Moving Analytical Chemistry Courses to an Online Format
Lessons Learned for In-person Teaching

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Abstract

Teaching during the SARS-CoV-2 pandemic required the introduction of alternative teaching methods to engage students to meet learning outcomes. Using undergraduate Analytical Chemistry courses, the shift to asynchronous collaborative online activities and formative quizzes in preparation for live class sessions is described. Just in time teaching of challenging problems during live sessions with contribution from students (peer instruction, group presentations of applications of the discussed concepts) is discussed, including feedback from students.

Introduction

Analytical Chemistry (AC) 1 and 2 is a mandatory two-semester introduction to chemical equilibrium, acid-base chemistry, complexometry, chromatography (AC 1) and redox chemistry, electroanalysis, spectroscopy (AC 2). Both courses have a lab component illustration the concepts discussed in class. The lab was open (albeit in abbreviated form) during the pandemic and will not be discussed here.

In-person course setup

- Pre-reading (no grades given)
- Four in-class quizzes
- Midterm exam; cumulative final exam
- Optional student group presentation (AC 2)

In-class work with iClickers (at end of thematic section) & peer problem solving (at end of chapter).

Remote Course Objectives

The previously primarily in-person course set up was divided into asynchronous (preparatory) and synchronous (practice) elements, while –

- Maintaining learning outcomes
- Increasing number of (low stakes) assessments
- Ensuring students come prepared to live class & bring questions!
- Focusing on complex problem-solving (multi-step/concept problems) in live class
- Maintaining elements of collaborative work & student contributions

Main Lesson Learned

Asynchronous collaborative pre-reading and formative quizzes are elements that easily transfer to an in-person class and help focus lecture time on complex problem solving and addressing student questions.

Remote Course Setup

- Mandatory weekly pre-reading
- Weekly self assessment quiz on pre-reading (included writing/assessing rationales to answers)
- (Peer) exercises & problem solving in class (guided & individual); Q& A session
- Optional student group presentation (AC 2)
- Two midterms; cumulative final exam

Perusall

Perusall: An interactive, asynchronous annotation tool for pre-reading of the course text (groups of 10 students). Seven high-quality annotations were required for full marks (Fig 1L). A data backend provided information about open questions and sections needing discussion (Fig 1R).

myDalite

myDalite: An interactive quiz platform that requires students to choose & provide rationales for answers they select. Rationales are added to a pool and are presented to other students (Fig 2).

Figure 1:Perusall data backend (R) & annotation example (L)

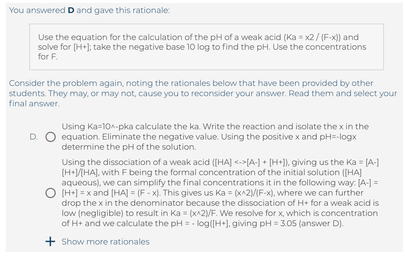

Figure 2:myDalite rationale choice and evaluation

Virtual Live Sessions

Remote live sessions (twice a week for 1h15 min) started with a Q & A from students. Just-in-time prepared class material (with data from Perusall pre-reading and myDalite quizzes) focused on problem-solving, first demonstrated on the (virtual) board and followed by collaborative or individual exercises. The formation of peer groups was encouraged. Class notes and recordings were posted for review.

Student Feedback

Student feedback were obtained through questionnaires and individual feedback (for AC 1 see Figs 3 & 4). Changes for AC 2 –

- Shortened & focused pre-reading on key concepts
- Live grade feedback for pre-reading and quizzes
- Choice of collaborative or individual problem-solving sessions

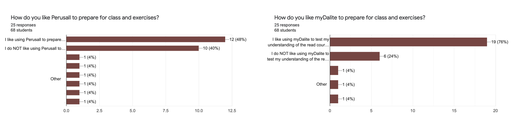

Figure 3:Student feedback on Perusall (L) and myDalite (R)

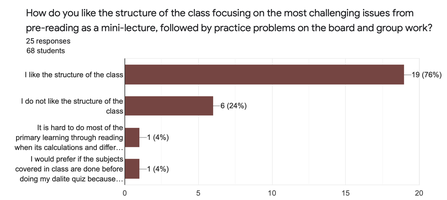

Figure 4:Satisfaction with class structure

Return to In-class Teaching

Mandatory pre-reading and quizzing prepared students well for class and with terminology and basic definitions clear the focus could be moved towards problem solving after a (usually) short Q & A session. In-class time was used more efficiently towards more complex problems splitting time between detailed on-board demonstrations and (collaborative & individual) practice time.

Acknowledgements

SALTISE and Concordia University for financial support; Alexandre Tétrault and Léticia Dupont for myDalite quiz question design

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Enlarged figures 1

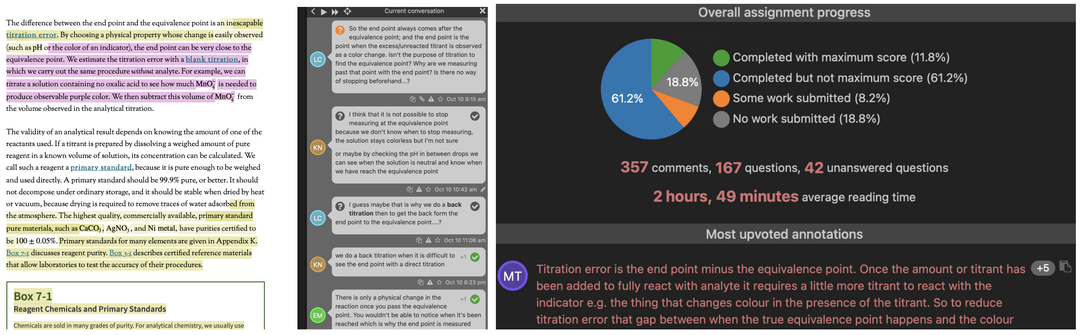

Figure 5:Perusall data backend (R) & annotation example (L)

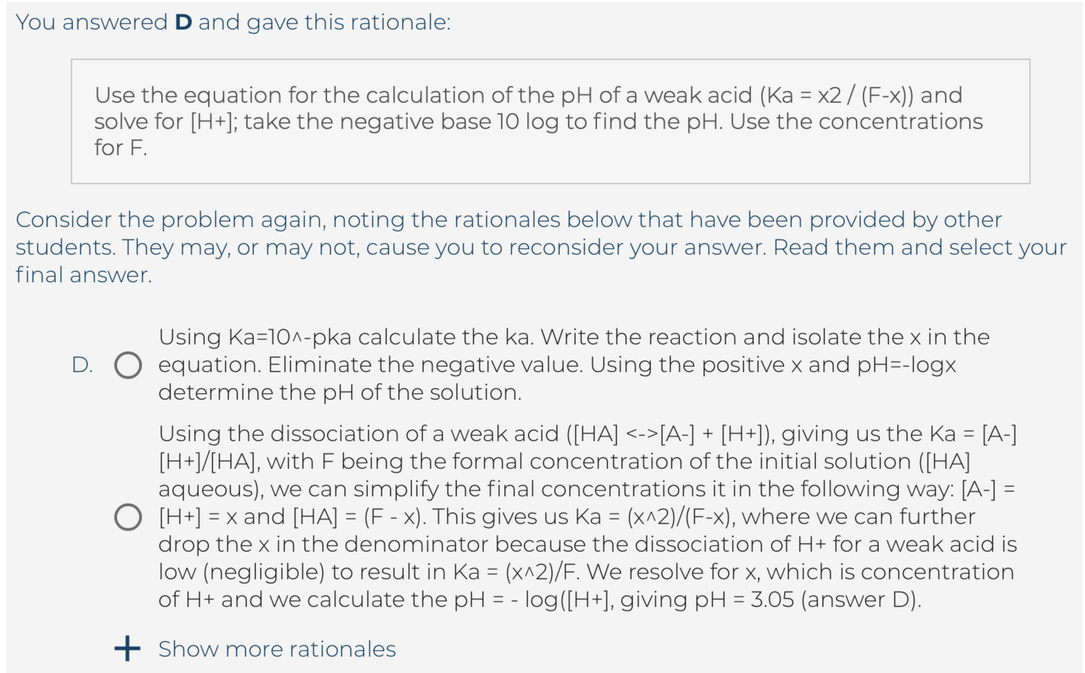

Figure 6:myDalite rationale choice and evaluation

Enlarged figures 2

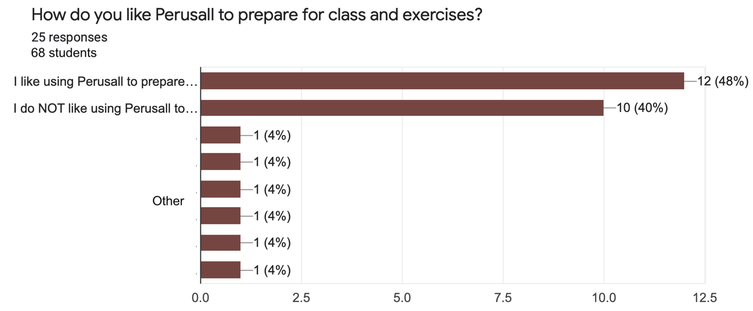

Figure 7:Student feedback on Perusall (L) and myDalite (R)

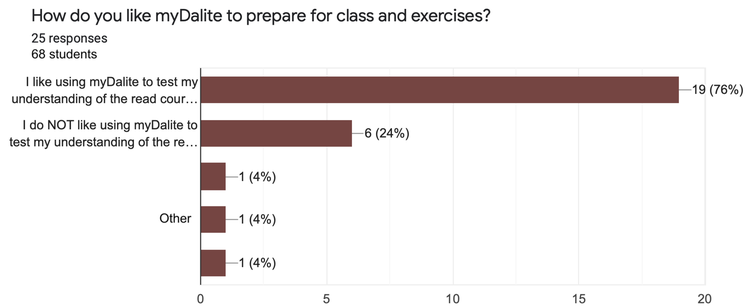

Figure 8:Student feedback on Perusall (L) and myDalite (R)

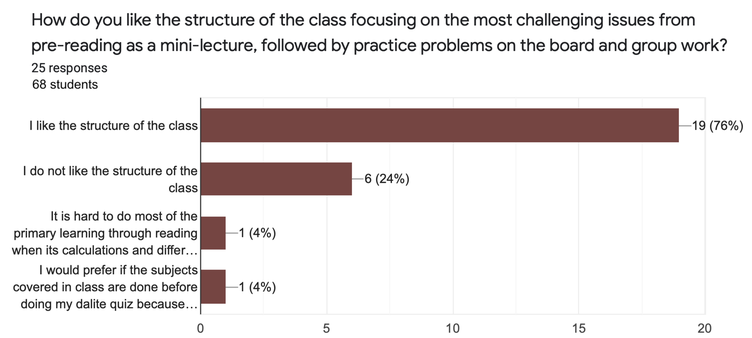

Figure 9:Satisfaction with class structure