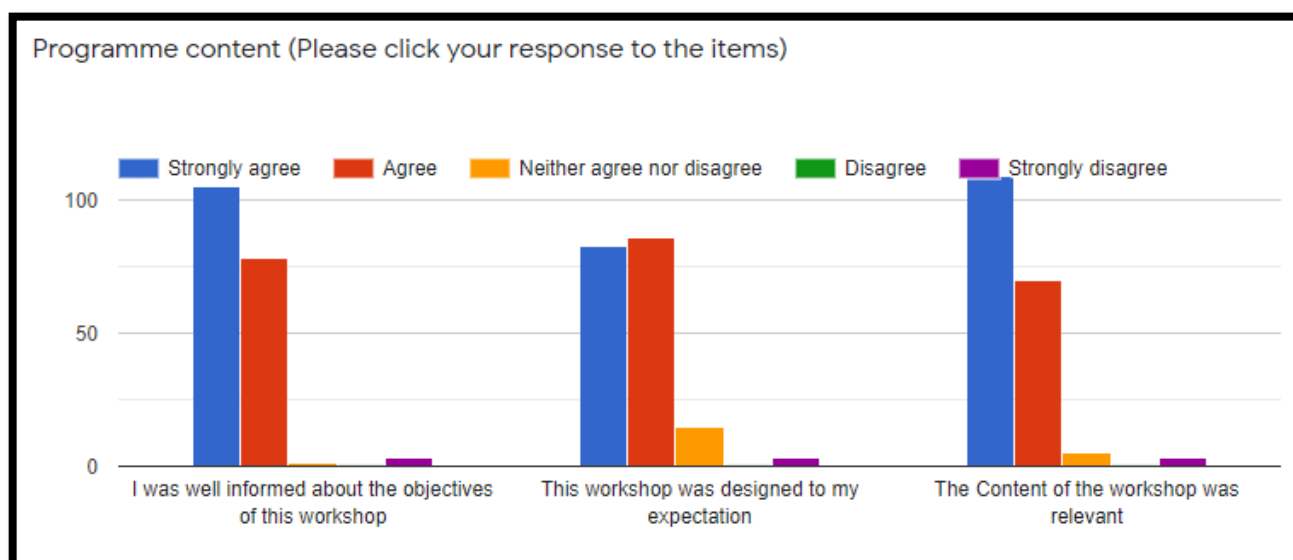
How would you rate the Day 2 workshop?

178 responses

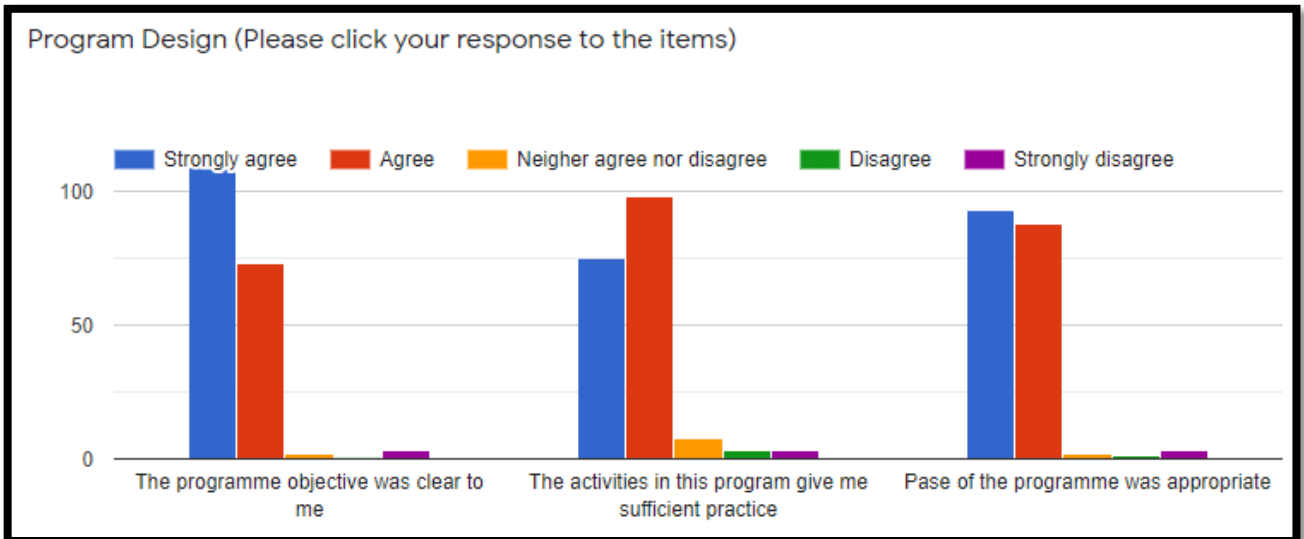


### Day 3 – Feedback

Feedback-3 was collected during the third day of workshop. 187 participants submitted the feedback.

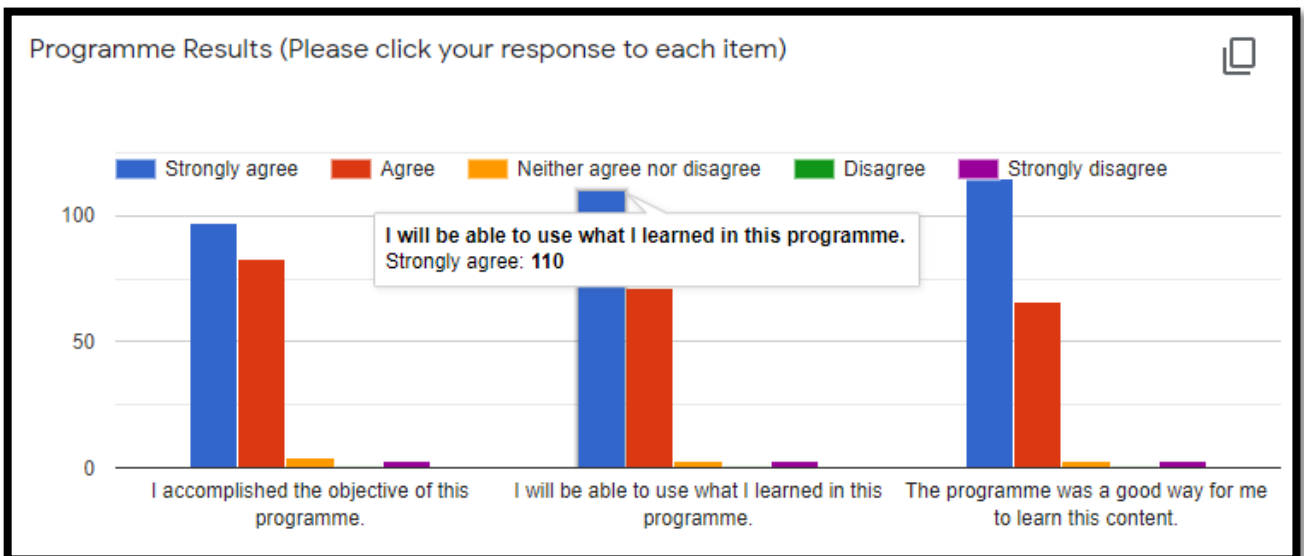


Most of the participants felt that they were informed about the objective and found the content relevant and designed as per their expectations. Three of the faculty members expressed their disagreement which should be explored to strengthen the workshop further.



The chart above shows feedback regarding the programme objectives, practice session, pace of teaching learning activities. Most of participants replied in affirmative as is evident in chart above. Very few (3) were not satisfied and reasons can be explored for improvement in future.

### Programme Results:



It is important to know what the participants perceived regarding the attainment of the objectives and how they would use the knowledge gained during the workshop. A look at the graph above shows that most of the participants were satisfied on these points. Two of the participants were not confident of their ability to use it in future. Some effort may be taken to explore the difficulty and solve it.

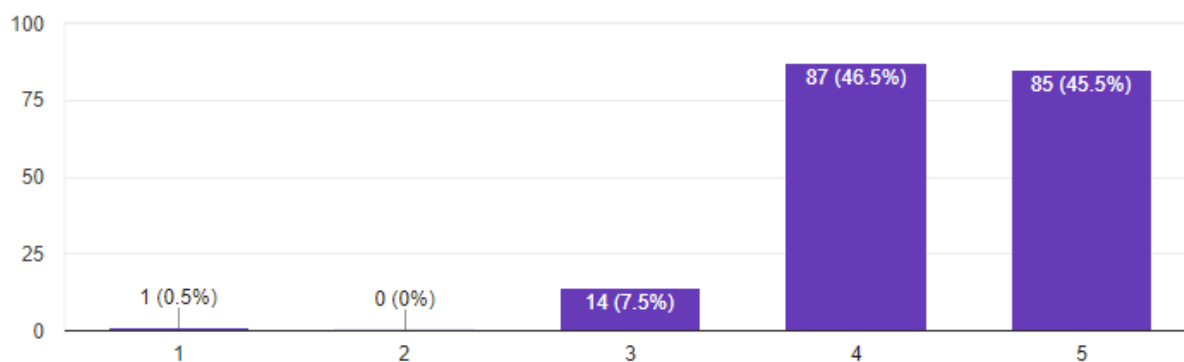
Do you require additional training in Virtual labs?

187 responses



How would you rate the workshop?

187 responses



## Suggestions from participants

- Require more time to practice virtual labs
- More number of experiments based on the syllabus would be very useful
- More training sessions required for each discipline
- Include online labs for primary grades
- Subject Areas and Topics and Simulations could be provided through Apps
- More activities on how to use labs



# Appendices

## Appendix 1: List of participants

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