Online and remote experiments in chemistry – analysis of delivery, assessment, tracking and student perception

Simon Collinson, Eleanor Crabb, Rob Janes and Nicholas Power

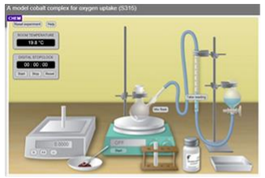
Introduction: The laboratory component is an essential experience for learning in science. At the OU this is delivered primarily through the use of online laboratory investigations. In recent years, this portfolio has extended to include remote access experiments. The aim of this project is to understand how students perceive and value these experiments.
This study relates to three online experiments in the module S315 (Chemistry: further concepts and applications), each supported with either a labcast or video recording:

- a live remote access autotitrator for an acid-base titration,
- a simulation of oxygen uptake with a cobalt complex, and
- a group investigation on drug-drug interactions using a simulated instrument

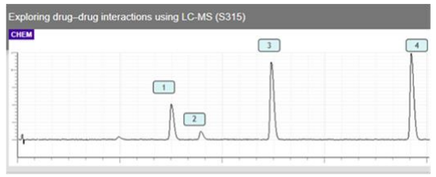
Remote access live experiment

Experiment 1: Remote autotitrator for an acid-base titration.

Remote access simulated experiments



Experiment 2: Simulation of oxygen uptake with a cobalt complex based on real data.



Experiment 3: Analysis of drug-drug interactions using a simulated Liquid Chromatography–Mass Spectrometer based on real data.

Figure 1

Study: Students were surveyed online after each experiment and the feedback evaluated initially in the context of their engagement and experience as well as their perception of their understanding of underlying theory.

14 Looking to the design of future experiments, please indicate which features of the experiments you would consider should be included if possible. Please rate the following on a scale from 1 to 6 where 6 is the highest in terms of importance..

Responses	Average Rank
Remote use of instrumentation rather than a simulated instrument	5.2
Associated live labcast covering the technique	5.1
Associated recorded video covering the technique	4.9
The opportunity to work with other students during the experiment	3.7
The opportunity to include elements of experimental design in the experiment itself	4.8

Initial analysis of student feedback:

- Students found all the experiments to be useful in supporting their understanding of the underlying theory and in how to perform the investigation itself. The majority stated that they would be fairly or highly confident in carrying out the investigation in a conventional laboratory afterwards. This scored most highly for the remote investigation.
- When asked about the authenticity of the experiments, students rated this to be important, with remote operation of real apparatus and webcam scoring particularly highly. For the simulated experiments the inclusion of real data and scenario were considered important.
- The features that students rated most highly in terms of design for future experiments were the
  - use of remote instrumentation rather than a simulated instrument
  - inclusion of a live labcast or video recording.
- For the labcast, live demonstrations were perceived to be of particular value.
- There is some ambivalence in regards to working with other students as a team – despite this, the group investigation was rated the highest in terms of both engagement and in supporting the theory.

Future work

Further analysis of the current questionnaires with potential follow-up via focus groups or further surveys is planned. An optional pilot of a new remote investigation is being run over the summer having taken some of this initial feedback into account.

Student quotes: *'Having done these experiments previously in a lab environment I was very impressed with how easy, realistic and flexible this was.'*
'*..these remote experiments are essential despite their simplicity. As I am struggling with motivation, this experiment has helped immensely*.'
'I thought the project was excellent and it really motivated me to improve my understanding and experimental skills.'
'I found the labcast very useful with regards to understanding the theory behind the experiment and how it works.'
'It was very good working together with another student live. Made it feel as real to as possible without been in a lab and is a more positive was of learning.'