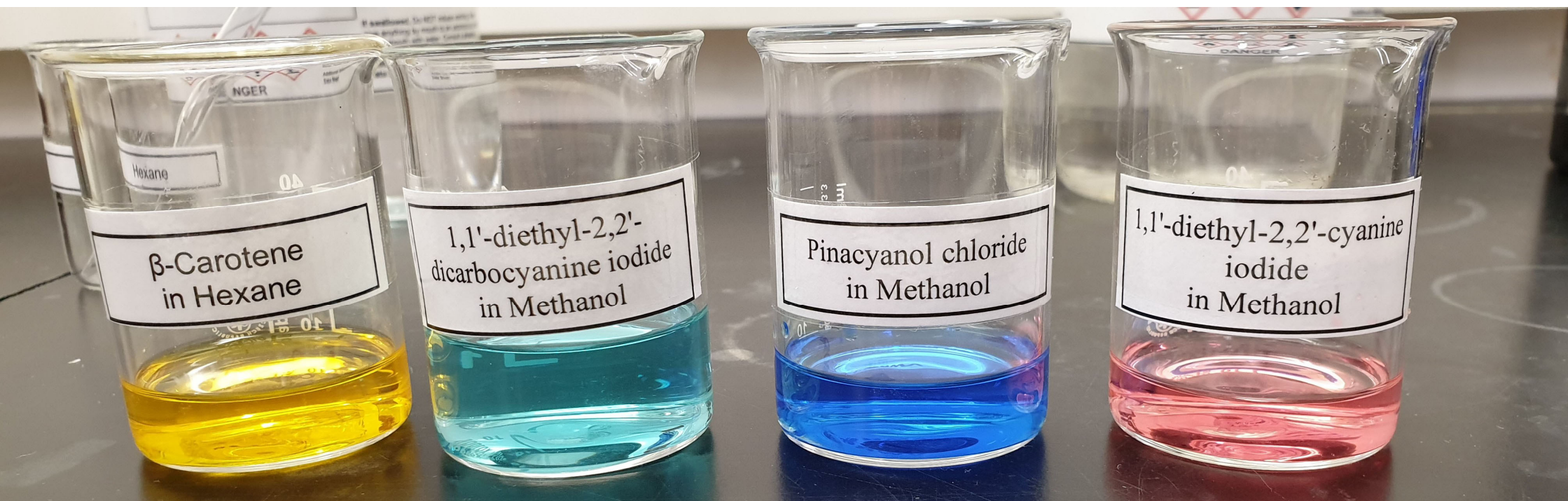


# LABOOM

## PHYSICAL CHEMISTRY LABORATORIES BY VIDEO AND ZOOM



# CHEM3401 – Physical Chemistry II

## 6 Practicals

- 1. Guide to Data Analysis and Uncertainty (Dry Lab)
- 2. Infrared Spectroscopy - Vibrational-Rotational Infrared Spectrum of Carbon Monoxide
- 3. UV-Vis Spectroscopy and Photochemistry – Cyanine Dyes, Carrot Colour and Iodine
- 4. Molecular Symmetry: Lewis Structures, VSEPR and Group Theory (Dry Lab)
- 5. Thermodynamics Think-In
- 6. Reaction Thermodynamics of the  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}/[\text{CoCl}_4]^{2-}$  Equilibrium

+ Lab book



# CHEM3401 – Physical Chemistry II

Started with 26 students (ended with 20 active students)

Split into two groups

Prac session was schedule for 4 hours (2 – 6 pm)

Pracs declared to be two-weeks long, but ...

In-lab prac every second week, encourage to attend “write-up” room during the off-week for work-up.

Both groups did Prac 1 before shutdown

One group did Prac 2 before shutdown



# Shutdown

Shutdown was called on Tuesday of Week 3

Mid-Session Break (2 weeks) brought forward immediately

By Wednesday we knew that all labs would be online

Needed 4 pracs to be videoed

Organised filming of CHEM3401 pracs for Friday and Wednesday

Had two u/g volunteers, Chanse and Isabella, to be “the face”

Both students were enrolled in CHEM3401 but more importantly they were enrolled in MOLS3002 – Engaging the Community in Science, and received credit towards this unit for their participation in the videoing.



# The Method

Lab staff prepared Prac 2 (Ro-Vib Spec) and Prac 3 (UV-Vis) for Friday, and Prac 5 (Thermo Think-in) and Prac 6 for Wednesday

Used my personal DSLR camera (Canon EOS 700D) and phone camera (Samsung S9), set up on tripods

Used internal microphone of DSLR

Students were asked to read through the lab notes prior to coming in

They were given a demonstration of the use of the equipment, what was needed to be conveyed and some ideas of how to say it

A script was not prepared but the students did make notes for themselves



# Making the Video

The prac was not filmed in “one take”

Started with videoing a student talking to camera, introducing the prac and describing the general aims of the prac

Filmed specific tasks/actions, with discussion with the students to sort out what was needed and how to present it

Was fairly discontinuous, with false starts and returning with a better method

Took still images of important aspects, such as instrument panels with parameters

Presenters were directed to be explicit about parameters that students should record in their lab books

If the same procedure was followed for a different species this was not filmed



# Presenting It

Filming = ½ day/prac; editing = ~ 1 week/prac (with Adobe Premier Pro)

Result was a ~10-15 minute video/prac

Some aspects, such as spectrum collection were sped up in the video

Videos were uploaded to YouTube, and a link provided through the LMS (iLearn = Moodle)

Representative data was provided – taken from previous years or calculated

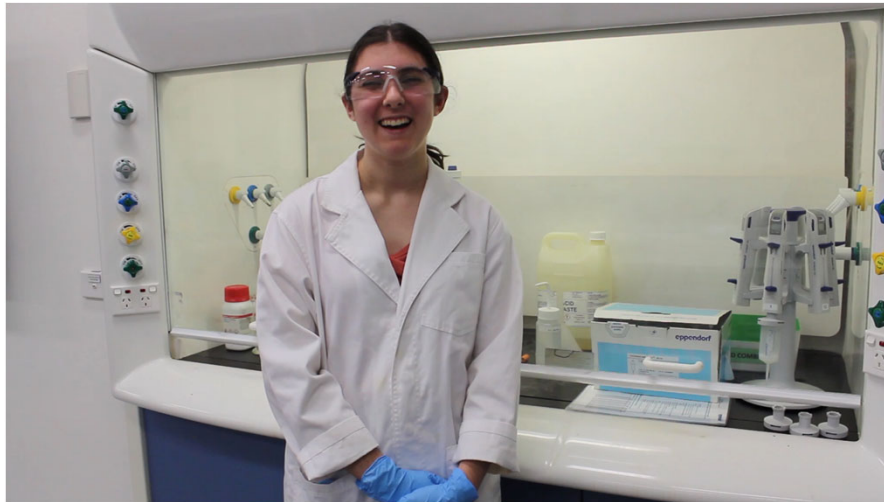
Data were spectra for Pracs 2, 3 and 6, and kinetic absorbance values for Prac 6

Other required data (concentrations, temperatures, etc) were embedded in the video

All students received the same data



# Implementation





# Implementation

Prac schedule was maintained

Students were encourage to view the videos before the scheduled session (except for Thermo Think-In)

Zoom meeting started with a general discussion about the prac and its aims, as per an in-lab session

Group split into break-out rooms of 3 – 4 students each + 1 break-out room for “off-week” students (max of 4, usually 0 – 1)

Given time to review the video, then got to work on “collecting” and analysing the data

I rotated through the break-out rooms, observing, answering questions and guiding as necessary

Students quickly became adept at sharing screens and permitting control of their computer by other group members

Most groups ended up with a single spreadsheet that all contributed to



# Problems

## Videoing

- Get set up properly – camera didn't focus well on some monitor screens initially, didn't catch that until editing; didn't always get the best angles
- Labs are noisy – lots of background noise
- Takes time and patience - expect lots of takes
- Lack of scripts and lack of rehearsal time gave a technically poorer result

## Zoom

- Software - Proved to be a problem – Proprietary spectrum viewer and editor (OMNIC from Thermo Fisher) PC/Windows only
- Instructions for running Windows as a virtual machine on Mac was provided but proved to be too technical for some and too resource intensive
- Links to freeware spectrum viewers for PC and Mac provided, but these were not satisfactory



# Problems

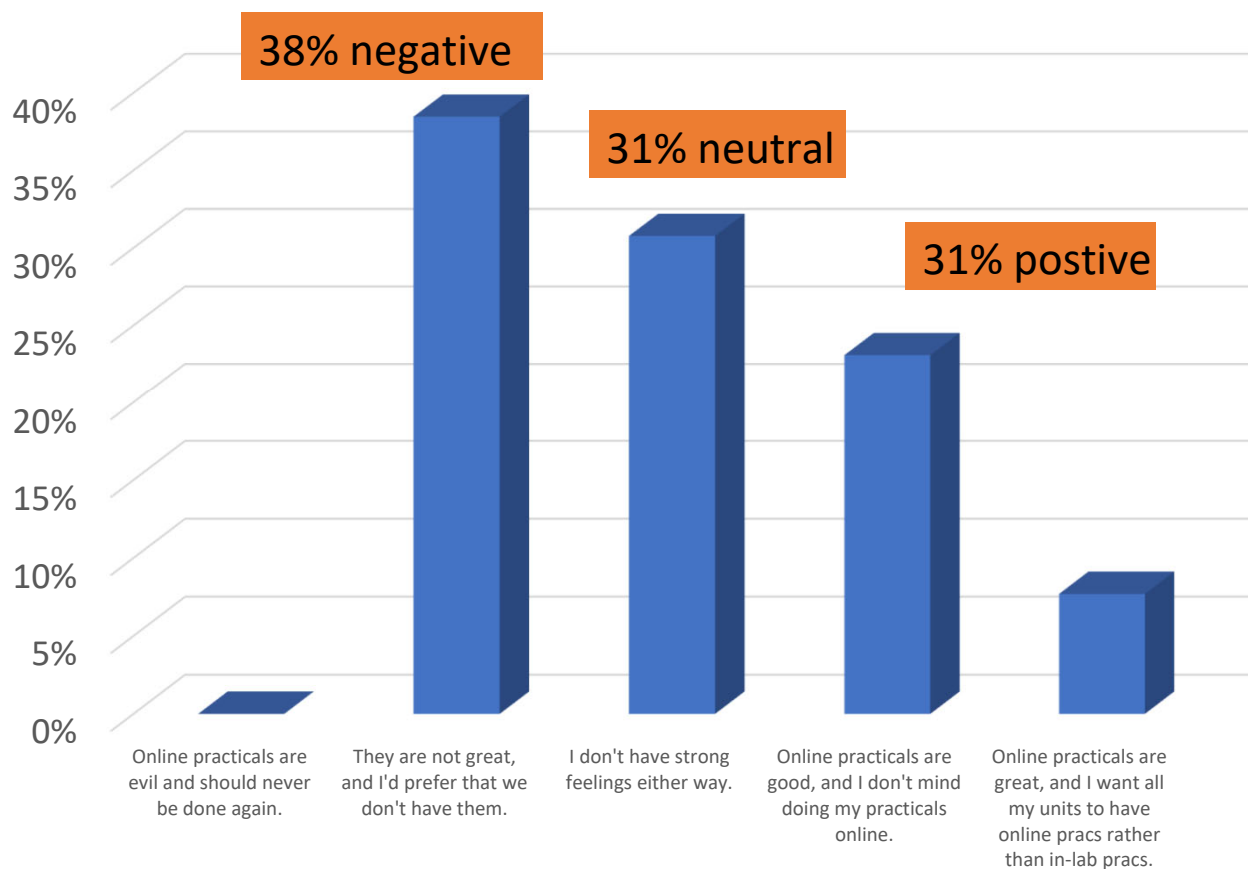
## Zoom

- Computers blew up
- Some students (claimed to have) no audio and/or video out
- Could be quite laggy when screen-sharing
- Hard to check on student progress



## Student Feedback - What is your opinion of the CHEM3401 online practicals vs in-lab practicals?

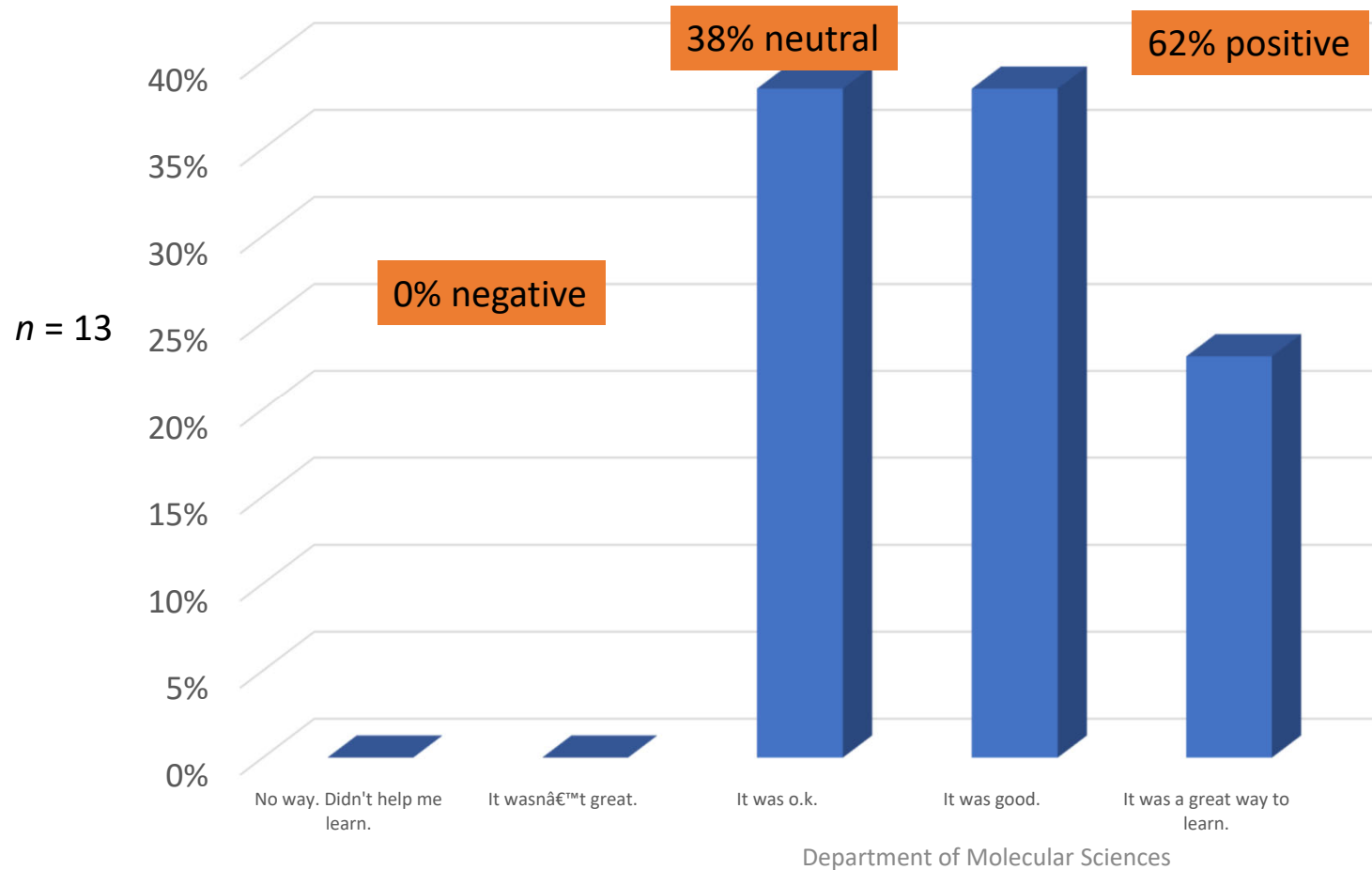
$n = 13$



Department of Molecular Sciences



## Student Feedback - I felt that the online practicals provided a good learning experience



## Student Feedback (-100 negative, 0 neutral, +100 positive)

$n = 13$

These practicals helped me to develop my data interpretation skills:	$51 \pm 35$
These practicals helped me to develop my laboratory skills Laboratory skills:	$-57 \pm 39$
I found these practicals to be interesting:	$49 \pm 33$
Completing these practicals has increased my understanding of chemistry:	$60 \pm 27$
The experimental procedure was clearly explained in the video:	$68 \pm 23$
I can see the relevance of these practicals to my studies:	$68 \pm 26$
Working in a Zoom breakout room was beneficial to me:	$48 \pm 40$
... provided me with the opportunity to take responsibility for my own learning:	$47 \pm 49$
Overall, as a learning experience, I would rate this online practicals as:	$29 \pm 37$



# Student Feedback - What, if any, were the *good* things about doing the CHEM3401 practicals online?

## Time

- provided **more time to do the report**, since the experiment doesn't need to be repeated if it were done wrong
- not having to physically perform the experiment meant more time for data processing – this was nice, because a) it's easier to discuss results with other students and b) it was **more time for report writing and less for menial lab tasks**.
- I felt that the practical online gave me more of an opportunity to think about the concepts of chemistry that the lab was based on. I was able to think for myself more in the online practicals. I also felt I did well as **I was able to work at my own pace**.
- I think using the time to analyse results, discuss the application of what we learnt in the course to the prac, and more teacher interaction time helped. It meant **less time was spent troubleshooting, setting up and discussing the lab**



# Student Feedback - What, if any, were the *good* things about doing the CHEM3401 practicals online?

## Communication and Collaboration

- I enjoyed collaborating with peers online. Zoom allowed everyone within the breakout room to watch another person's screen, so we could all learn how together. **This collaborative aspect was likely the most enjoyable aspect of zoom/online learning.**
- A lot of **communication between peers which was beneficial** for discussing any discrepancies/misunderstandings about the content.
- Having them on zoom was the best part (as compared to other subjects where it was just watch a video and then do your work with no interaction) - **the breakout rooms in particular made it easier to ask questions**
- **Discussion amongst classmates seemed more vigorous** than in-lab practical, and working over the lab together helped develop an in depth understanding of the experiment.
- Compared to my other classes, practicals were more well organised for this subject (especially with the **laboom sessions as some other subjects only provided videos, not a chance to discuss and work through the material in groups**).

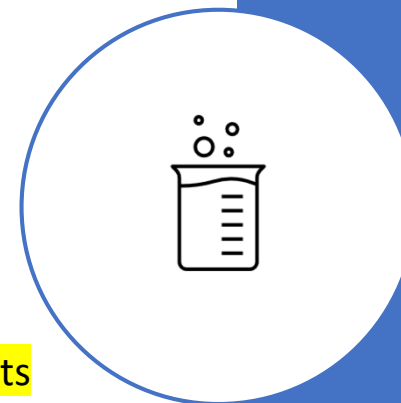




# Student Feedback - What, if any, were the *good* things about doing the CHEM3401 practicals online?

## Clarity

- Having the **videos available was useful for me to refer back to** which assisted me in completing my lab report.
- The practicals were very effective in **developing data analysis skills**.
- Since majority of the observations were pointed out in the videos I **didn't have to make guess work of what i needed**. This was really helpful as the information that i was expected to record was never clear to me up until this online learning
- I felt that the practical online gave me **more of an opportunity to think about the concepts of chemistry** that the lab was based on.



# Student Feedback - What, if any, were the *bad* things about doing the CHEM3401 practicals online?

## Lab Skills/Hands-On

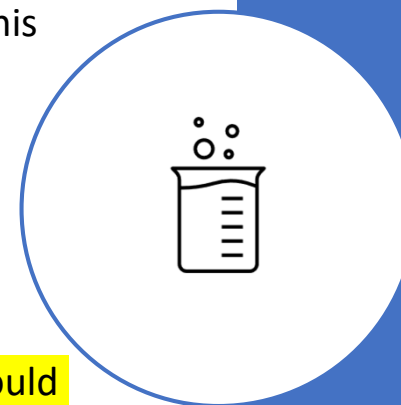
- Not having the chance to actually use the instruments in the labs and develop hands on skills
- The way it was done was probably the best that could be made of a bad situation. I definitely learn by doing the experiments so just watching someone else do them, in amongst the dozens of hours of video that we had to watch this semester wasn't ideal, but there wasn't much that could be done about that.
- You aren't doing them yourself
- For the first 2 practicals I couldn't figure out what was happening or what I was expected to do in the 4 hour time period. Also I missed a practical as my computer stopped working at one point. It made the online experience overall harder.
- It was a shame we couldn't actually do the experiments ourselves as that is an aspect that I believe I missed out on which would have been also beneficial
- Lack of development of lab skills was apparent



## Student Feedback - What, if any, were the *bad* things about doing the CHEM3401 practicals online?

### Lab Skills/Hands-On

- It **didn't give me a chance to develop my lab skills**. I don't see this to be a huge issue in this particular course as it is much more theory based and concept based than some other chemistry courses so I don't think that negatively impacted my learning. I think the benefits far outweighed this.
- Limited use of lab equipment which led to me personally **not being able to understand effectively how the equipment operates**.
- The only downside **is if i was asked to go into a lab and do the experiment physically I would probably struggle abit** as I would not have that experiment with that specific lab equipment.
- I found CHEM3401 online pracs to be an overall good experience, and I believe this was due to the fact that the unit involved a lot of data analysis. **This type of work was well suited to online learning and could be integrated properly.** However, I think that it will **never be a suitable substitute for an actual prac**. There are important skills (such as identifying errors which I make during labs) which can't be obtained from online learning.



# Student Feedback - What, if any, were the *bad* things about doing the CHEM3401 practicals online?

## Communication and Collaboration

- Collaboration was very difficult when peers did not have webcams, microphones, or good enough internet to sustain a connection to the group. I also felt communication through zoom was "one-way". Specifically, only one person can share their screen at one time. This lead some peers being unable to properly communicate how they approached a problem. As well, this collaboration was not as effective/enjoyable as sitting in the same room with peers and having an open discussion.
- it was also more difficult to ask questions as the lecturers attentions were more divided.
- Zoom breakouts are good, BUT are only as strong as the group doing them. If your tut/prac partners are quiet and uncooperative it's frustrating - I'd rather see students who are interested in talking and helping each other rather than just thrown into a group where people can say nothing for 4 hours and everyone is quietly working away at their own pace - there's no point if you're not going to help each other.



# Student Feedback - What, if any, were the **bad** things about doing the CHEM3401 practicals online?

## Communication and Collaboration

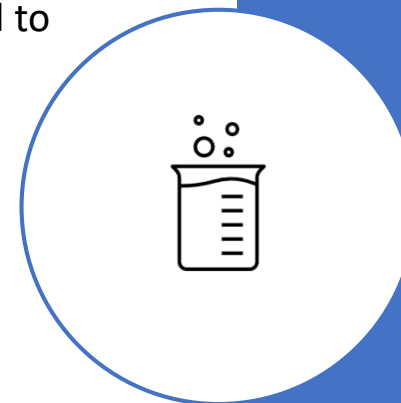
- Working in groups made it difficult as we would only see each other once, generally the group would not reunite the next week during the other groups practical, making it difficult to collaborate.



## Student Feedback - What, if any, were the *bad* things about doing the CHEM3401 practicals online?

### Clarity

- For the first 2 practicals I **couldn't figure out what was happening** or what I was expected to do in the 4 hour time period.



## Student Feedback - If CHEM3401 practicals were to be done online again, how might they be improved?

- **Please don't do them online** unless completely necessary, except for maybe workshops and the pracs that didn't rely on being in the lab.
- experiments that can be easily done at home but relevant to the study would be good
- **Clearer outlines** of what should be completed in the 4 hours.
- Obviously, **better cameras and microphones** would have made the viewing experience more pleasant.
- I think it would have been wise to encourage students to **turn on their face cams**. There were circumstances when all members of my breakout room did not have webcams on, and this made the communication very unenjoyable (I also have observed these peers using webcams other units).
- ... maybe just a **few extra videos or sources** for extra information when we are struggling and the lab instructor is busy which is understandable spreading yourself among 4 groups at minimum
- A **more thorough walk through of the lab techniques** involved would be helpful.



## Student Feedback - If CHEM3401 practicals were to be done online again, how might they be improved?

- When reading the lab procedure and the videos sometimes it would be done in a different order. Not a major issue though.
- Be provided directly with external information to the used tools and compounds, this could be used to gain a better understanding of what's going on.
- I understand the videos were done in a rush but i feel if the videos had more work done. Maybe screen recording what is happening on the monitor of experiment that have a monitor would work better to see what is happening.





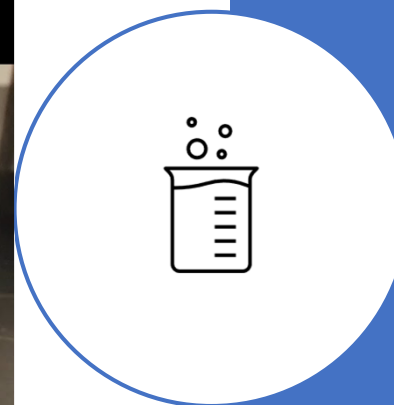
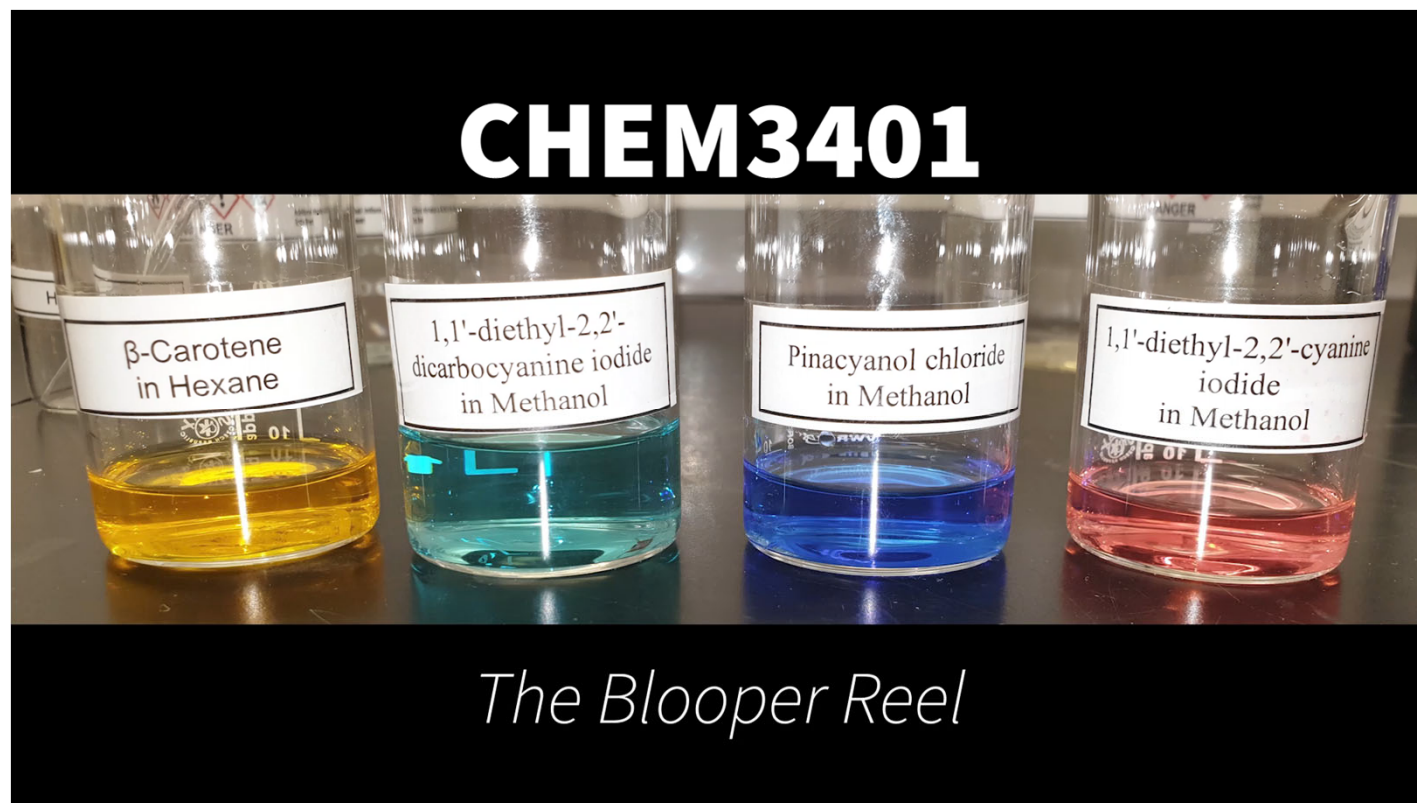
## Personal Observations and Opinions

- I do not like looking and listening to myself!
- It is good to have “young people” presenting
- Online works o.k. for Phys Chem because of the emphasis on data analysis over bench skills
- Did improve the focus on the data analysis aspects
- Need to spend more time on the instruments themselves (could be supplemental videos), perhaps including simulation
- Students spent slightly longer on-task (weren't rushing to catch a bush or train or drive two-hours home)
- Software is a problem
- Networks are still a problem (lags, dropouts, etc)
- Access to technology is a problem – technology-inequality

**It is not a substitute for the lab**



# The Blooper Reel



## Thanks and Acknowledgements

- Isabella Steen and Chanse Hollier for being the face of CHEM3401
- Mark Tran and Tony Wong for getting the pracs set up in short order
- Some survey questions adapted from ASLE - ASELL Student Laboratory Experience
- Thermodynamics Think-In lab from USyd via APCELL/ACELL/ASELL

