CEMCA

AMRITA VISHWA VIDYAPEETHAM
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KENYATTA UNIVERSITY
EUMU NI NGUVU

Report on

Workshop on Virtual Labs for Kenyatta University Faculty Members

12-13 January 2022

Organised by

Commonwealth of Learning

In partnership with

Kenyatta University

Report Submitted by

Mr. Saneesh P F

Project Manager
Virtual Labs
Amrita Vishwa Vidyapeetham

Introduction

Virtual Labs is an initiative of the Ministry of Education, Govt. of India under the National Mission on Education through Information and Communications Technology (NME-ICT). This initiative provides an opportunity for all students to use virtual labs free of cost. The aim to provide high quality remote laboratory access in Science and Engineering disciplines for students and teachers of the country and is applicable to undergraduate (B.Sc., B.Tech, B.E.) and post-graduate (M.Sc., M.Tech, M.E.) students including Physical Sciences, Biological Sciences, Chemical Sciences, Computer Science and Electronics and Mechanical Engineering. Virtual Labs are being developed by consortium of 12 institutes which include Amrita Vishwa Vidyapeetham, IIT Delhi, IIT Bombay, IIT Kanpur, IIT Kharagpur, IIT Madras, IIT Roorkee, IIT Guwahati, IIIT Hyderabad, Dayalbagh Educational Institute, NIT Surathkal and College of Engineering, Pune.

Main website: https://www.vlab.co.in/
University website: http://vlab.amrita.edu/

Virtual Labs are new immersive e-learning environments that provide a media-rich, interactive user interface that teachers can use to supplement their curriculum. These labs are located on an open webpage that can be accessed by anyone through a web browser, on any Internet-connected computer in the world. A variety of laboratory experiments can be conducted virtually using animation, simulation, or remotely triggered hardware. Laboratory experiments are modeled very close to real-life experiments and when used as a learning tool by students it allows them to learn the material more efficiently and can make doing the practical experiments easier.

Laboratory experiments are an integral component of science and engineering education. Access to lab equipment is often limited due to geographical distances and resource constraints. Virtual 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 a need for creating awareness on how to access, use, and integrate virtual labs in teaching and learning. Recognizing this need, the Commonwealth Educational Media Centre for Asia (CEMCA) facilitated expertise support for an online awareness creation workshop on virtual labs for higher education faculty members of Kenyatta University in Nairobi, Kenya. This workshop was initiated by the Commonwealth of Learning (COL), Vancouver and was organized by COL in partnership with Kenyatta University.

Aim

This program 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 Virtual labs to conduct a two-day online workshop on 12th and 13th January 2022 for teachers of Kenyatta university, Kenya.

Participants

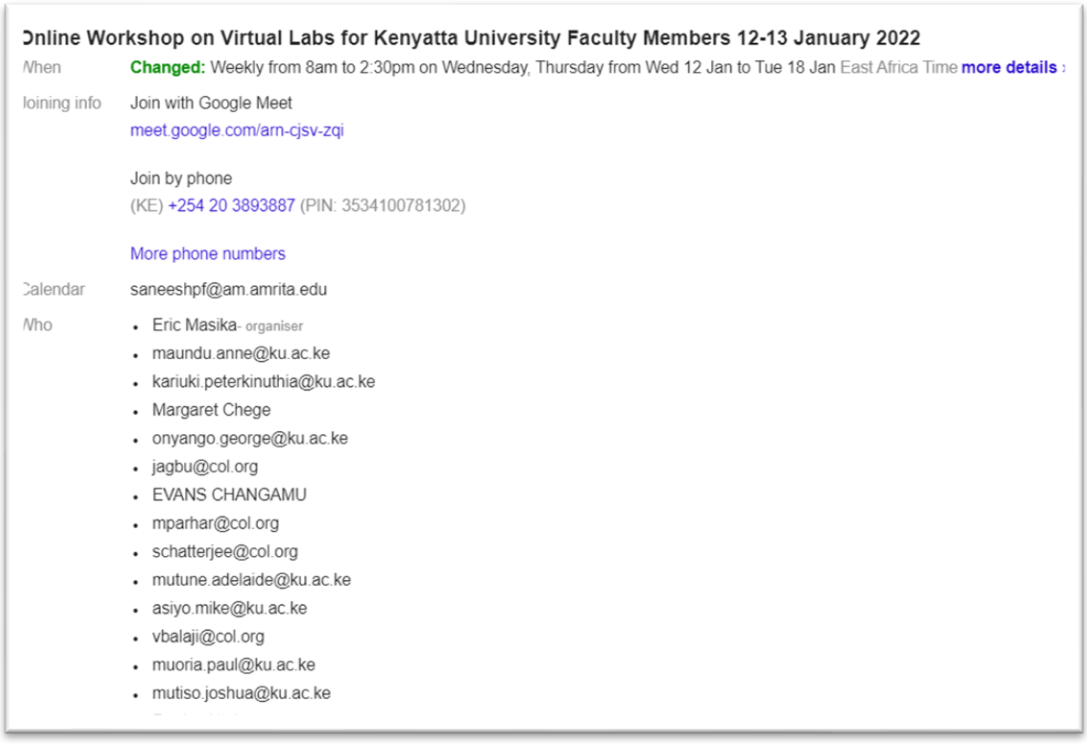
Sixteen participants from various disciplines attended the online workshop. The list of participants is placed in Appendix 1.

Dates: The workshop was for two days – January 12th and 13th 2022; held from 11:20AM to 3PM (IST) on Day 1 and from 12PM to 3PM IST on Day 2.

Venue: The workshop was conducted through the Google Meet virtual platform.

Methodology

The capacity building workshop was conducted through Google Meet platform. The workshop was conducted through a blend of presentation and demonstrations of virtual labs by the expert and learning by doing activities for participants to explore virtual labs, and to assimilate, practice, and apply what they have learnt. Interactive sessions were facilitated for feedback on assignments, clarification of doubts regarding use of virtual labs and experience sharing. The methodology used was a live demonstration of Virtual Lab experiments from the university website vlab.amrita.edu and the virtual lab main website vlab.co.in followed by hands-on practice by participants using the assignment questions provided by the resource person.



Online Workshop on Virtual Labs for Kenyatta University Faculty Members 12-13 January 2022

When: **Changed:** Weekly from 8am to 2:30pm on Wednesday, Thursday from Wed 12 Jan to Tue 18 Jan East Africa Time **more details**

Joining info: Join with Google Meet
meet.google.com/arn-cjsv-zqi

Join by phone
(KE) +254 20 3893887 (PIN: 3534100781302)

More phone numbers

Calendar: saneeshpf@am.amrita.edu

Who:
- Eric Masika- organiser
- maundu.anne@ku.ac.ke
- kariuki.peterkinuthia@ku.ac.ke
- Margaret Chege
- onyango.george@ku.ac.ke
- jagbu@col.org
- EVANS CHANGAMU
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- vbalaji@col.org
- muoria.paul@ku.ac.ke
- mutiso.joshua@ku.ac.ke

Google Meet link sent to the participants and experts

Workshop Schedule

Timings

	Kenya time (EAT)	Indian time (IST)
Workshop start time	9:30 AM (Arrival time 8:30 AM)	12:00 PM
Workshop end time	12:30 PM	3:00 PM

Day 1 (Wednesday): 12th January 2022		
Time	**Activity**	**Session details**
8:50 – 9:00 am (EAT) 11:20 – 11:30 am (IST)	Brief on KU-COL Virtual Lab Project	**Dr. George Onyango** Dean, Digital School
9:00 – 9:10 am (EAT) 11:30 – 11:40 am (IST)	Welcome Remarks and launch of the training workshop	**Prof. Michael Gicheru** Dean, School of Pure and Applied Science
9:10 – 9:20 am (EAT) 11:40 – 11:50 am (IST)	Welcome Remarks by COL	**Prof. Jane Frances Obiageli Agbu** Adviser: Higher Education Commonwealth of Learning
9:20 – 9:30 am (EAT) 11:50 am – 12:00 pm (IST)	Introduction of CEMCA and Remarks	**Prof. Madhu Parhar** Director; Commonwealth Educational Media Centre for Asia (CEMCA)
9:30 – 9:45 am (EAT) 12:00 – 12:15 pm (IST)	Inaugural session	**Dr. Eric Masika** Inaugural session
9:45 -10:15 am (EAT) 12:15 – 12:45 pm (IST)	Introduction to Virtual Labs	Participants gain an overall understanding of virtual labs; the concept, overview, and virtual lab related activities
10:15 -11:00 am (EAT) 12:45 – 1:30 pm (IST)	Demonstration of virtual lab experiments and simulations from different disciplines including Physical Sciences, Chemical Sciences and Biotechnology.	Participants learn how to access virtual labs and how to perform experiments through virtual labs
11:00 -11:30 am (EAT) 1:30 – 2:00 pm (IST)	Activity for participants to explore virtual labs	
11:30 am -12:15 pm (EAT) 2:00 – 2:45 pm (IST)	Demonstration of virtual lab experiments and simulations	
12:15 -12:30 pm (EAT) 2:45 – 3:00 pm (IST)	Interactive session	Queries of participants are shared and answered Practice assignments are explained

Day 2 (Thursday): 13th January 2022		
Time	**Activity**	**Session Details**
9:30 – 9:45 am (EAT) 12:00 – 12:15 pm (IST)	Opening session	Recapitulation of overview of virtual labs
9:45 – 10:00 am (EAT) 12:15 – 12:30 pm (IST)	Impact of virtual labs	Significant research findings on virtual labs presented
10:00 – 11:00 am (EAT) 12:30 – 1:30 pm (IST)	Demonstration of virtual lab experiments and simulations from different disciplines including Physical Sciences, Chemical Sciences, and Biological Sciences	Participants learn how to navigate the virtual lab interface and perform experiments
11:00 – 11:30 am (EAT) 1:30 – 2:00 pm (IST)	Activity for participants to explore virtual labs and perform experiments	
11:30 am – 12:00 pm (EAT) 2:00 – 2:30 pm (IST)	Virtual labs for innovative teaching and learning	Presentation and discussion on how to integrate virtual labs to enhance teaching and learning
12:00 – 12:20 pm (EAT) 2:30 – 2:50 pm (IST)	Interactive session	Queries shared and answered Experiences of using virtual labs shared Feedback on practice assignments
12:20 – 12:30 pm (EAT) 2:50 – 3:00 pm (IST)	Concluding session	Concluding remarks

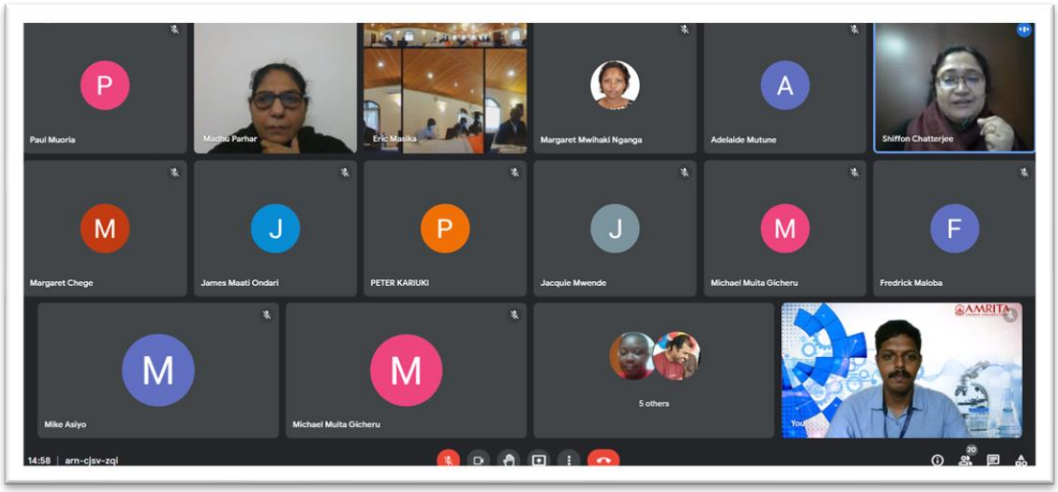
Day 1 - January 12th, 2022

Inauguration

The inauguration was graced by the presence of Dr. George Onyango, Dean, Digital School, Kenyatta University; Prof. Michael Gicheru, Dean, School of Pure and Applied Science, Kenyatta University; Prof. Jane Frances Obiageli Agbu, Adviser, Higher Education Commonwealth of Learning; and Prof. Madhu Parhar, Director, CEMCA.

During the inaugural session, Dr. George Onyango, Dean, Digital School, mentioned how virtual labs could help students achieve their learning outcomes. Professor Madhu Parhar, Director CEMCA, highlighted the critical role of virtual labs in science education; particularly during the pandemic, and appreciated Kenyatta University's initiative in moving forward with virtual labs. Professor Michael Gicheru, Dean, School of Pure and Applied Sciences, emphasised that virtual labs, simulations, and demonstrations of experiments promote better understanding of scientific concepts through hands-on activities and practice. He expressed the belief that such labs would make teaching and learning easier. Professor Jane-Frances Agbu, Adviser, Higher Education COL, spoke of virtual labs as the future of education.

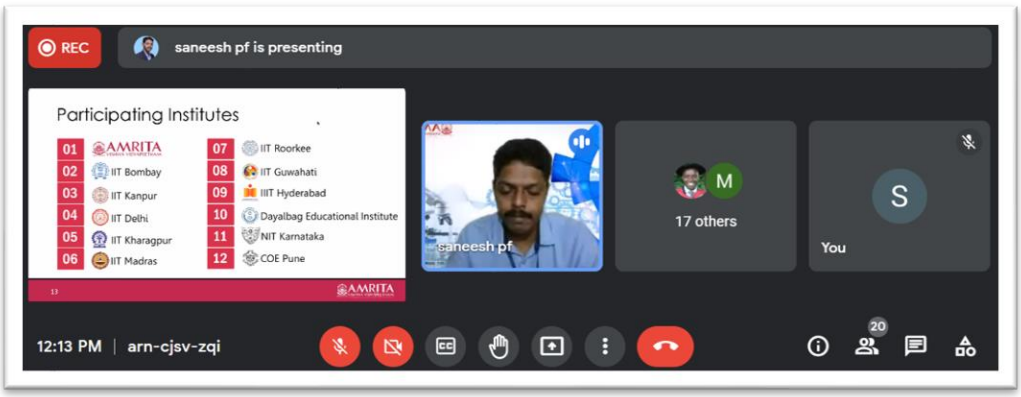
Dr. Eric Masika, Coordinator in Charge of Continuing Education Programme (CEP) at Kenyatta University moderated the session and presented the objectives of the workshop. Dr. Shiffon Chatterjee, Senior Programme Officer CEMCA and workshop coordinator from CEMCA, spoke about the workshop structure and activities and invited the expert resource person, Mr. Saneesh to start the session. Mr. Saneesh P F served as the resource person of the workshop. He demonstrated various experiments in Physical Science, Chemical Science, Biotechnology and Biomedical Engineering.



Screenshot of the inaugural session.

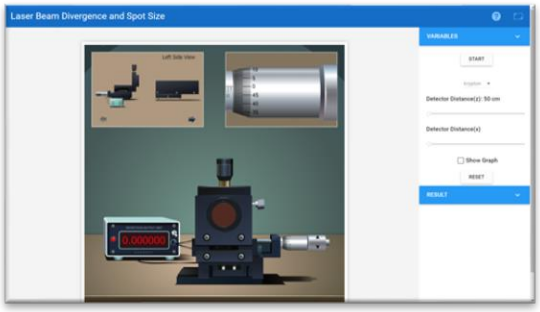
Session details from 12:00PM to 3:00PM (IST)

Introduction to the virtual laboratory: Mr. Saneesh presented an overview of the virtual lab project and demonstrated experiments from vlab.amrita.edu and vlab.co.in. During the session, he asked several questions to the audience through polls. There was a good interaction between the resource person and the participating teachers through the polls. Mr. Saneesh delivered a talk on how to transform the teaching learning process using virtual labs and shared a few research findings on how virtual labs are effective for students and faculty members.



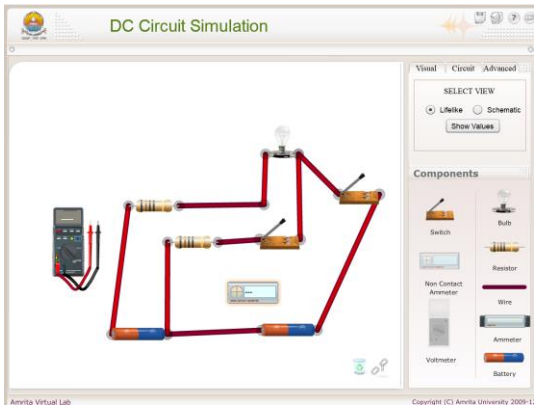
Mr. Saneesh presenting an overview of virtual labs

Virtual Lab Experiment Demonstration Day 1

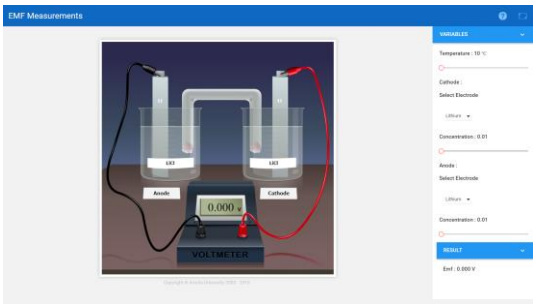


Laser beam divergence and spot size- Physics

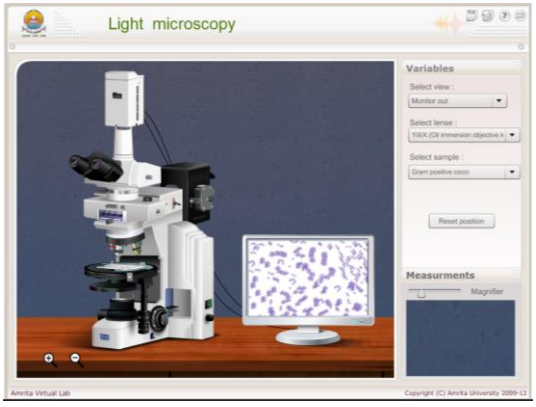
Compound Pendulum- Symmetric, Physics



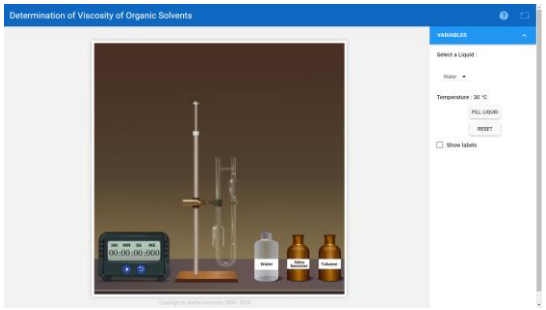
Electric circuit simulations- Physics



EMF Measurment - Chemistry

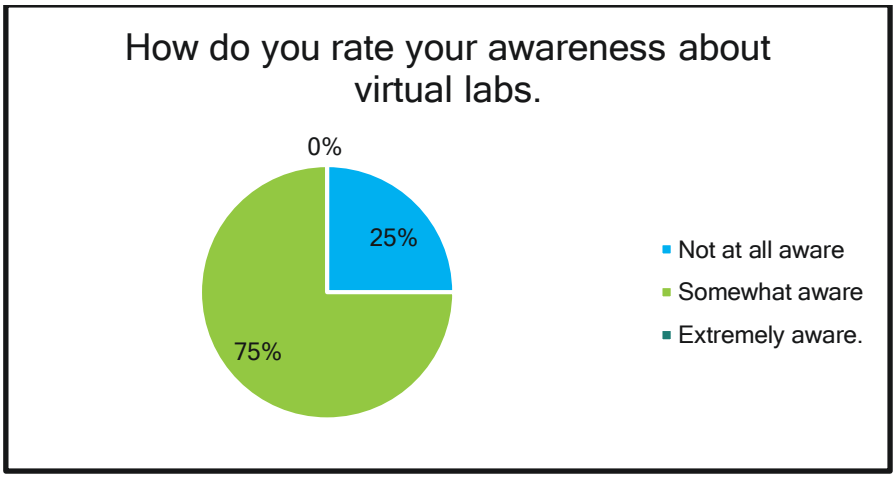


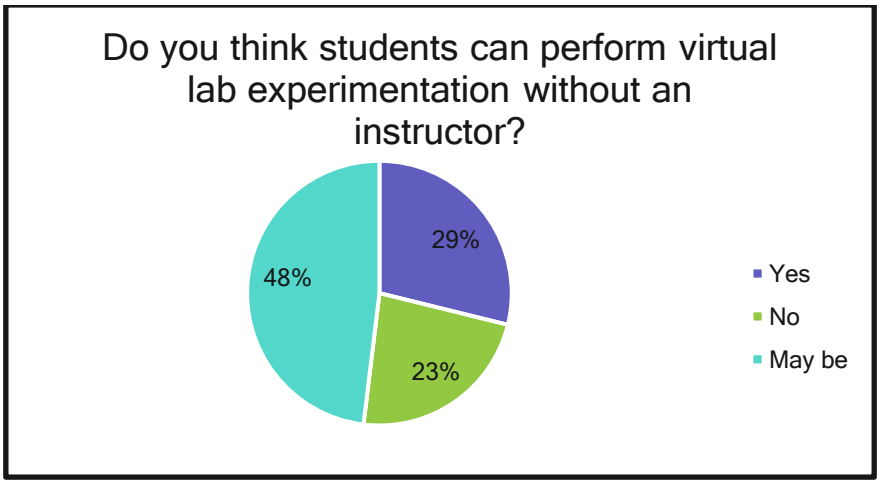
Gram stain Technique - Biotechnology



Determination of Viscosity of Organic Solvents - Chemistry

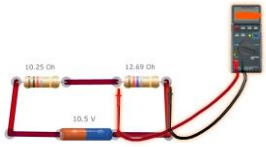
Poll question responses

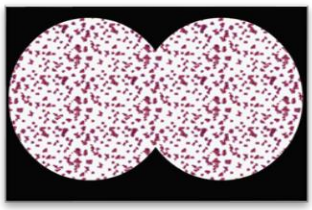




Hands-on activity

During the workshop, participants were requested to perform experiments based on the questions provided in the polls. All the participants participated with enthusiasm in the exercise to answer the poll question.

Exercise	% of correct answers
Find the period of oscillation of **Compound pendulum- Symmetric** if the length of the pendulum is **70cm** and select environment as **Moon**.	95%
What is the potential difference across the resistor **12.69** Ohm? 	83%
Identify the voltage of the cell if the cathode electrode as Gold (Concentration: 4M) and anode electrode as Copper (concentration: 2M) at 20 degree Celsius temperature	75%

Determine the time taken for Nitrobenzene to flow from point 'C' to 'D' in the experiment	66%
Find the end point of the titration, where **Acetic acid** as Titrant, **Potassium hydroxide** as Titrate, Normality of titrate: **1N** and Volume of titrate : **10 ml**	58%
Identify the sample. 	100%

Virtual lab practice assignment questions

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

Physical Sciences

Problem 1: Study of Variation of Specific Heat of Cardboard with Temperature
Link: http://vlab.amrita.edu/index.php?sub=1&brch=194&sim=353&cnt=1

Problem 2: Determination of Stefan- Boltzmann constant σ
Link: http://vlab.amrita.edu/index.php?sub=1&brch=194&sim=548&cnt=1

Problem 3: Ultrasonic Velocity in Liquids Ultrasonic / Interferometer Method
Link: http://vlab.amrita.edu/index.php?sub=1&brch=201&sim=803&cnt=1

Problem 4: Determination of Numerical Aperture
Link: http://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1

Problem 5: For a circular coil of 30 turns and diameter 10cm, find the magnetic field at the centre of the coil, if 1A current flows through it. Also obtain the fields at different points on the axial line and verify the Gaussian distribution of magnetic fields.
Link: https://vlab.amrita.edu/index.php?sub=1&brch=192&sim=972&cnt=1

Problem 6: What should be the minimum applied potential for complete stoppage of photocurrent in an experiment if the target material is zinc, area of the plate 0.2cm^2, intensity of light 15w/m^2 and wavelength of light 120nm?
Link: https://vlab.amrita.edu/index.php?sub=1&brch=195&sim=840&cnt=4

Chemical Sciences

Problem 1: Find out the unknown concentration of the sample – Rose Bengal.
Link: http://vlab.amrita.edu/index.php?sub=2&brch=190&sim=338&cnt=1

Problem 2: Determine the absolute viscosity of organic liquids.
Link: http://vlab.amrita.edu/index.php?sub=2&brch=190&sim=339&cnt=1

Problem 3: Determine chemical parameters such as hardness, alkalinity, and chemical oxygen demand COD) of water samples.
Link: http://vlab.amrita.edu/index.php?sub=2&brch=193&sim=1548&cnt=1

Problem 4: Identify unknown concentration of the 'Rose Bengal'
Hint: Spectrophotometry

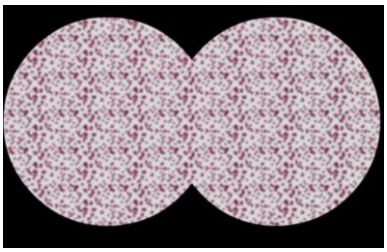
Problem 5: What is the absolute viscosity of the Nitrobenzene
Hint: Determination of Viscosity of Organic Solvents

Problem 6: Which of the following is a weak base?
Hint: Acid Base Titration

1. KOH
2. HF
3. NaOH
4. K_2CO_3

Biotechnology and biomedical engineering

Problem 1: Differentiate between the two major categories of bacteria: Gram positive and Gram negative.
Link:http://vlab.amrita.edu/index.php?sub=3&brch=73&sim=208&cnt=1
Problem 2: What are the requirements for establishing a tissue culture laboratory?.
Link:http://vlab.amrita.edu/index.php?sub=3&brch=187&sim=1100&cnt=1
Problem 3: Two parents with blood types A and O have a child who has type O blood. What is the probability that their next child will be type A?
Link: http://vlab.amrita.edu/index.php?sub=3&brch=69&sim=192&cnt=1
Problem 4: Identify the sample
Hint: Gram Stain Technique



Problem 5: How much voltage is applied across the electrode of the electrophoretic chamber?
Hint: Agarose Gel Electrophoresis

Civil engineering

Problem 1: Conduct the performance test on centrifugal pump and to plot the operating characteristics.

Link: https://fmc-nitk.vlabs.ac.in/exp/centrifugal-pump/

Problem 2: determine the water content of the soil by the oven drying method.

Link: https://smfe-iiith.vlabs.ac.in/exp/water-content/

Electrical engineering

Problem 1: study the speed control of DC Motor by field resistance Control

Link: https://ems-iitr.vlabs.ac.in/exp/dcmotor-field-resistance-control/

Problem 2: understand the working of a count up instruction in a Programmable Logic Controller.

Link: https://ied-nitk.vlabs.ac.in/exp/exp-plc-count-up-nitk/index.html

Mechanical Engineering

Problem 1: Simulate the construction of polar 3D printer and to get in-depth knowledge of mechatronics of polar 3D printer

Link: https://3dp-dei.vlabs.ac.in/exp/simulation-of-polar-machine/

Problem 2: Dynamic Analysis of Four Bar Mechanism

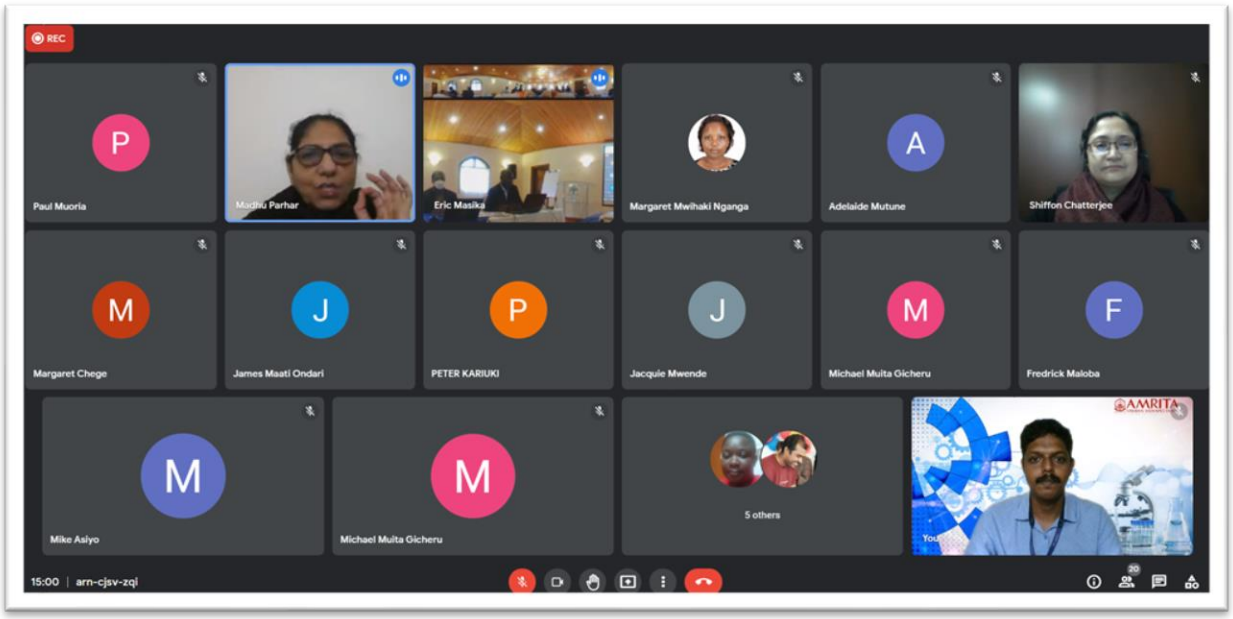
Link: https://dom-nitk.vlabs.ac.in/exp/four-bar-mechanism/

Closing remarks

During the closing session, Dr. Eric Masika appreciated the variety of simulations and animations which were demonstrated and explored during the session. Prof. Madhu Parhar emphasised the need for teachers to perform the experiments themselves and learn more to make an impact on the teaching-learning process.

Dr. George Onyango, Dean, Digital appreciated the “informative, interesting, and interactive session” and expressed the view that it would be very fruitful for the faculty members. Dr. Shiffon

Chatterjee spoke of the participation and enthusiasm of the faculty members attending the programme and appreciated the success of the first day of the workshop.



Prof. Madhu Parhar addressing the audience during the closing session of Day 1

Closing session of Day 1

Day 2 –January 13th 2022

Dr. Eric Masika welcomed all the dignitaries and the resource person for the second day of the workshop. He provided an overview of the virtual lab experiments which the participants had explored on Day 1 and mentioned about the assignment provided for the exploration of the virtual labs. Dr. Eric mentioned that "through collaborative effort, we are able to navigate and do the various assignments provided for practicing virtual labs". He expressed the view that teachers are being empowered with skills in terms of handling virtual labs experiments which will go a long way towards supporting practical sections of various subject in sciences. In her address on the opening session on Day 2, Prof. Madhu Parhar spoke of the need for teachers to integrate these experiments into teaching and learning.

Dr. Shiffon Chatterjee addressed the audience before starting the virtual lab session. She appreciated the level of engagement, involvement, and the collaborative spirit in which the entire learning experience was being transacted. Dr. Shiffon invited Mr. Saneesh to the sessions.

Mr. Saneesh delivered a talk on the impact of virtual labs using several research articles. He explained several learning activities that teachers can implement in the classroom to transform the teaching process. After that, he demonstrated virtual lab experiments from various disciplines- Biotechnology, Physics, Chemistry, Civil Engineering and Mechanical Engineering. During the session, the resource person provided several tasks to the participants so that hands-on experience of virtual laboratories could be obtained. All the participants actively engaged with the hands-on session and interacted with the recourse person.

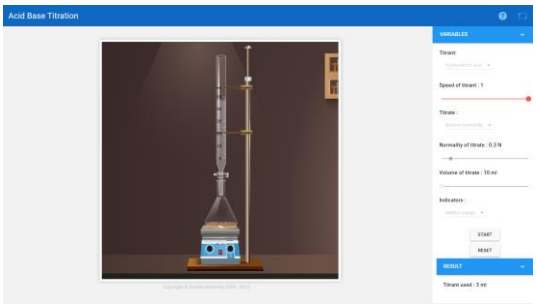
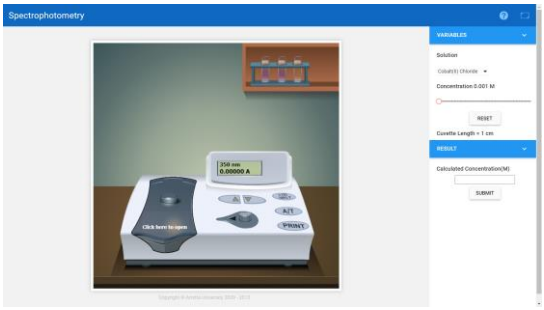
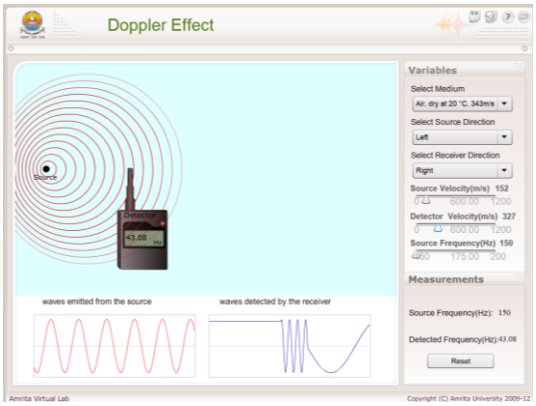
Dr. Eric welcoming the participants during the opening session of the second day of the workshop

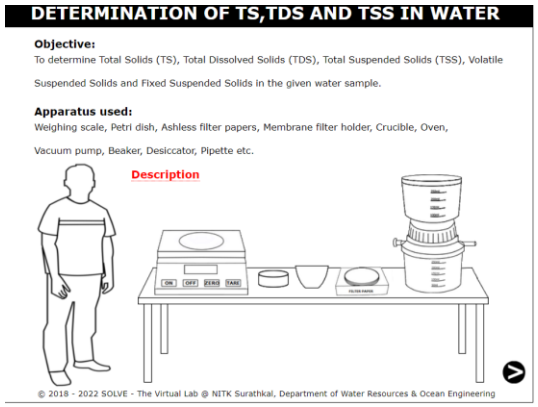
Mr. Saneesh delivering talk on impact of virtual labs

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, teachers, 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, SayoojyamBrahmanandan, 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 on Day 2	
 *Blood grouping experiment, Biotechnology*	 *Isoelectric Precipitation of Proteins: Casein from Milk, Biotechnology*
 *Acid base titration- Chemistry*	 *Spectrophotometry - Chemistry*
 *Magnetic Field Along The Axis of A Circular Coil Carrying Current - Physics*	 *Doppler effect - Physics*

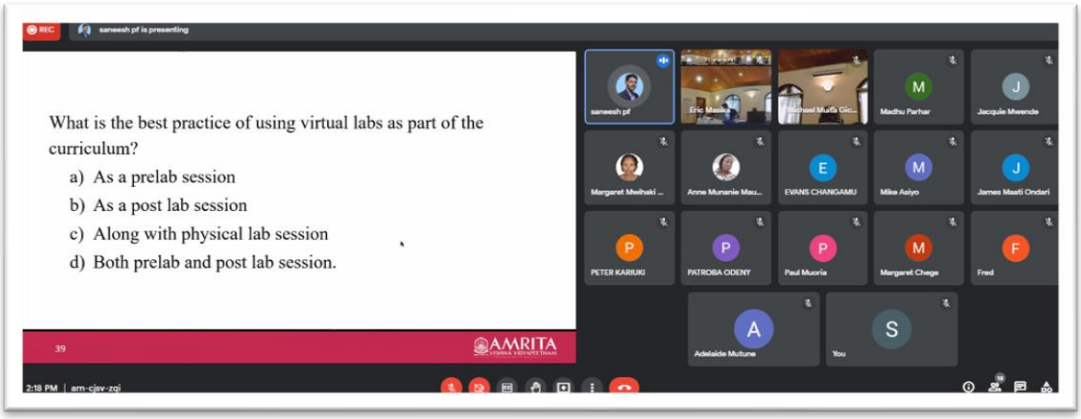


Environmental Engineering Lab, Civil Engineering

Basics of Scanning Electron Microscop, Mechanical Engineering

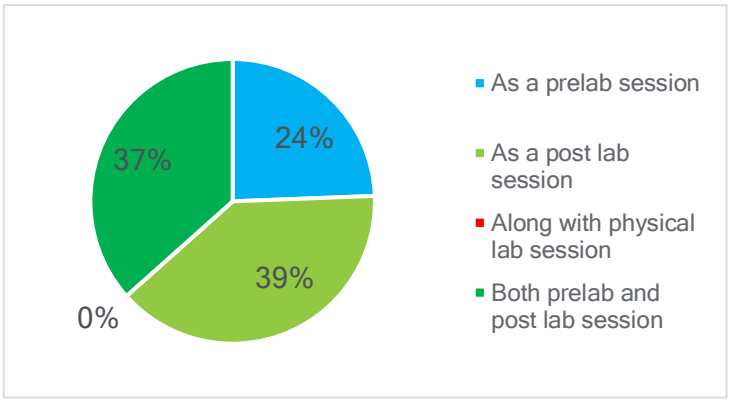
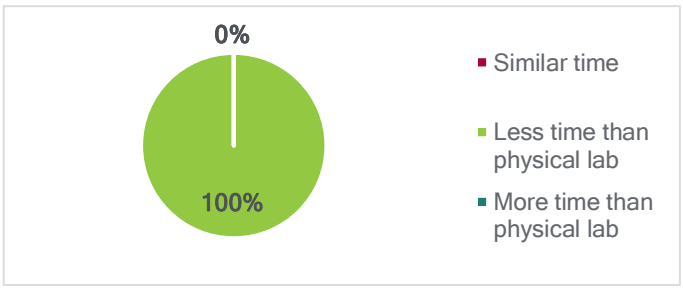
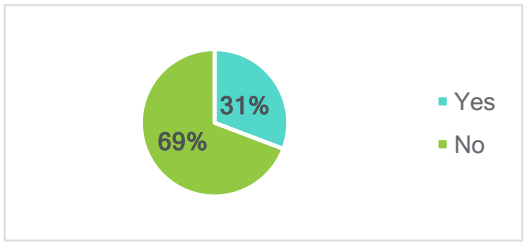
Poll question responses

Poll questions were used to facilitate a useful interaction with the participants. There were several questions asked to the participants during the session, for example, questions related to views on the best practice of using virtual labs, time comparison between virtual lab and physical lab, etc. The table below represents the responses from the participants for the poll questions.



Screenshot of poll questions shared with the participants.

Poll question	Choice	% of responses
What is the best practice of using virtual labs as part of the curriculum?	As a prelab session	24%
	As a post lab session	39%
	Along with physical lab session	0%

	Both prelab and post lab session	37%
How much time do you think to is needed to complete a virtual lab experimentation as compared with physical lab? 	Similar time	0%
	Less time than physical lab	100%
	More time than physical lab	0%
Can we use virtual labs instead of real physical lab experimentation?	Yes	31%
	No	69%

Hands-on task result

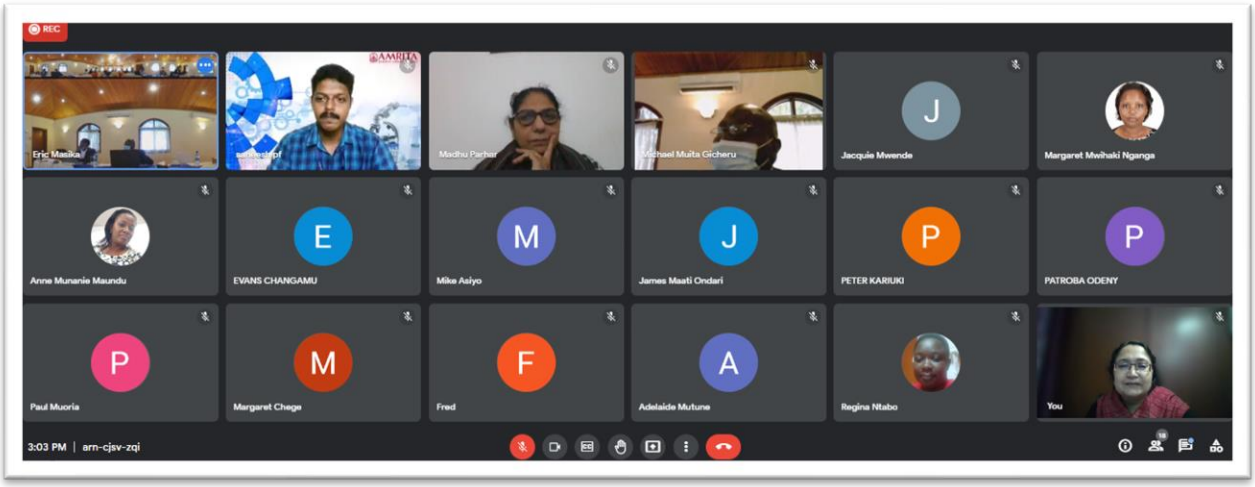
As part of the workshop, there were several tasks assigned to the participants to practice the virtual labs and submit the answers. Around 10 - 15 minutes were provided to complete each task and submit the answer through polls. Participants who could not submit the correct answer were encouraged to repeat the experimentation at their own pace as part of the assignment after the online sessions. The resource person encouraged participants to share their queries while attempting the exercise. Several participants shared their screen and performed live presentation of the virtual lab hands-on experiments. The resource person provided feedback on the presentations and responded to queries to facilitate hands-on activities.

Hands-on task	% of correct responses
Find the end point of the titration, where **Acetic acid** as Titrant, **Potassium hydroxide** as Titrate, Normality of titrate: **1N** and Volume of titrate: **10 ml**	86%
What will be the deflection in the Compass if the Number of turns of the coil: **25;** Radius of the coil: **6**cm; Compass position: **10**cm; Rheostat value: **50**	100%

Concluding session

During the concluding session, Dr. Eric spoke of how the interactive sessions, detailed demonstration, participation, and hands-on activity over the two-day workshop would be useful for the faculty members in term of planning how to implement virtual labs and how to apply and integrate virtual labs in teaching and learning for different subjects. One of the participants, Dr. Paul Muoria, mentioned that the training was very beneficial and useful for various departments in science and engineering and appreciated this opportunity to explore virtual labs.

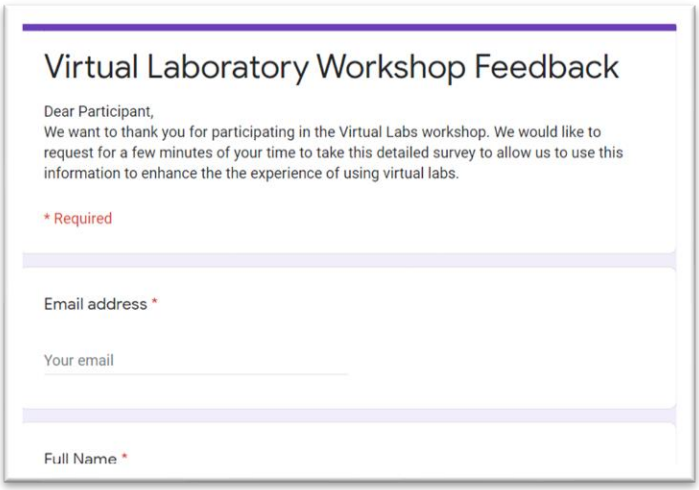
Prof. Madhu Parhar spoke of the need to learn and implement technologies such as virtual labs in day-to-day teaching and learning methods." Prof. Gicheru, Dean, School of Pure and Applied Science delivered the vote of thanks and appreciated the team from Kenyatta University and the organizing committee for successfully implementing the sessions. He expressed the belief that this workshop was a beginning which provides an opportunity to "change the way we teach science".



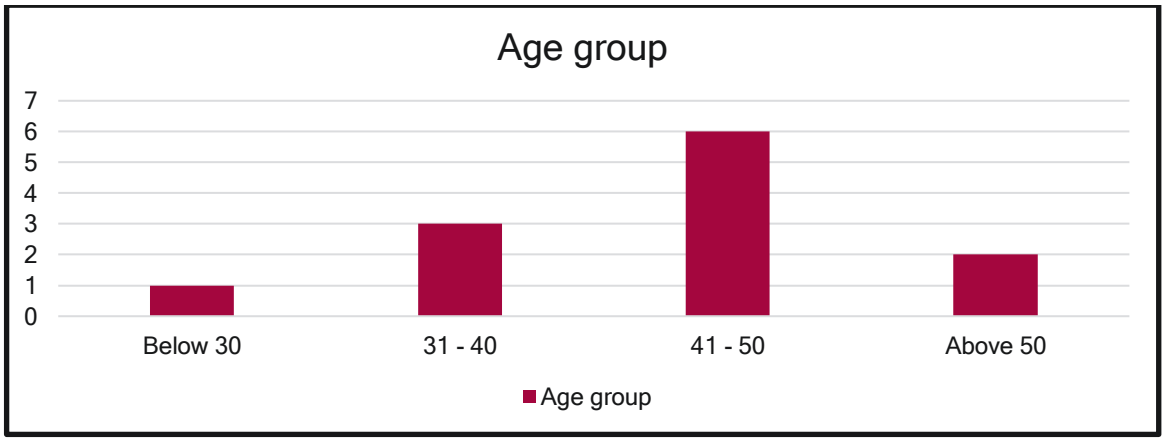
Concluding session

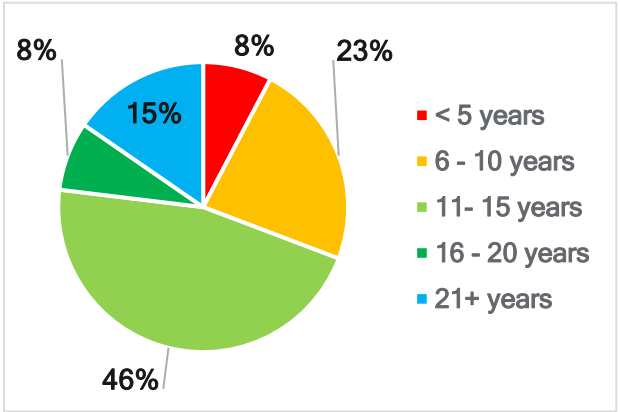
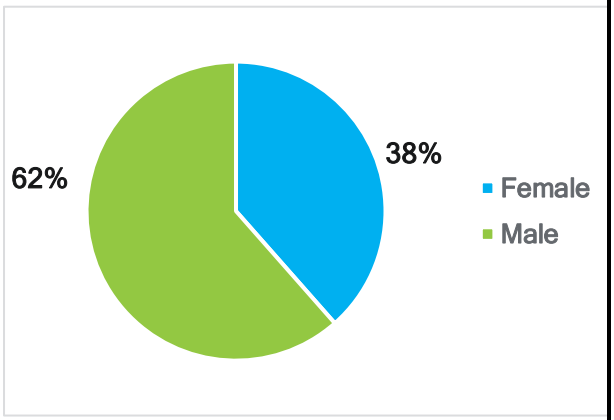
Feedback from the workshop

Participants were requested to fill up the feedback form at the end of the workshop. The link to this Google Form was shared via the Google Meet platform as well as Email. Feedback is used to adjust and improve current and future actions and behaviors.



13 responses were received after the workshop. Majority of the participants were in the age group 40 to 50 years.



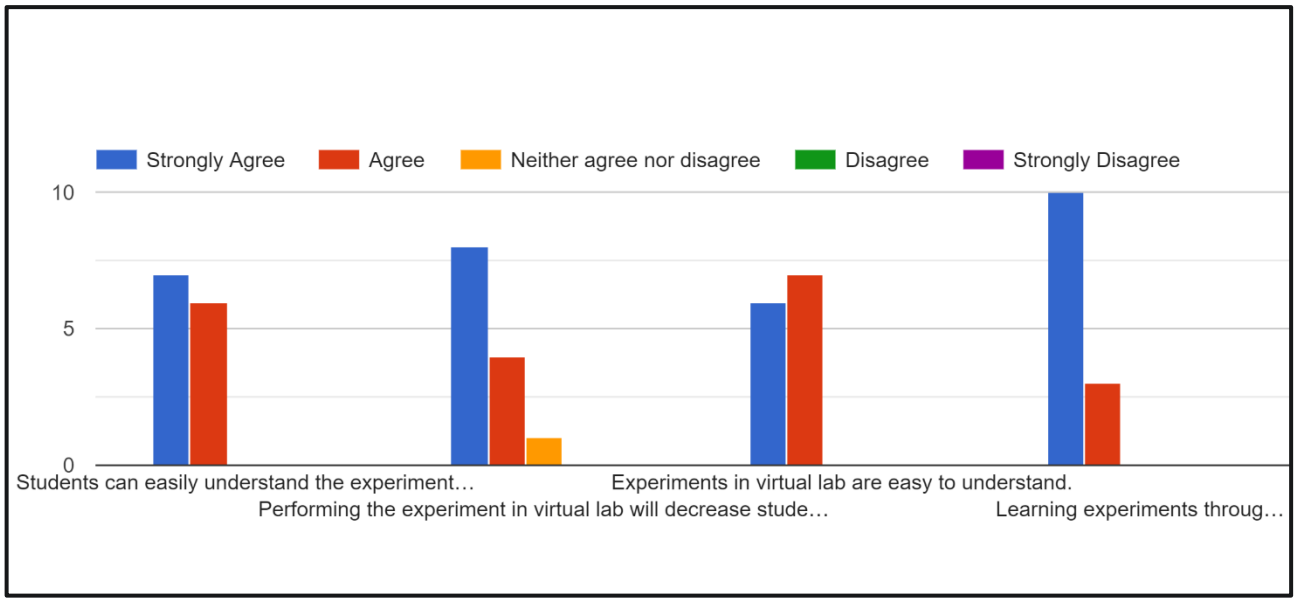
Years of experience	Gender
	

8% of the participants had less than 5 years of experience, Majority of the participants had around 11-15 years (46%) and 23% of the participants had 6 – 10 years of experience. 15% of the participants had 21+ years of teaching experience. 38% of the participants were female and 62% of the participants were male candidates.

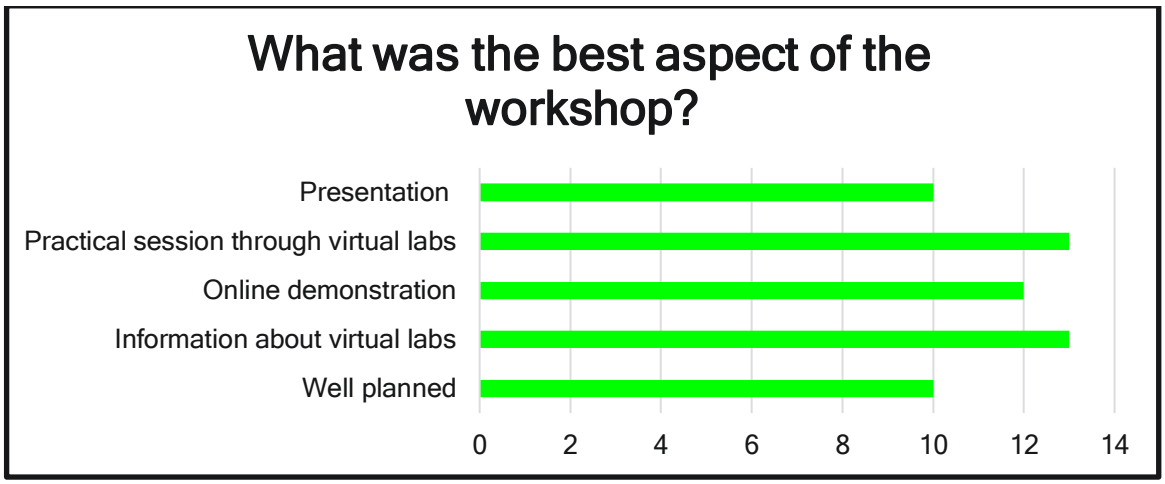
The common challenges faced by teachers during laboratory teaching were analyzed. 92.3% of the participants responded that there is a shortage of apparatus in the traditional laboratory. 53.8% of the participants faced difficulty in handling groups of students. 46.2% of the participant face time constraints in the physical lab session. 23.1% of the participants responded that unmotivated students also pose a challenge in conducting laboratory sessions. 38.5% responses said that the apparatus error made it difficult to complete the experimentation. 15.4% of the participants faced difficulty in teaching new experiments to the students because teachers must learn the experiment rigorously before conducting the laboratory session.

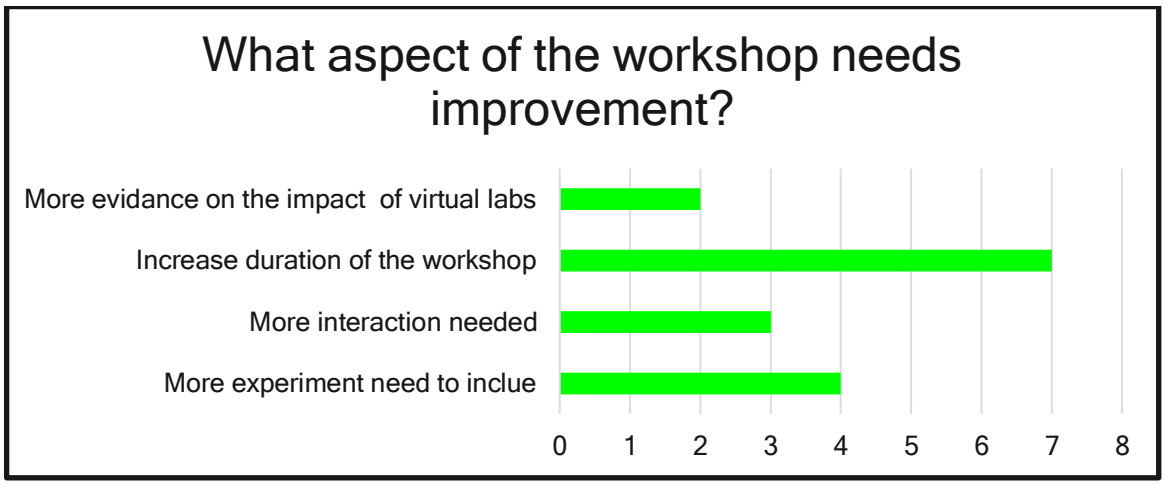
Based on the teachers' experience, we analyzed the effectiveness of virtual labs using the below questions. Responses are reported in the graph below. Majority of the teachers either Strongly agreed or Agreed that virtual labs are effective to teach and understand laboratory experiments.

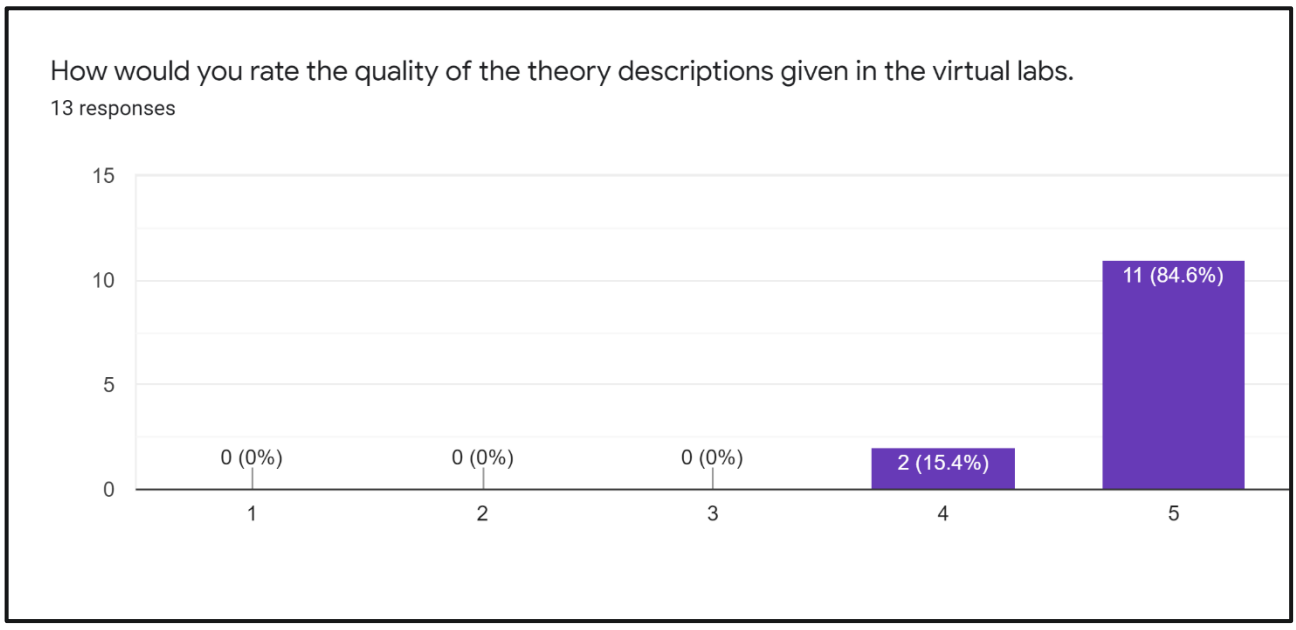
1. Students can easily understand the experiment by performing it in a virtual lab.
2. Performing the experiment in a virtual lab will decrease student's anxiety with physical lab experimentation.
3. Experiments in virtual lab are easy to understand.
4. Learning experiments through virtual lab is fun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



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

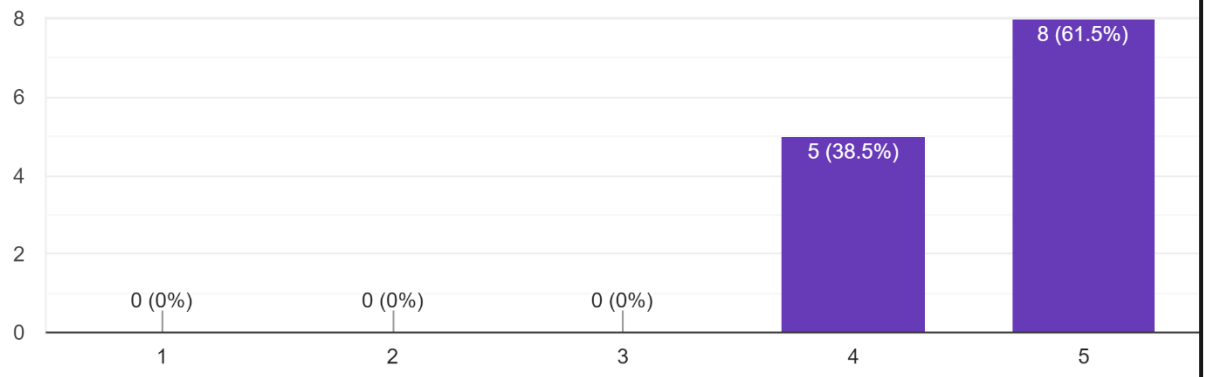

What was the best aspect of the workshop?
Presentation
Practical session through virtual labs
Online demonstration
Information about virtual labs
Well planned
0
2
4
6
8
10
12
14


What aspect of the workshop needs improvement?
More evidance on the impact of virtual labs
Increase duration of the workshop
More interaction needed
More experiment need to inclue
0
1
2
3
4
5
6
7
8


How would you rate the quality of the theory descriptions given in the virtual labs.
13 responses
15
10
5
0
0 (0%)
0 (0%)
0 (0%)
2 (15.4%)
11 (84.6%)
1
2
3
4
5

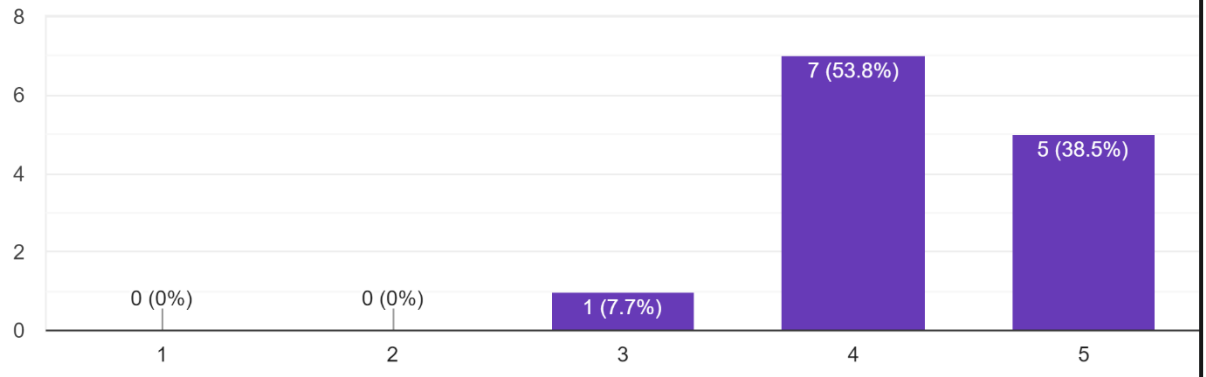
How would you rate the quality of the lab procedure given in the virtual labs

13 responses



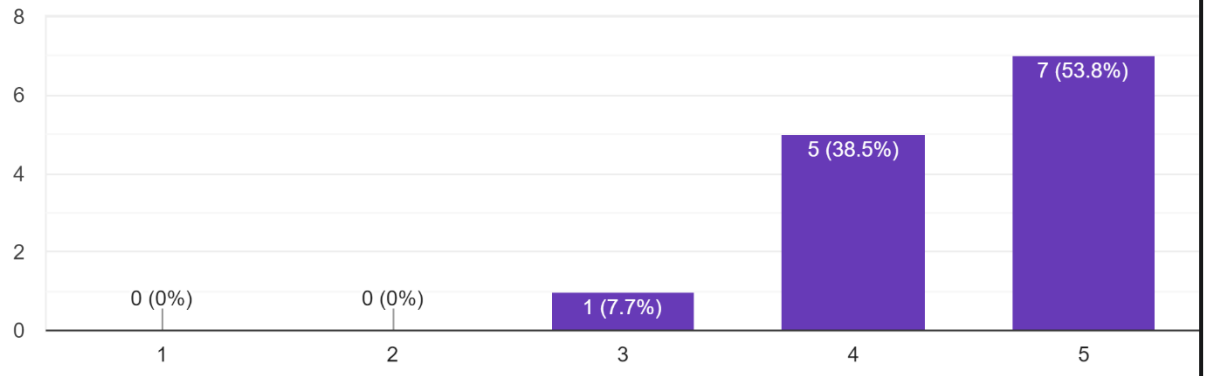
How would you rate the quality of the simulator provided in virtual labs

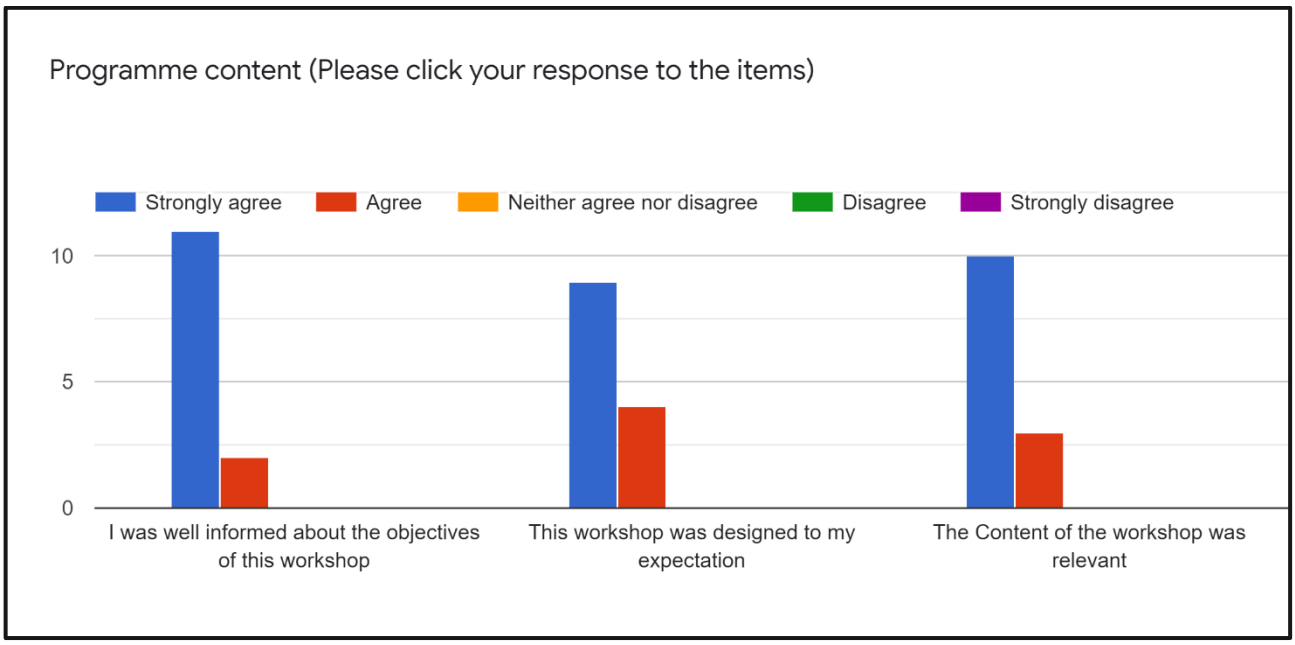
13 responses



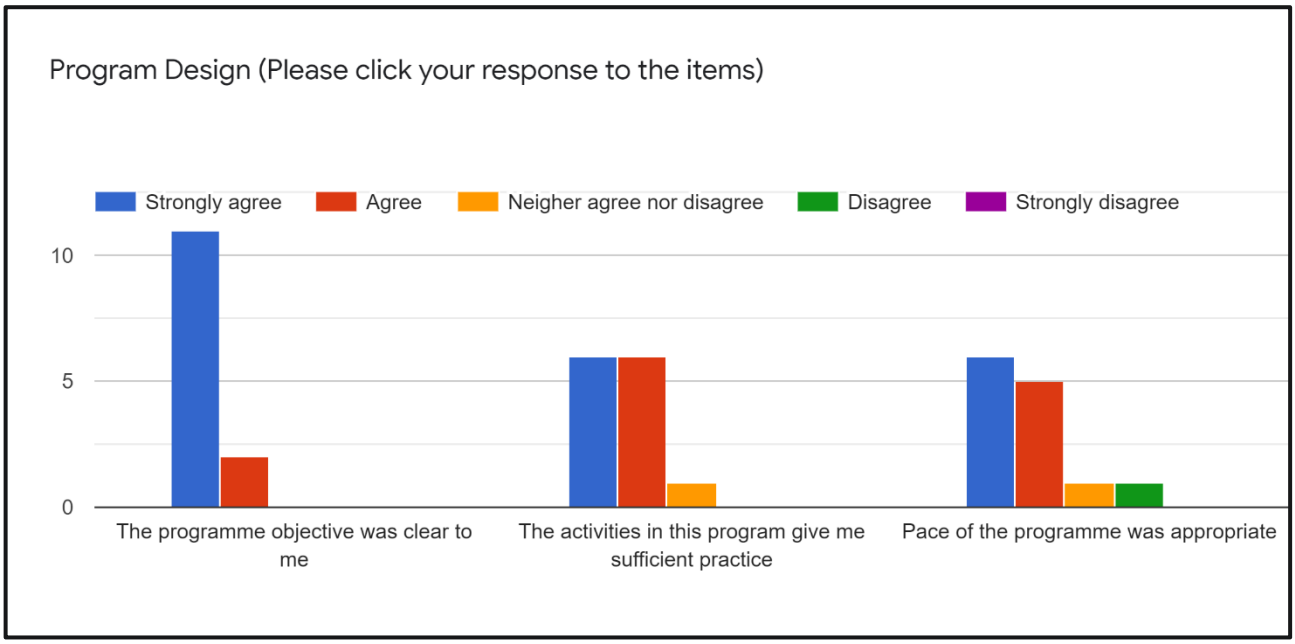
How would you rate the overall quality of the content from virtual labs

13 responses



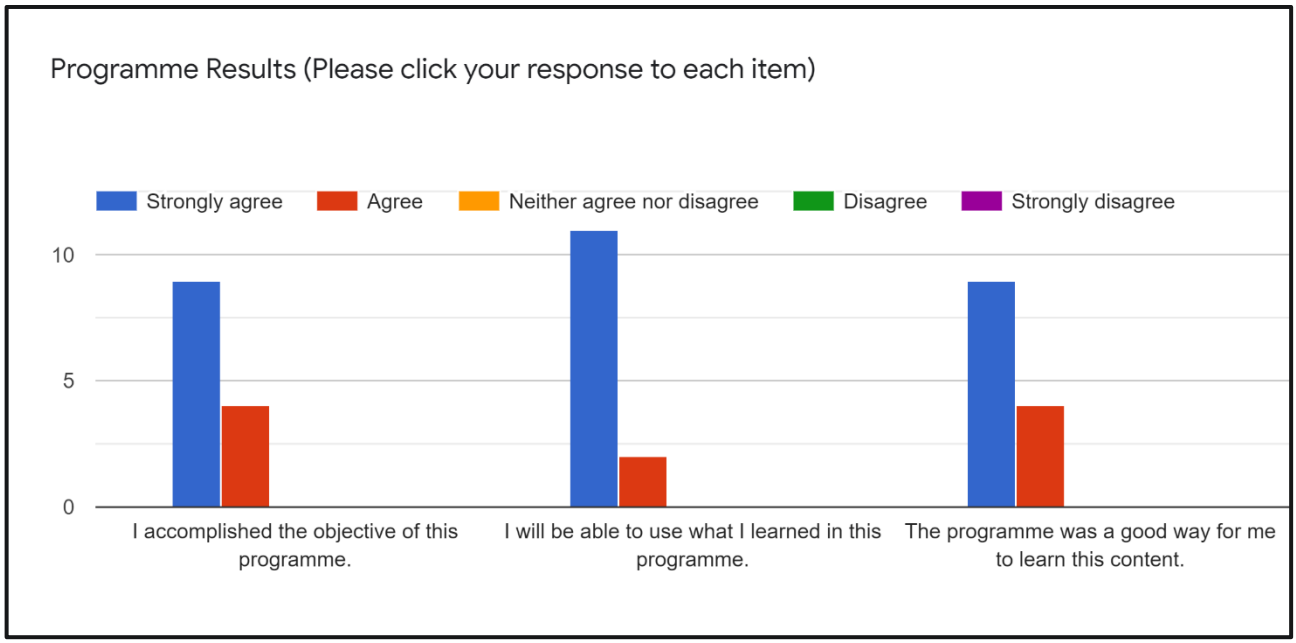


Most of the participants felt that they were well-informed about the objective and found the content relevant and designed as per their expectations.

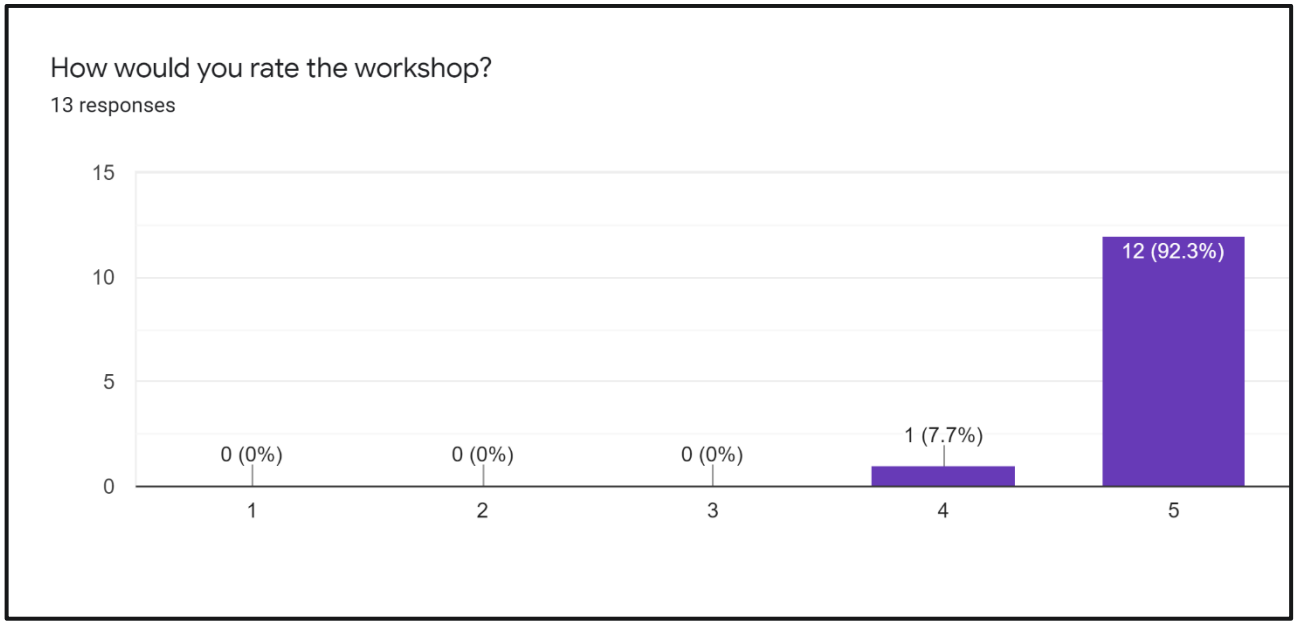


The chart above shows feedback regarding the programme objectives, practice session, pace of teaching learning activities. Most of participants replied in affirmative as is evident in chart above. Responses in the other categories could be explored to further strengthen the workshop.

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 found the workshop to be effective on these points.



12 out of 13 respondents gave the highest rating (5 on a scale of 1 to 5) to the overall quality of the workshop.

Suggestions from participants include conducting workshops with a longer duration and including more experiments across disciplines.

Appendix

List of participants

S/ No.	Instructor's Name	Gender	Instructor's email ID	School	Department/Discipline	Role(s)
1	Dr. George Onyango	Male	Onyango.george@ku.ac.ke	Digital School	Educational Management Policy and Curriculum Studies	Principal Investigator/Dean Digital School
2	Dr. Ntabo Regina Mongina	Female	ntabo.regina@ku.ac.ke	Pure and Applied Sciences	Biochemistry	Instructor
3	Dr. Patroba Ojola	Male	odeny.patroba@ku.ac.ke			Instructor
4	Dr. Margaret Ng'ang'a	Female	nganga.margret@ku.ac.ke		Chemistry	Instructor
5	Dr. Evans Changamu	Male	changamu.evans@ku.ac.ke			Instructor
6	Dr. Eric Masika	Male	Masika.eric@ku.ac.ke			Project Coordinator/ Instructor
7	Dr. Paul Kimata Muoria	Male	muoria.paul@ku.ac.ke		Plant Sciences	Instructor
8	Dr. Adelaide Mutune	Female	Mutune.adelaide@ku.ac.ke			Instructor
9	Prof. Gicheru Micheal	Male	gicheru.michael@ku.ac.ke		Zoological Sciences	Dean School of Pure and Applied Sciences /Instructor
10	Dr. Anne Munanie Maundu	Female	Maundu.anne@ku.ac.ke			Instructor
11	Dr. Joshua Mutiso	Male	mutiso.joshua@ku.ac.ke			Instructor
12	Dr. Pete K. Kariuki	Male	KARIUKI.PETERKINUTHIA@ku.ac.ke		Physics	Instructor
13	Dr. Margaret W. Chege	Female	chege.margaret@ku.ac.ke			Instructor
14	Eng. James Maati Ondari		ondari.james@ku.ac.ke	Engineering &Technology	Civil Engineering	Instructor
15	Mike Omondi Asiyo	Male	asiyo.mike@ku.ac.ke		Electrical and Electronic Engineering	Instructor
16	Jackline Mwende Mutungua	Female	mutunga.jackline@ku.ac.ke		Mechanical Engineering	Instructor