RCSI UNIVERSITY OF MEDICINE AND HEALTH SCIENCES

Flipped Classroom Blended Learning in the Laboratory Sciences for Scalability and Student Success

Dr Graeme Kelly
Mrs. Suzanne Donnelly
Prof. Donal O'Shea

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Quality in Higher Education:
Sectoral Findings & Enhancement Showcase:

Dublin Royal Convention Centre

Background

- Dr Graeme Kelly
- Senior Technical Officer in Chemistry (2011-present)
- PhD in Chemistry (2012)
- MSc in Leadership (2016)
- PG Dip in Health Professions Education (2019)
- PhD in Health Professions Education (2024-Ongoing)

graemekelly@rcsi.ie

<u>Primary Role</u>

Manage the Undergraduate Chemistry Laboratory
Key interest – Innovation in Teaching & Learning, Student Engagement and Student Success

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Chemistry Department Laboratory Team

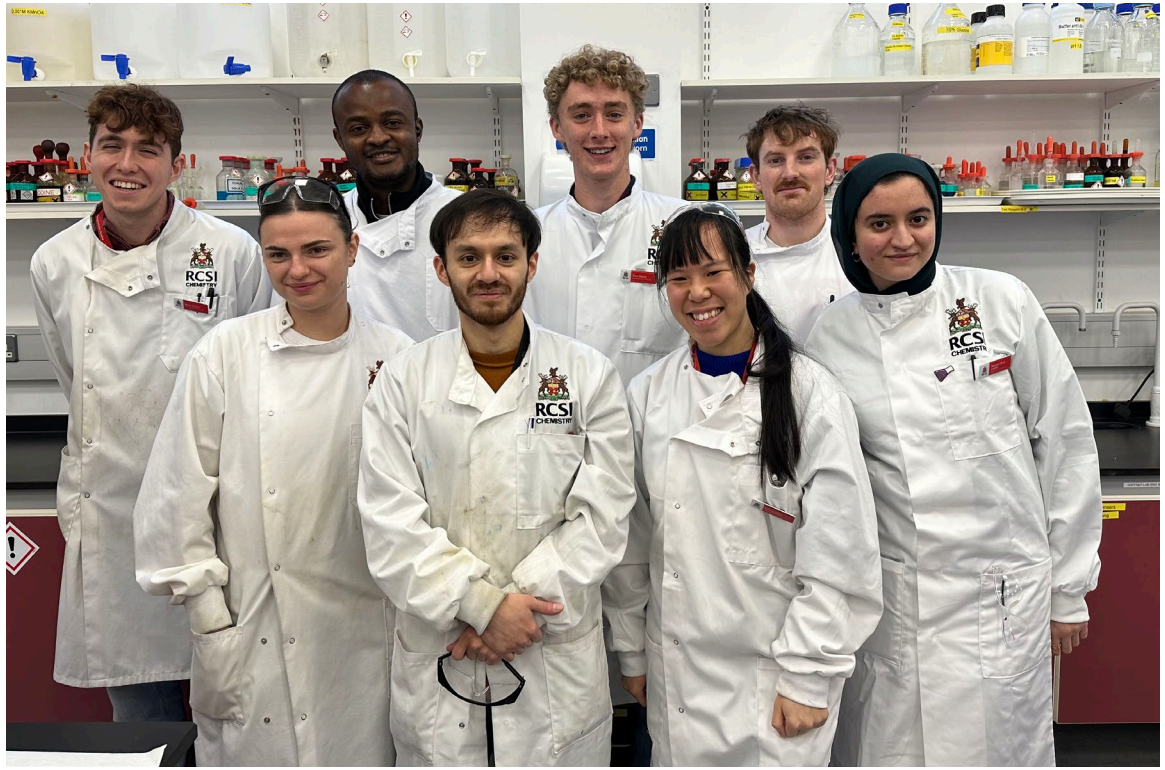
Head of Department

Prof. Donal O'Shea

Senior Technicians

Dr Graeme Kelly

Mrs. Suzanne Donnelly



Demonstrating Team
(12-14 PhD Students)

The role of the demonstrator is essential to this process.

- **Face-to-Face Teaching**
- **Correcting**
- **Administration**

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Challenge 2014

Finite Space + Resources

Increased Student Population

Digital Solutions

Student Success

Lab was built in 2005

(Max. Cap. 52 Students) Chemistry Practical Run in 3 Hour Sessions

Total = 270

AY 2014/2015

Total = 370

Build Robust Model

Increase Student Numbers

Total = 1000

What Digital Interventions can we use for Scalability and Student Success?

Moderate Increase 73%

Large Increase

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What Digital Interventions can we use for Scalability and Student Success?

Virtual Learning environment (VLE)

- Build within the Universities VLE (Moodle)
- No additional platform costs
- IT Support
- Stability
- Sustainability

Introduction of Technology Enhanced Learning (2014)

TEL

1. **Health and Safety concerns**
2. **Students under-prepared**
3. **Students with no prior chemistry**

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Flipped Classroom

Pre Practical MCQ's & Safety

- **Self Assessment**
- **Direct Feedback**
- **Contributes to CA Grade**

- Engage with the material
- Address the health and safety concerns
- Prepare for in-lab activity

Seery MK. Flipped learning in higher education chemistry: emerging trends and potential directions. Chemistry Education Research and Practice. 2015;16(4):758-68.

Correia, P.R.M., Kinchin, I.M., Paixão, T.R.L.C. et al. Flipping the lab with AI support: a scalable model to address the theory–practice gap in analytical chemistry education. Anal Bioanal Chem 417, 4283–4290 (2025). https://doi.org/10.1007/s00216-025-05961-6

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What type of solvent goes in the **Non-chlorinated waste** container below?

Select one:

- a. Acetic Acid, Sulphuric Acid, Acetic Anhydride
- b. Acetone, Methanol, Ethanol
- c. Chloroform, Dichloromethane

Health and Safety

Pictograms
Solvent Awareness
Dangers of mixing Chemicals

Chemical risks and hazards label
Pictograms

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TEL

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Blended learning

What is the molar mass (rounded to two decimal places) of the sugar ribose, $C_5H_{10}O_5$?

HINT: (http://www.rsc.org/periodic-table)

Select one:

- A. 222.46 g/mol
- B. 150.13 g/mol
- C. 180.12 g/mol
- D. 120.25 g/mol
- E. 96.58 g/mol

Check

- Students Engage with content
- Engage with calculations needed for the upcoming lab
- Moodle corrected
- % of CA

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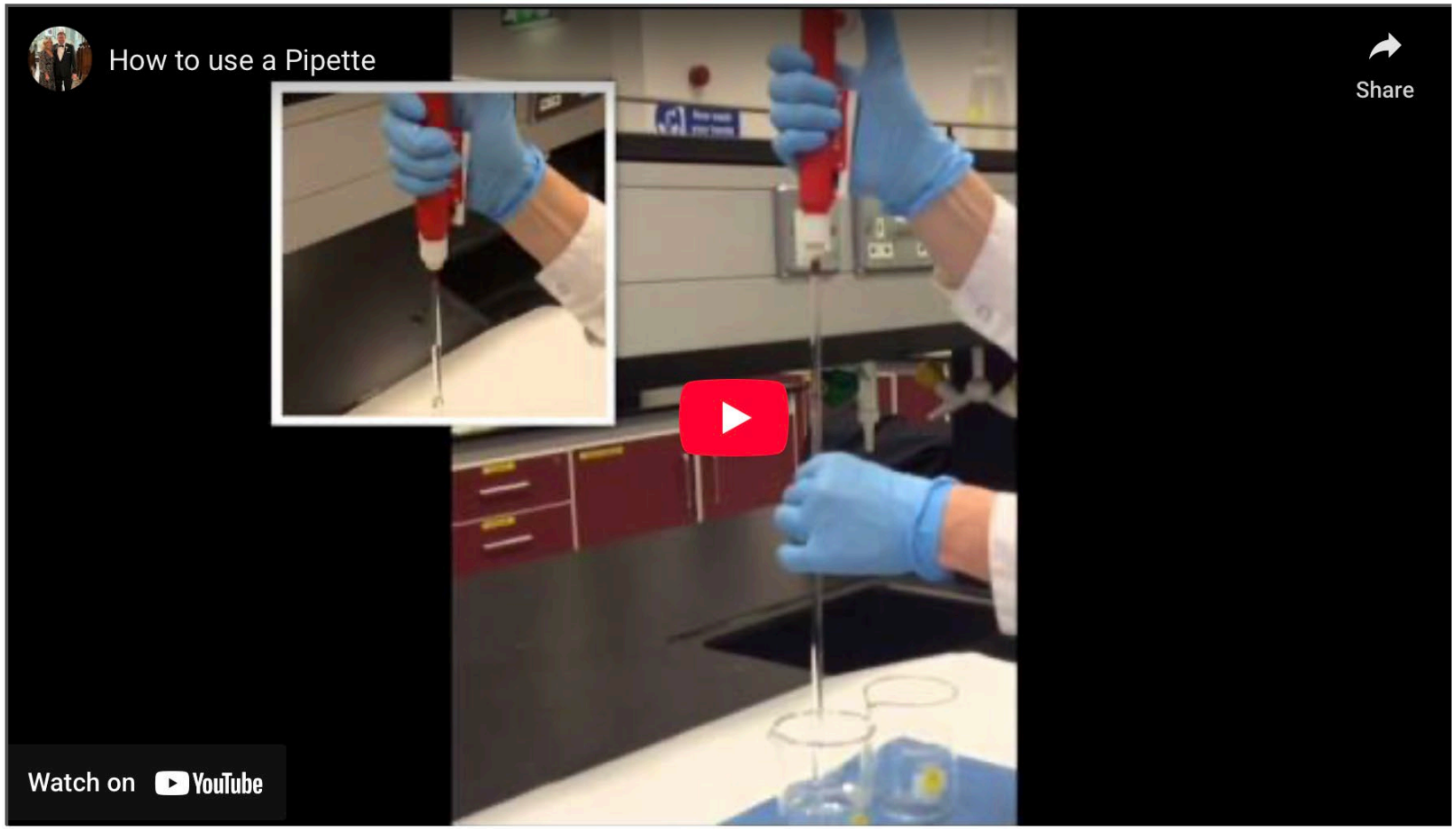
Blended learning



YouTube

Initial series of videos

20+ online **”How to do”** type videos

Important - Use our own Equipment

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Results – Flipped Classroom Blended Learning

Students Hit the Ground Running

Additional Time in the Lab

NMR

FTIR

UV-Vis

Increased Complexity & Personalised Results on a large scale

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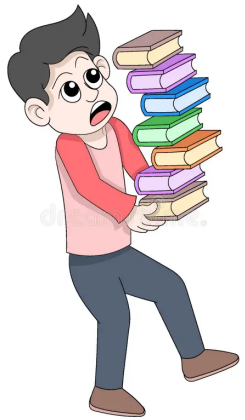
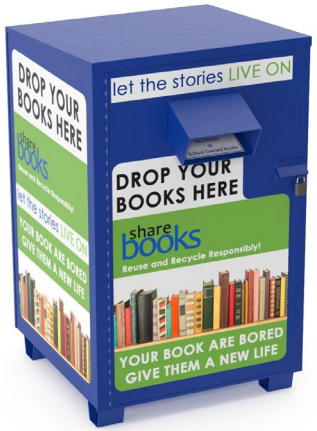
Post Laboratory

High levels of administration – Correcting – Logistical Issues



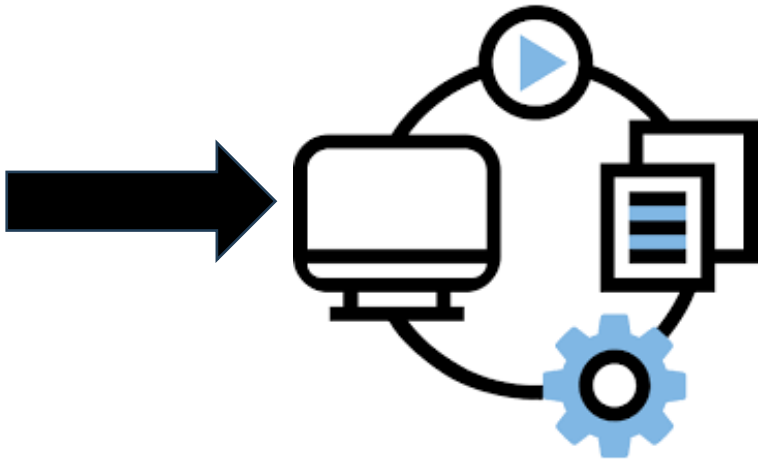


Blended Learning

Increase in Student Numbers

- Logistical issues with hard copy Lab Books
- Slow feedback and turn around times
- Students plagiarizing – low accountability
- Poor marking (From Demonstrators)

Digital Solutions



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Post Laboratory Online Report

Students take notes and data for results In Labs

3 Hour Practical

Write up at home
Analysis of personalized Data
Deeper understanding

48h to submit Report

Submit through Moodle

48h to Correct Report

Corrected and feedback through Turn-it-In

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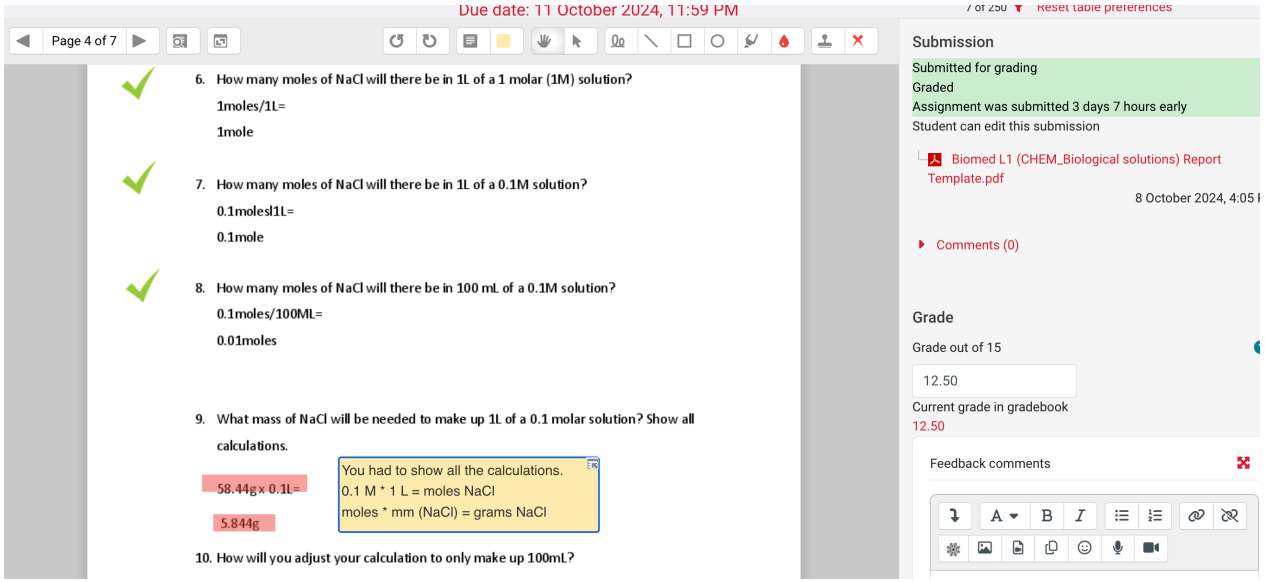
Post laboratory Report Correcting



- Direct Grading with formative feedback by Demonstrators
- Every Question with personalised feedback (48h turn around time)
- High accountability
- Marking Rubrics
- 75% of the Laboratory marks

- Implemented for 2014/2015 Academic Year
- All Chemistry Practicals with Pre and Post CA
- Increased Student Engagement

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Excellence In Academic Integrity Award 2018

United Kingdom And Ireland, Higher Education

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Completion Statistics of Tasks AY 2014/2015

Tracked completion tasks

Semester 1 Review
Pharmacy Year 1 / FY Med/Physio (n=212)

2728 tracked assignments online
99% of assignments were completed on time

Semester 1 Review
Pharmacy Year 2 (n=48)

*288 assignments
94% of assignments were completed on time

Selected assignments were monitored throughout the Semester

AY 2013/2014 Laboratory tasks completed was only 65%

*no CA associated

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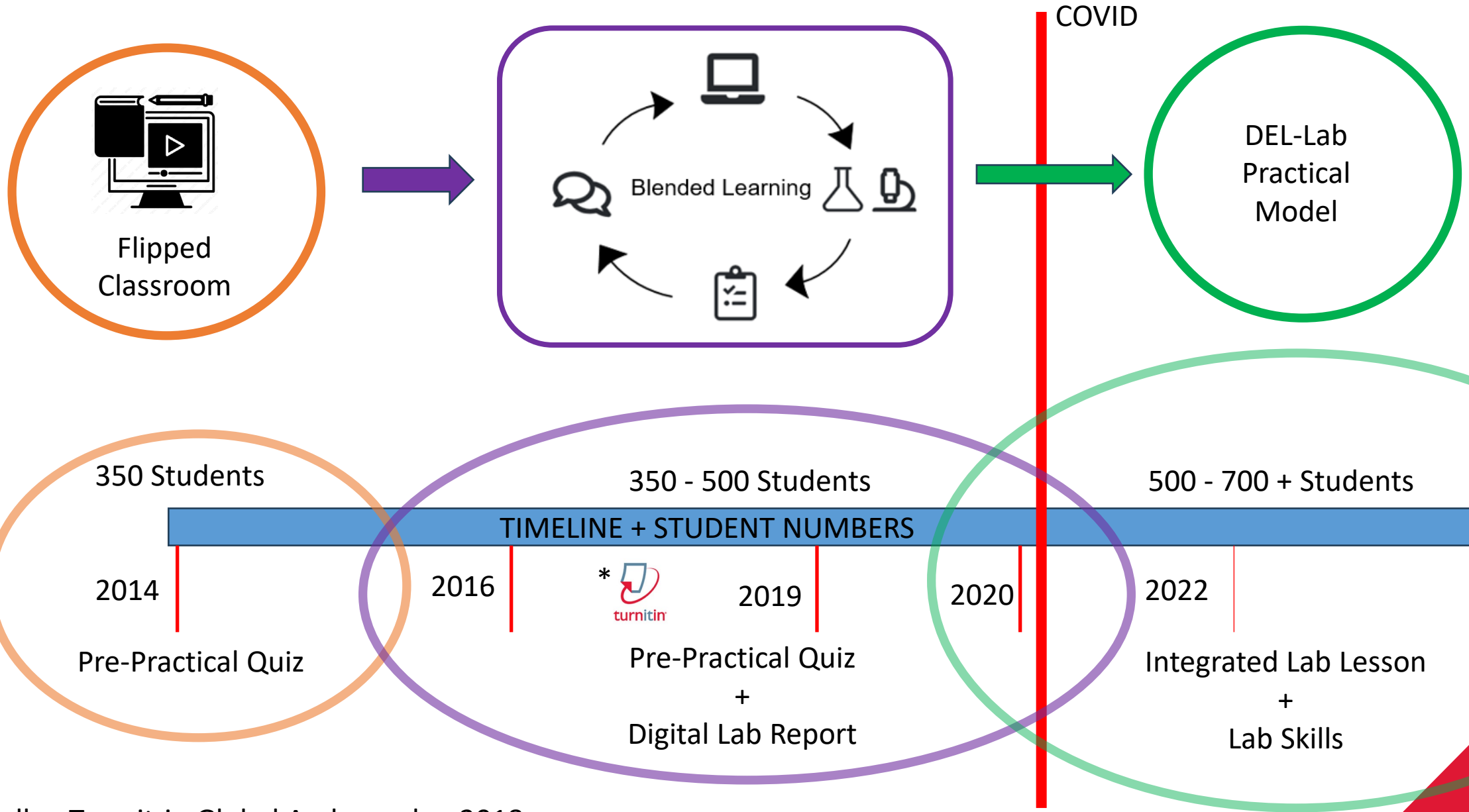
Background – 2014/2015 to Present



*Dr Kelly - Turn-it-in Global Ambassador, 2018

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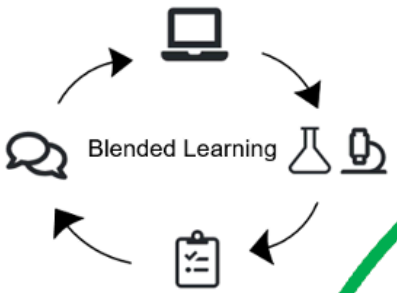
Blended Learning



Online Practical Course

Reduced In-person Teaching

International Campuses
Bahrain
Penang

COVID

DEL - Lab Practical Model

Evolution and Driving Forces

Content Creation Drive
50 + Experiments Filmed packaged into “Moodle Lessons”
Approx. 250k Views (YouTube + Panopto)

Scaling Effect
Pandemic - Social Distancing (22 repetitions of each lab)
Optimization of finite laboratory space
Robust Model Increasing Student Numbers
Transferable Module to other Disciplines/Campuses

Focus on Core Lab Skills
Video Procedure of lab skill
Physical Lab practice doing the technique
Observational Structural Practical Exam (OSPE)

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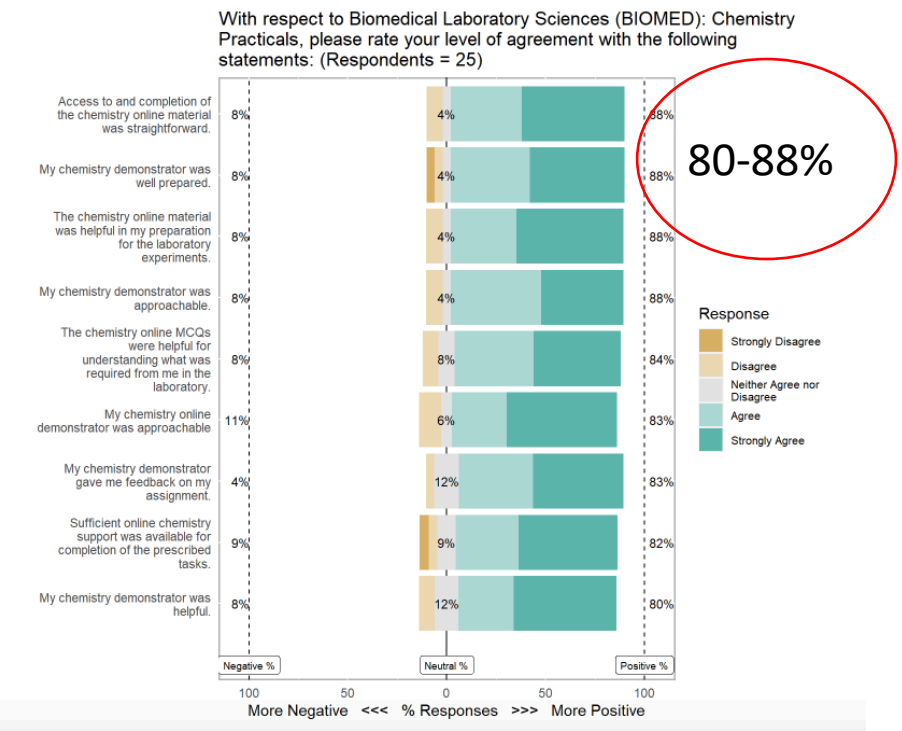
Student Satisfaction and Completion Rate

Q025 With respect to Biomedical Laboratory Sciences (BIOMED): Chemistry Practicals, please rate your level of agreement with the following statements:



80-88%

Responded Positively

2015/2016 – 77-88%	2019/2020 – 79-88%
2016/2017 – 62-92%	2020/2021 – 82-92%
2017/2018 – 71-90%	2021/2022 – N/A
2018/2019 – 66-85%	2022/2023 – 80-88%

Completion Rate From 65% in 2014 (n=350) to 96% in 2023 (n=530) on CA Assigned Tasks

SUMMARY

We have developed a robust lab practical model which allows the student population to grow while maintaining high student satisfaction and success rates.

We have created a library of video content packaged into lessons

From the content creation drive during Covid, we are using “Moodle Lessons” in a blended learning approach to focus on core lab skills to prepare students for research projects.

Initial analysis indicates that student satisfaction has been retained as the student population continues to grow.

The DEL lab practical model is transferrable to other laboratory-based disciplines. The model prepares students for laboratory-based practicals, allows for direct personalized feedback and monitors progression of lab skills.

Thank You
Chemistry Department Laboratory Team

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