Disciplinary Excellence in First Year Chemistry

DigitalEd

Ollscoil Teicneolaíochta an Atlantaigh

Atlantic Technological University

T&L

DELTA AWARD

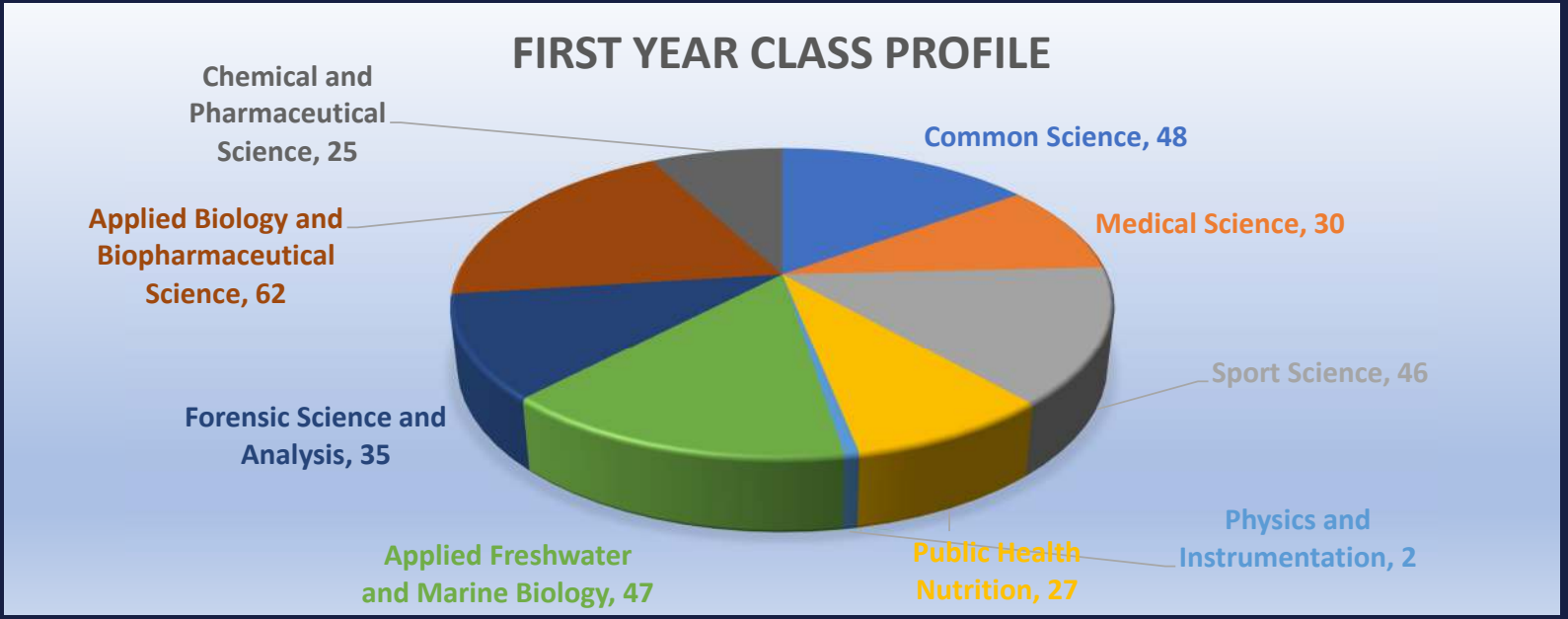
Disciplinary Excellence in Learning, Teaching and Assessment

Pictured at the awards ceremony are some members of the First Year Chemistry team with HEA staff, after winning the National Forum's Disciplinary Excellence in Learning, Teaching and Assessment (DELTA) Award, November 2022

L to R: Tim Conlon, Head of Policy and Strategic Planning at the Higher Education Authority, Anne Downes, ATU, Dr Aisling Crowley, ATU; Dr Cormac Quigley, ATU, Dr Lynn Ramsey, Chair – National Forum, Dr Etain Kiely, ATU, Dr Eugene McCarthy, ATU, and Dr Michelle Glacken, ATU.

Additional members of the team: Judith Wurmel, John Graham, Philip White, Siobhan Wall, and Moira Schlingermann.

Profile of the First Year Chemistry Lab



- Two hours per week practical class embedded in year long modules
- Approximately 300 students annually
- 8 destination programmes

DELTA Action Plan Breakdown:

Component 1
Leadership, Policy Development, and Professional Development of Staff

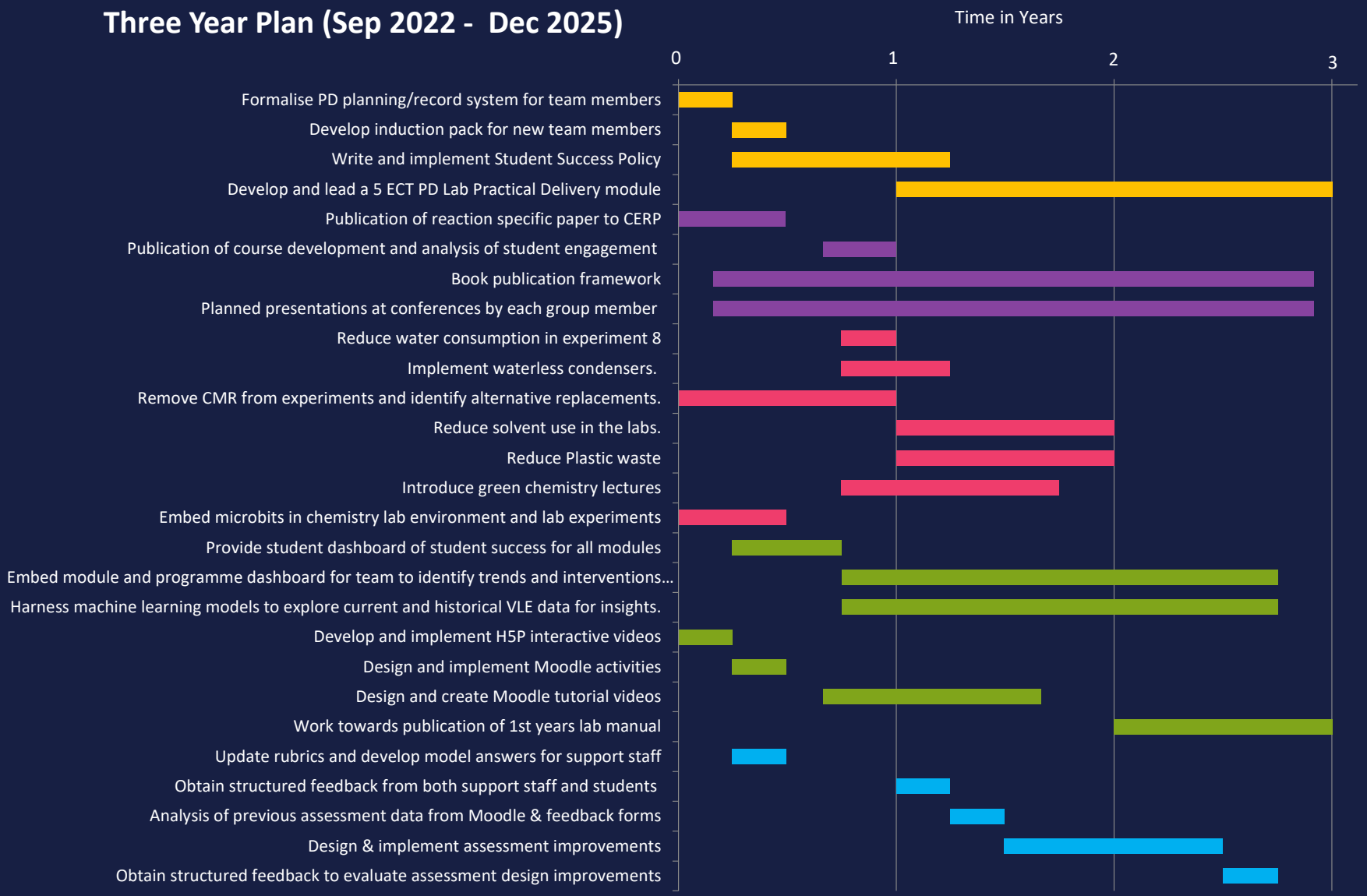
Component 2
Evaluation, Scholarship of Teaching and Research-Informed Teaching

Component 3
Designing Curriculum, Connections and Collaboration; Learning Environment

Component 4
Engaging Teaching/Learning Approaches, Supporting Students in Transition, and Blended/Online Approaches

Component 5
Assessment Purposes and their Rationale

Three Year Plan (Sep 2022 - Dec 2025)



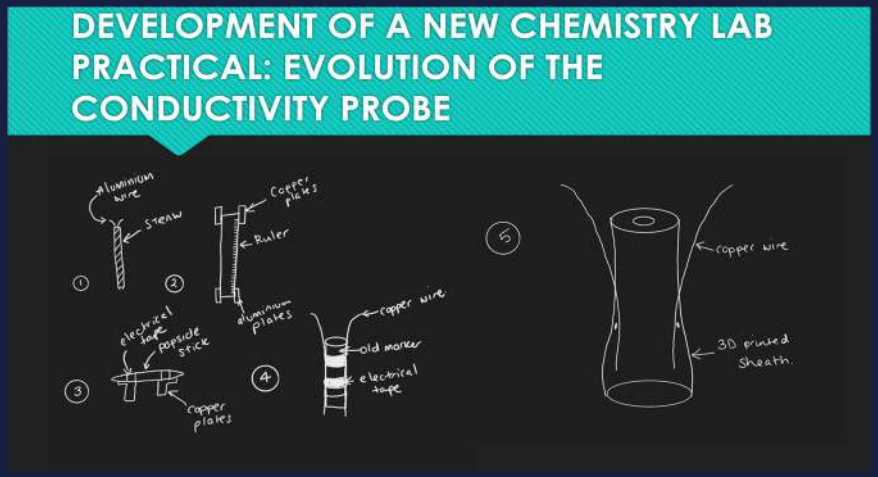
Embracing the Sustainable Development Goals

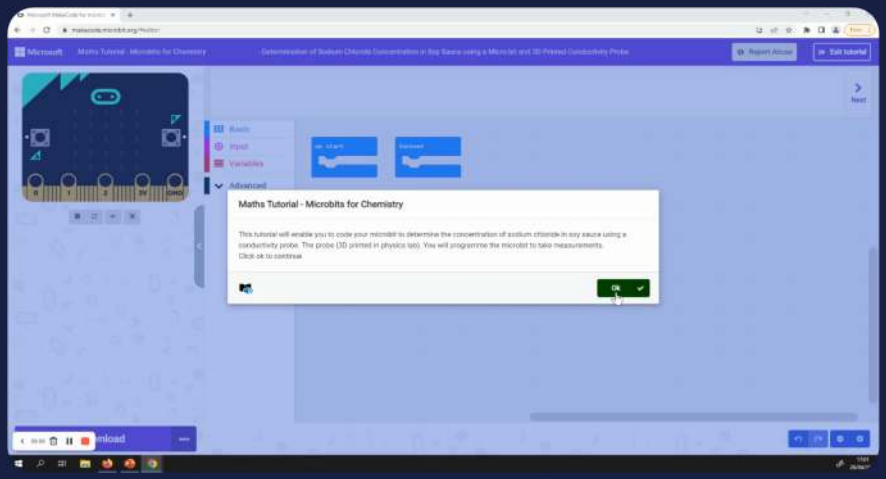
Aim: To help our students become sustainability-literate and conscious scientists.

Actions:

- Introduction of Green Chemistry to First Year LIS module
- Revision of experiments to reduce volume size/solvent use.
- Revision of lab manual to reduce plastic cuvette usage and eliminate use plastic weigh boats.
- Design of new experiments to include waterless condensers.
- Replacement of CMRs with safer alternatives.

Students as Partners in Teaching and Learning





- The Micro:bit experiment has now been integrated into Common Science Year 1 Maths tutorials.
- It is available as a lab practical for Year 1 Common Science students.
- It has been improved based on staff & student feedback and will run again next year.

Students as Partners in Teaching and Learning

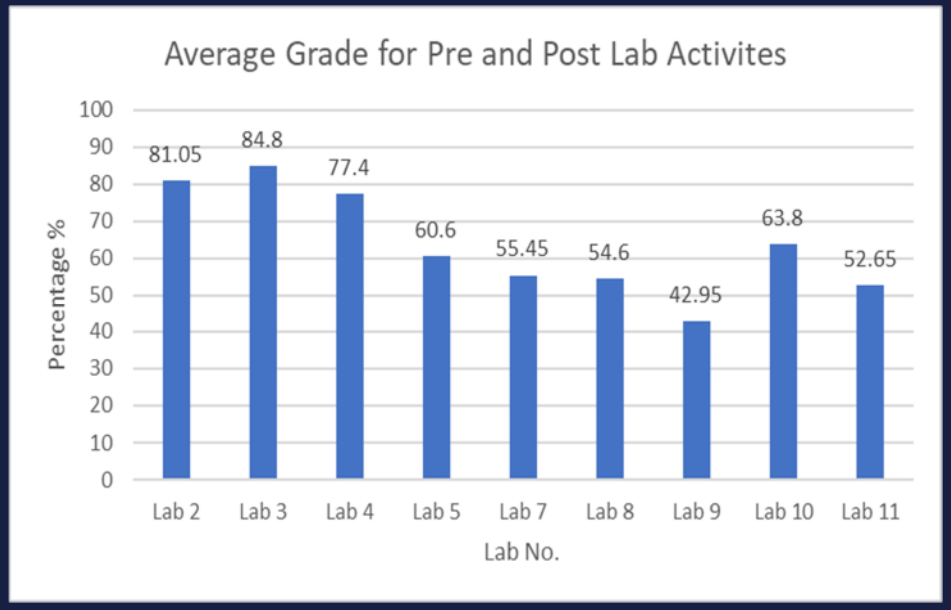
- Postgraduate students are key partners in delivering and developing the first year labs
- Four post graduate demonstrators

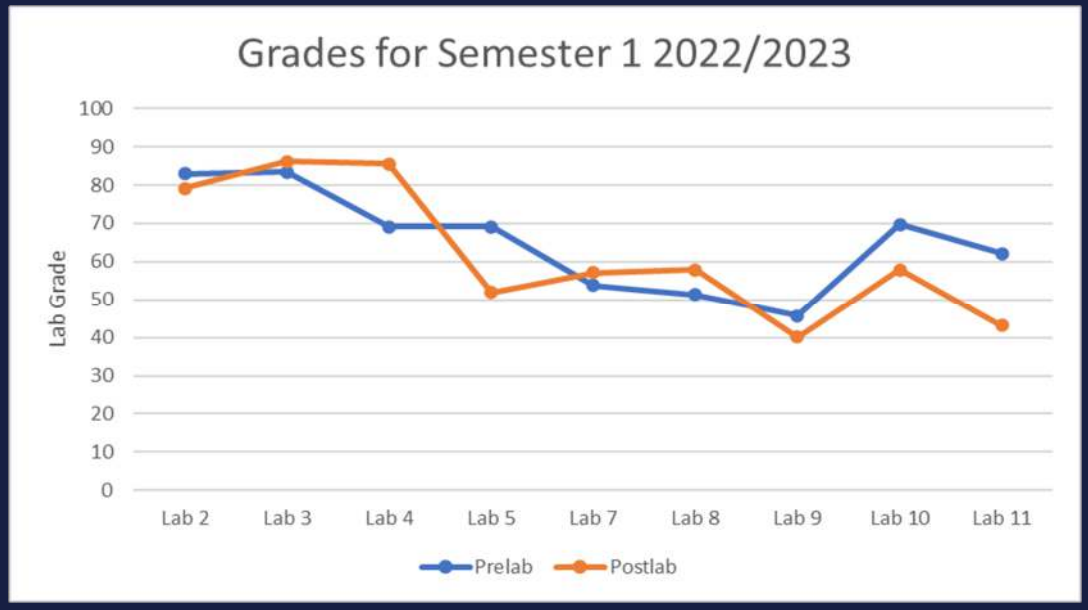
(YuanTing Low, Moira Schlingermann, Ryan McGowan, Aine Sally)

- Two postgraduates working in Learning Analytics (pictured)

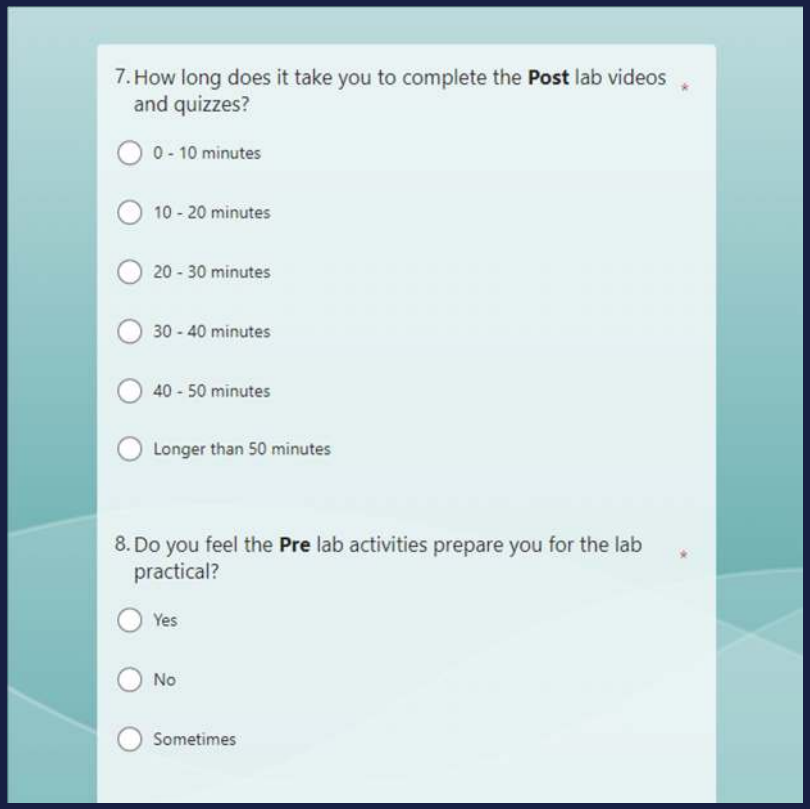
Supervisor: Dr Etain Kiely, Ikechukwu Ogbuchi, Ontiretse Ishmael

Investigating Reduced Engagement & Grades in Semester 1





Investigating Reduced Engagement & Grades 1



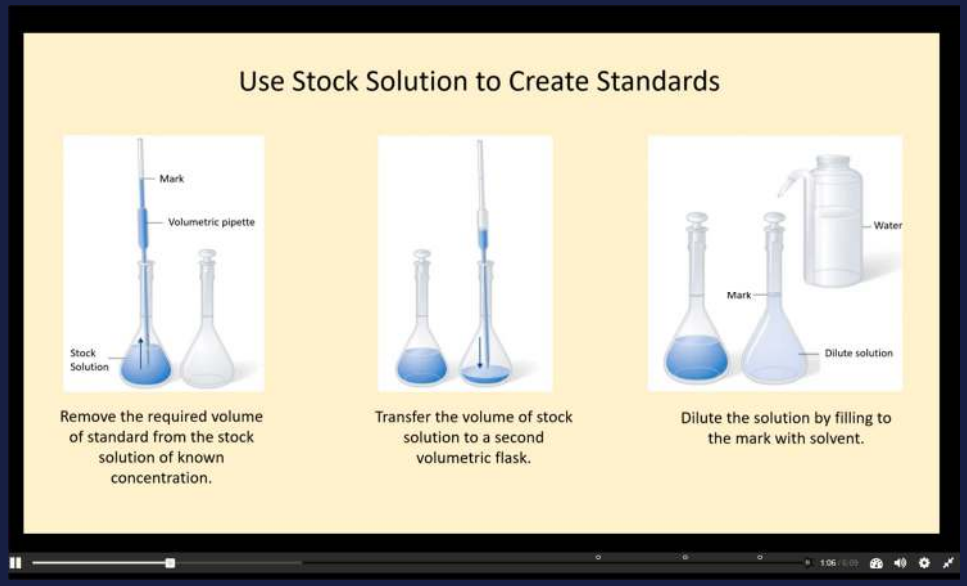
14. How would you like to see the first year chemistry labs improved. *
Refrain from personal comments or naming individuals.

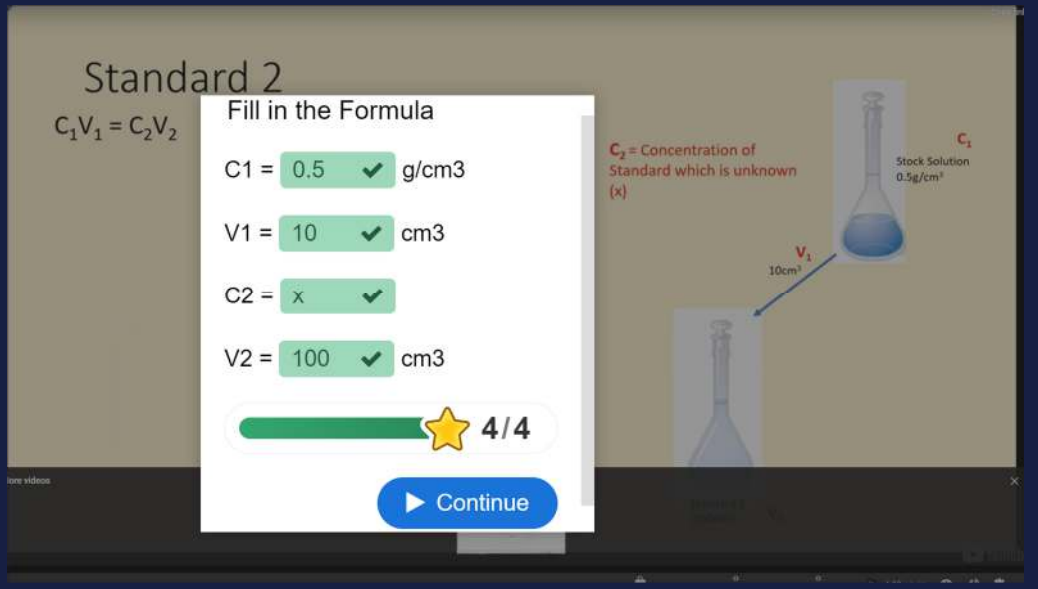
Enter your answer

15. How would you like to see the first year chemistry online activities improved. *

Enter your answer

Investigating Reduced Engagement & Grades in Semester 1





Digital Transformation in Teaching & Learning

The First Year Chemistry Moodle Page:

Bank of over 600 questions

21 Pre-Lab & Post-Lab Quizzes

36 Video Tutorials

Improving Feedback on Moodle Quizzes

QUESTION TEMPLATE

In the following **titration experiment**, calculate the concentration of the acetic acid solution.

35.00 ml of 1.000M LiOH solution is titrated against a solution of acetic acid (CH_3COOH) of unknown concentration (xM). {vol} ml of acetic acid solution is required to reach the endpoint.

The equation for the reaction is

$LiOH + CH_3COOH \rightarrow CH_3COOLi + H_2O$

Answers should be given to three decimal places.

WHAT THE STUDENT SEES

In the following **titration experiment**, calculate the concentration of the acetic acid solution in the following experiment?

35.00 ml of 1.000M lithium hydroxide (LiOH) solution is titrated against a solution of acetic acid of unknown concentration (xM). 19.32 ml of acetic acid solution is required to reach the endpoint.

The equation for the reaction is $LiOH + CH_3COOH \rightarrow CH_3COOLi + H_2O$

Answers should be given to three decimal places.

Answer: 1.865 M ✖

OLD FEEDBACK

NEW FEEDBACK

First get the number of moles of LiOH. Remember to change volume to litres 35ml = 0.035L

No. of moles = M x V

$LiOH + CH_3COOH$ react in a 1:1 ratio therefore the number of moles of CH_3COOH is equal to the number of moles of LiOH .

Molarity (concentration) of CH_3COOH = Moles/ volume (titration endpoint in litres).

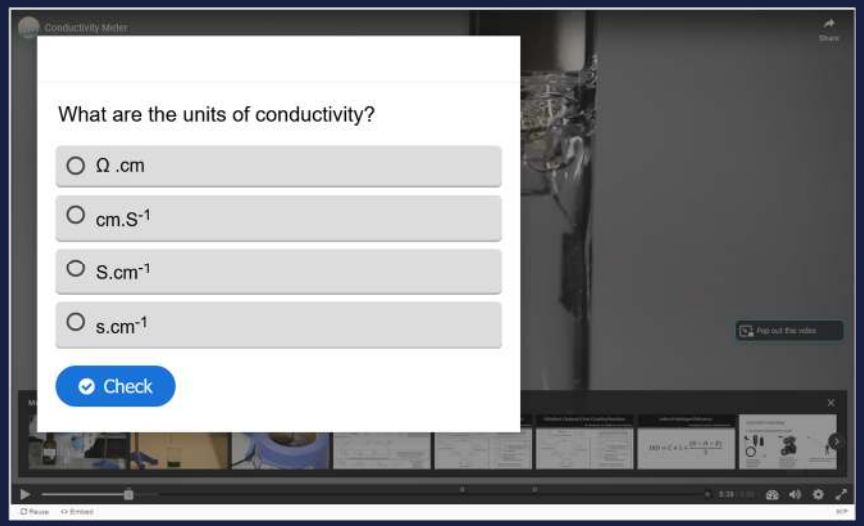
The correct answer is: 1.812

Streamlining Pre-Lab Engagement & Assessment

NOW

+

SEPTEMBER 2023

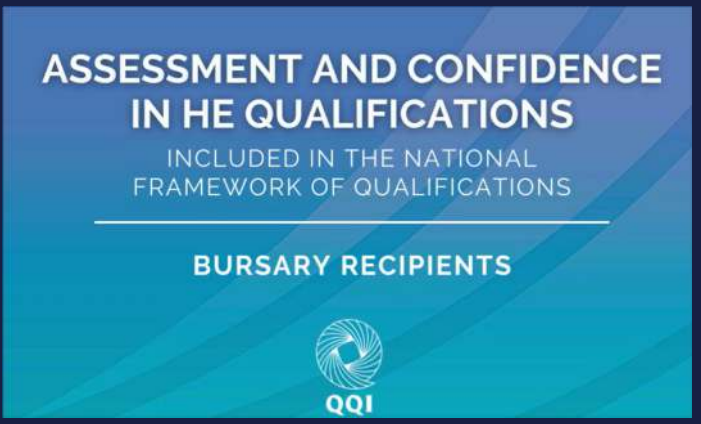


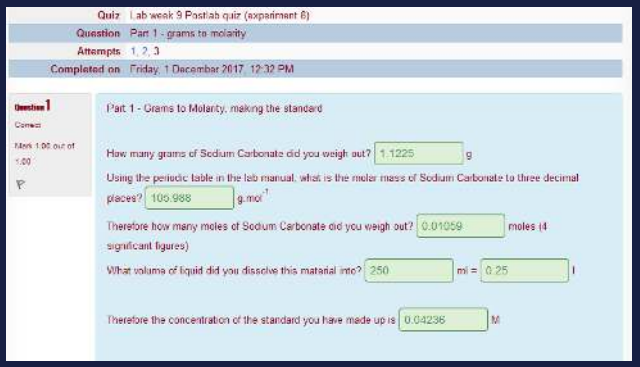
Benefits of H5P:

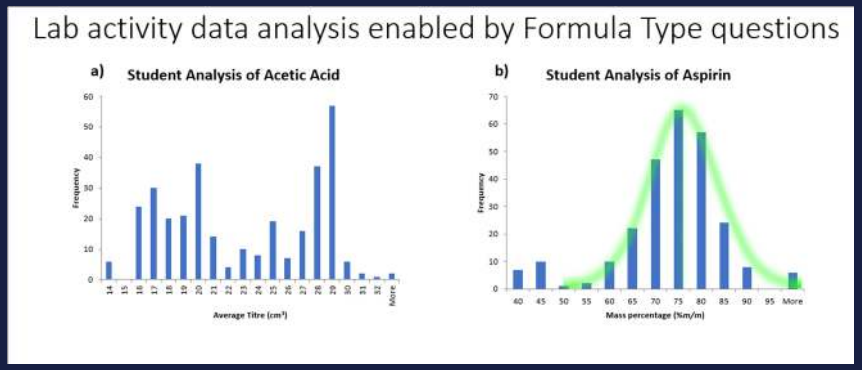
- Increases active engagement with video.
- Reduces friction in learning by synchronising theory and assessment.

QQI funded assessment development and analysis

- REAL Assessment Strategies for NFQ standards
- QQI Anniversary grant call funding (€59,651)
- Recruitment of postdoctoral researcher underway
- Designing new robust question types and leveraging analytics



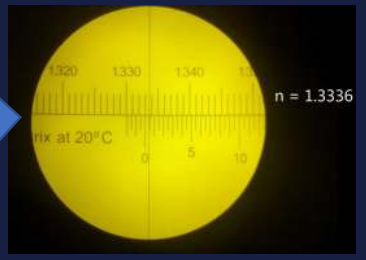


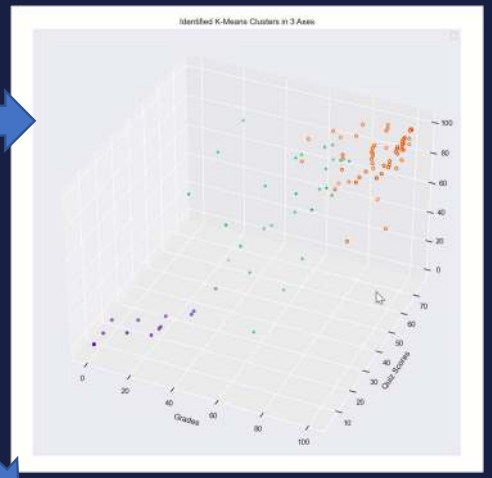


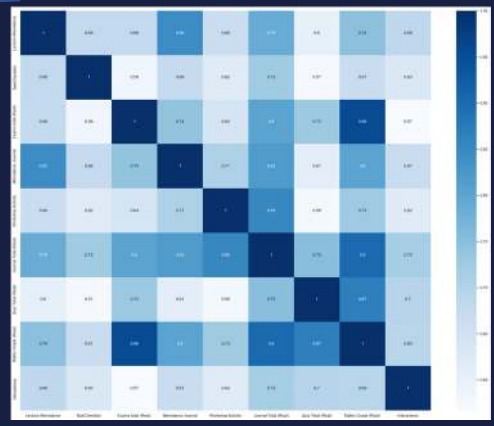
Academic Integrity and Artificial Intelligence

- **AI and first year chemistry:**
- **Machine Learning vs Artificial intelligence**
- **ML used to model student success probability**

- **Creating assessment that is robust to AI:**

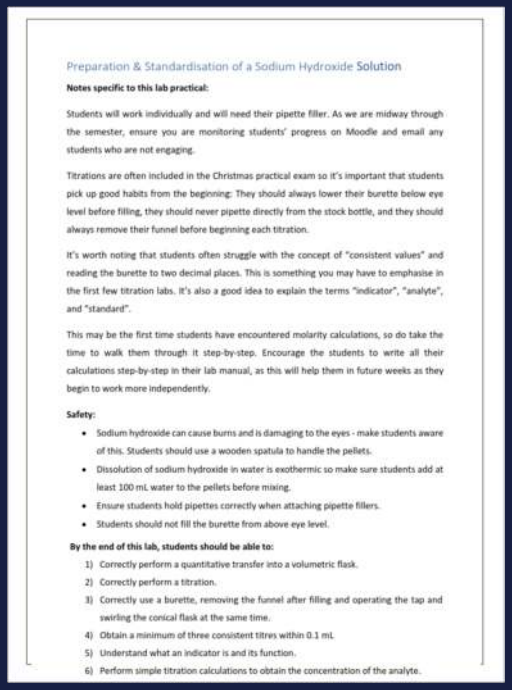






Project Outputs to Date

First Year Chemistry Lab Induction Pack Including Lecturers Handbook and Manual with Sample Data



Preparation & Standardisation of a Sodium Hydroxide Solution

Notes specific to this lab practical:

Students will work individually and will need their pipette filler. As we are midway through the semester, ensure you are monitoring students' progress on Moodle and email any students who are not engaging.

Titrations are often included in the Christmas practical exam so it's important that students pick up good habits from the beginning: They should always lower their burette below eye level before filling, they should never pipette directly from the stock bottle, and they should always remove their funnel before beginning each titration.

It's worth noting that students often struggle with the concept of "consistent values" and reading the burette to two decimal places. This is something you may have to emphasise in the first few titration labs. It's also a good idea to explain the terms "indicator", "analyte", and "standard".

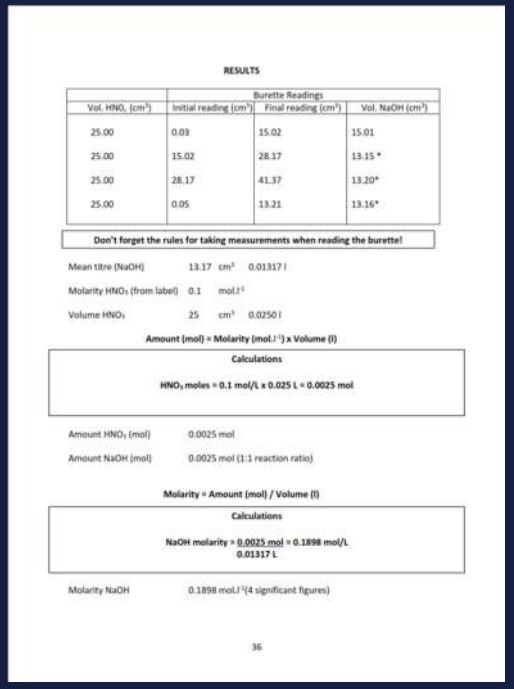
This may be the first time students have encountered molarity calculations, so do take the time to walk them through it step-by-step. Encourage the students to write all their calculations step-by-step in their lab manual, as this will help them in future weeks as they begin to work more independently.

Safety:

- Sodium hydroxide can cause burns and is damaging to the eyes - make students aware of this. Students should use a wooden spatula to handle the pellets.
- Dissolution of sodium hydroxide in water is exothermic so make sure students add at least 100 mL water to the pellets before mixing.
- Ensure students hold pipettes correctly when attaching pipette fillers.
- Students should not fill the burette from above eye level.

By the end of this lab, students should be able to:

1) Correctly perform a quantitative transfer into a volumetric flask.
2) Correctly perform a titration.
3) Correctly use a burette, removing the funnel after filling and operating the tap and swirling the conical flask at the same time.
4) Obtain a minimum of three consistent titres within 0.1 mL
5) Understand what an indicator is and its function.
6) Perform simple titration calculations to obtain the concentration of the analyte.



RESULTS

	Burette Readings		
Vol. HNO_3 (cm^3)	Initial reading (cm^3)	Final reading (cm^3)	Vol. NaOH (cm^3)
25.00	0.03	15.02	15.01
25.00	15.02	28.17	13.15 *
25.00	28.17	41.37	13.20*
25.00	0.05	13.21	13.16*

Don't forget the rules for taking measurements when reading the burette!

Mean titre (NaOH) 13.17 cm^3 0.01317 l

Molarity HNO_3 (from label) 0.1 $mol.l^{-1}$

Volume HNO_3 25 cm^3 0.0250 l

Amount (mol) = Molarity ($mol.l^{-1}$) x Volume (l)

Calculations

HNO_3 moles = 0.1 mol/L x 0.025 L = 0.0025 mol

Amount HNO_3 (mol) 0.0025 mol

Amount NaOH (mol) 0.0025 mol (1:1 reaction ratio)

Molarity = Amount (mol) / Volume (l)

Calculations

NaOH molarity = 0.0025 mol / 0.01317 L = 0.1898 mol/L

Molarity NaOH 0.1898 $mol.l^{-1}$ (4 significant figures)

36

What is the pH for a 0.0068 molar solution of KOH?

Answers should be given to two decimal places.

Answer: 2.1756 ✖

If Acid with1 hydrogen (ex: 0.01M HCl) then use the formula:

pH=-log[H^+]

=-log[0.01] =1

If Acid with 2 Hydrogens (ex: 0.01M H_2SO_4) then multiply the concentration by 2:

pH=-log[H^+x2]

=-log[0.01x2] = 0.699

If Base with 1 OH group (ex: 0.01 M NaOH) then use the formula:

pH=14-(-log[H^+])

=14-(-log[0.01]) = 13

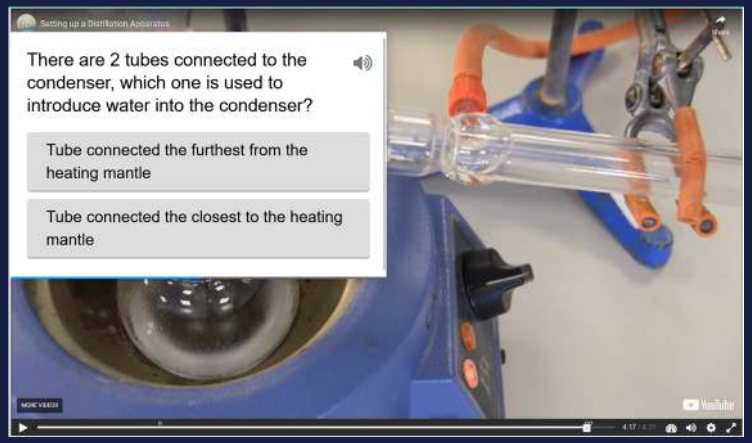
If Base with 2 OH group (ex: 0.01 M $Ba(OH)_2$) then multiply the concentration by 2:

pH=14-(-log[H^+x2])

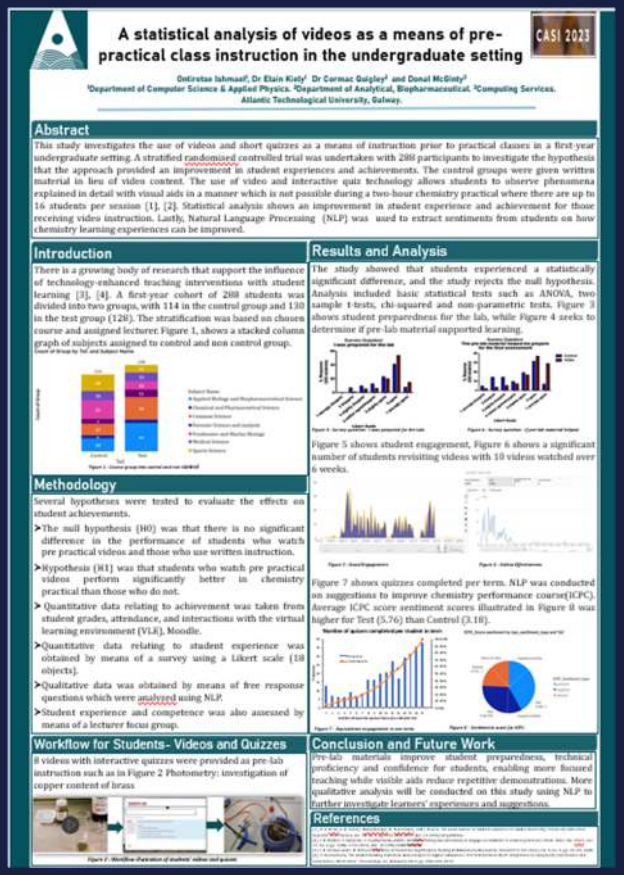
=14-(-log[0.01x2]) = 13.30

Improved Feedback for over 600 Moodle Questions

Eight New H5P Videos Created



Project Outputs and Dissemination



What's Next?

Short-Term Goals

- Improved lab manual.
- Design of a new esterification experiment which utilises UDL principles and use waterless condensers
- QQI funded assessment development and analysis.
- Publication of undergraduate experiments in CERP.

Mid-Term Goals

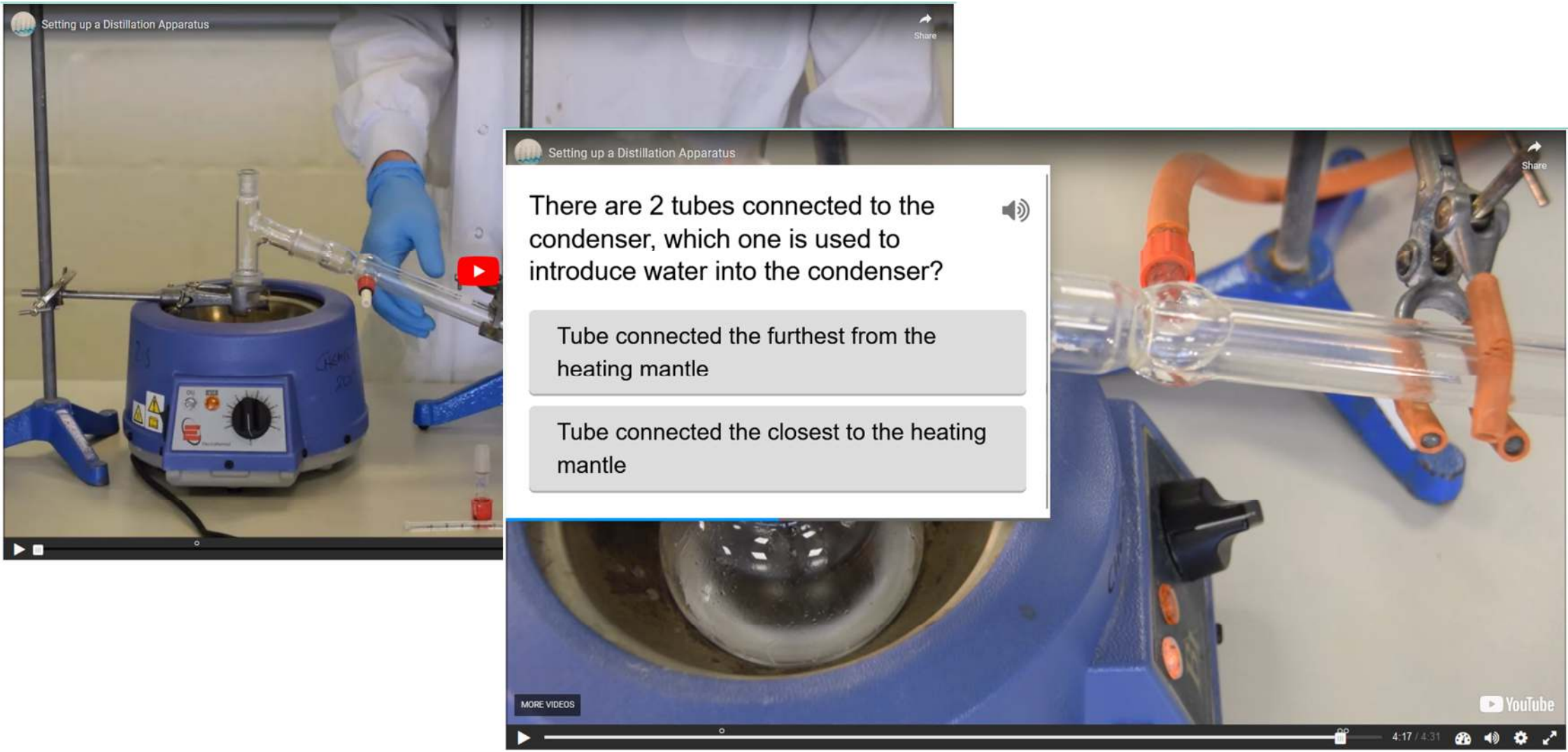
- Student feedback and focus groups on engagement and assessment in Semester 1.
- Development of new tutorial videos.
- Publication of course development and analysis of student engagement.

Long-Term Goals

- Design of a 5 ECT CPD Lab Practical Delivery module.
- Publication of First Year Lab Manual.


THANK YOU

Example of H5P video



Example Moodle p

What is the pH for a 0.0068 molar solution of KOH?

Answers should be given to two decimal places.

Answer:

In the following **titration experiment**, calculate the concentration of the acetic acid solution in the following experiment?

35.00 ml of 1.000M lithium hydroxide (LiOH) solution is titrated against a solution of acetic acid of unknown concentration (xM). 19.32 ml of acetic acid solution is required to reach the endpoint.

The equation for the reaction is $LiOH + CH_3COOH \rightarrow CH_3COOLi + H_2O$

Answers should be given to three decimal places.

Answer: 1.865 M ✖

First get the number of moles of LiOH. Remember to change volume to litres 35ml = 0.035L

No. of moles = M x V

LiOH + CH_3COOH react in a 1:1 ratio therefore the number of moles of CH_3COOH is equal to the number of moles of LiOH .

Molarity (concentration) of CH_3COOH = Moles/ volume (titration endpoint in litres).

The correct answer is: 1.812

What is the pH for a 0.0068 molar solution of KOH?

Answers should be given to two decimal places.

Answer: 2.1756 ✖

If Acid with1 hydrogen (ex: 0.01M HCl) then use the formula:

$pH=-\log[H^+]$

$=-\log[0.01] \quad =1$

If Acid with 2 Hydrogens (ex: 0.01M H_2SO_4) then multiply the concentration by 2.

$pH=-\log[H^+x2]$

$=-\log[0.01x2] \quad = 0.699$

If Base with 1 OH group (ex: 0.01 M NaOH) then use the formula:

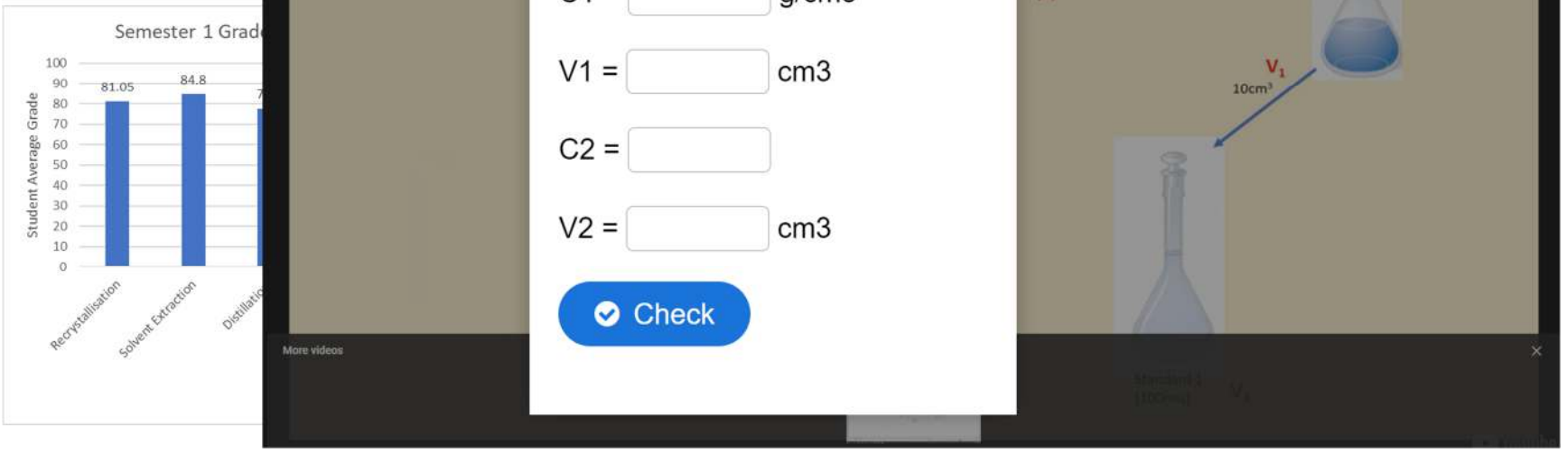
$pH=14-(-\log[H^+])$

$=14-(-\log[0.01]) \quad = 13$

If Base with 2 OH group (ex: 0.01 M $Ba(OH)_2$) then multiply the concentration by 2.

$pH=14-(-\log[H^+x2])$

$=14-(-\log[0.01x2]) \quad = 13.30$


Semester 1 Grad
Student Average Grade
100
90
80
70
60
50
40
30
20
10
0
81.05
84.8
Recrystallisation
Solvent Extraction
C1V1 C2V2 dilutions
Standard 2
$C_1V_1 = C_2V_2$
Fill in the Formula
C1 = g/cm3
V1 = cm3
C2 =
V2 = cm3
Check
C_2 = Concentration of Standard which is unknown (x)
C_1
Stock Solution
0.5g/cm³
V_1
10cm³
More videos