Technology Enhanced Feedback for 3rd Year Laboratory Practical Sessions

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Third Year Analytical Laboratory Session

- Support teaching objectives for various analytical chemistry modules in year 3
- Preparation for student's industrial placement (INTRA)
- Semester 1 module (Sept – Dec)
- 12 week duration
- 9 hours per week

Third Year Analytical Laboratory Session

- Experiment aims: develop cognitive skills and analytical problem solving capabilities
  - Primary focus: instrumental methods of analyses and analytical techniques
  - Compliments current industrial and academic requirements and practises e.g. pharmaceutical, environmental, forensic, food and beverage analyses

Lab Session Structure

- Academic staff (3 team members)
- Postgraduate demonstrator (2/3 experiments)
  - guide student groups through experiment
  - correct laboratory reports
- Students work in pairs (occasionally 3s)

Assessment: Laboratory Report

- Students are guided through the experiment, report writing, submission process and expectations during week 1 of semester 1
- Guidelines (available online)
  - report format and structure
  - technical writing technique and content
  - section marks

- Historical: up to 2013
- Current: 2013-2014
- Future: 2014-2015

….up to 2013

- 4 week cycle of *improvement*:
  - Lab session (day 1)
  - Report submission (day 7) and grading
  - Face to face feedback and result given to the student by academic (day 14)
  - Implementation of feedback (day 28)

Analysis of module delivery up to 2013

- Advantages
  - Detailed individual feedback
  - Students see a correlation between effort and result over 12 week period
- Disadvantages
  - Time consuming
  - Limits academic input during labs
  - Verbal feedback only
  - Challenging to feed forward (2 week interim period for student to see result of renewed effort)

2013 - 2014

- Scaffolding of feedback
- Moodle gradebook

Scaffolding of Feedback

- Weeks 3-6: indepth verbal feedback, grades for each report section, overall grade, student questions
- Weeks 7-9: grades for each report section, overall grade, questions by students
- Weeks 10-12: overall grade, student questions

Comments from tutors on student "perception" and "interpretation" of feedback: lack of ownership <u>until</u> the realisation that feedback was being withdrawn

Gradebook Development

- Moodle gradebook setup (complicated and time consuming)
- Validation and verification of data manipulation (excel spreadsheet)

Analysis of module delivery 2013/2014

- Advantages
  - Students more cognisant of feedback structure, took more notes, encouraged reflection
  - Automated export of marks from moodle into LTS at term end
  - Reduced administrative error
- Disadvantages
  - Time consuming and intensive for academics for 6 week setup and feed back phase
  - Verbal feedback
  - Tutor variances in marking scheme

2014-2015

- Online delivery of feedback
  - Further optimise academic time management
  - Enable students to develop an individualised feedback database
  - Development of grading rubric to minimise tutor variance during report correction

Options for delivering feedback online

- Individual aural commentary – podcasts
  - Advs: maintains components of verbal feedback including inflections, emphasis etc., and reduces possibility of misinterpretation
  - Disadvs: script preparation by academics, requires students speakers/headphones etc. (what about library setting?)
- Assessment rubrics
  - Advs: clarifies requirements for grades, improvements clearly observed
  - Disadvs: limited feedforward about how to improve, loss of individualisation
- Individual written commentary
  - Advs: personalised feedback, feeds forward into process and informs students of learning, facilitates student reflection
  - Disadvs: time consuming, potential for misinterpretation, subjectivity of feedback of multiple tutors

Options for delivering feedback online

- Assessment rubrics ***AND*** Individual written commentary
  - clarifies grading system
  - improvements clearly observed from week to week
  - Stream lines time management of system as written commentary complements rubric
  - Feeds forward on how to improve
  - Reduce/eliminates demonstrator subjectivity

- Sample report matched to rubric

Assessment rubric for analytical labs

Aims **(Max 5)**	*1-2* The purpose/reasons for the experiment are outlined, but not every aspect is included.	*3-4* Each component of the purpose/reasons for the experiment are detailed, but the section is not concise; it is too long.	*4-5* Each component of the purpose/reasons for the experiment are detailed, concisely.		
Introduction ***(Method – max 5; Analytes – max 5; Suitability – max 5; Original thought – max 10)***	*0-6* Gives a brief discussion of at least one of the following: - theoretical basis of method; - chemical and physical properties of analytes; - discussion of suitability of methods for analytes. No original component.	*5-10* Gives a detailed scientific discussion, relevant and accurate, of 1 or 2 of the following: - theoretical basis of method; - chemical and physical properties of analytes; - discussion of suitability of methods for analytes. No original component.	*10-15* Gives a detailed scientific discussion, relevant and accurate, of 2 or 3 of the following: - theoretical basis of method; - chemical and physical properties of analytes; - discussion of suitability of methods for analytes. No original component.	*15-20* Gives a relevant, accurate scientific discussion of all 3 of theoretical basis of method, chemical and physical properties of analytes and discussion of suitability of methods for analytes; **AND** includes original work which demonstrates *to a limited extent* the student understands the theory earlier in this section.	*20-25* Gives a detailed scientific discussion of all 3 of theoretical basis of method, chemical and physical properties of analytes and discussion of suitability of methods for analytes; **AND** includes original work which *clearly* demonstrates the student understands the theory earlier in this section *in depth*.
Materials and Methods **(Max 5)**	*1-2* Lists the outline chemicals and instrumentation used, but not sufficient detail. Deviations from the manual are not noted.	*3-4* Lists the scientific name of chemicals and make and model of instrumentation used. Deviations from the manual are not noted.	*4-5* Lists the scientific name of chemicals and make and model of instrumentation used. Deviations from the manual are noted.		
Calculations **(Max 15)**	*0-5* Raw data is tabulated. Average, standard deviation and %RSD are calculated and tabulated. Data sets are comprehensive but no data graphs plotted.	*6-8* Raw data is tabulated. Average, standard deviation and %RSD are calculated and tabulated. Data is interpreted and plotted using Microsoft excel.	*8-10* Raw data is tabulated. Average, standard deviation and %RSD are calculated and tabulated. Data is interpreted and plotted using Microsoft excel. Graph axes are labelled, error bars are incorporated.	*10-12* Raw data is tabulated. Average, standard deviation and %RSD are calculated and tabulated. Data is interpreted and plotted using Microsoft excel. Graph axes are labelled, error bars are incorporated. Correlation	*Additional 2-3 marks for this section* QC data are tabulated and included with the calculations.

Assessment rubric AND written commentary

Feedback on assignment

Feedforward for next assignment

Presentation	Writing is mostly well-focused; arguments or perspectives are precisely defined and explained; coherent flow in developing an insightful idea demonstrated. Reflection incorporates multimedia such as visuals, hyperlinks, videos or audio in a way that deepens the content of the reflection and are cited properly. ***1 points***		Chaotic in organization and presentation of ideas. The writing lacked an organized flow and the ideas were hard to follow ***0 points***	
Relevance to course content	The use of literature both inside and outside the course exceeds expectations. ***3 points***	Reflection meaningfully incorporates resources from the course as well as outside sources. Sources are relevant, of high quality, and are used in a way that display a deep understanding of the content. ***2 points***	Acquired knowledge from course content is linked to personal reflection in a meaningful way that shows a deep understanding of content. ***1 points***	No reference to course content or course content is linked at a superficial level. ***0 points***

Feedback comments

Hi Blánaid

A reminder that this is your first marked journal entry

You have provided a good overview of your own context and the particular challenges encountered in developing higher order thinking skills in your own students. You have also provided an example of how a discussion forum might be used to support the development of higher order thinking. In order to move to the deeper level of reflection required in this course in would have been helpful for you to continue your discussion of this example to more specifically focus on how this might apply to your own particular context. I think that writing your next entry in the first person might help with this.

Looking forward to your next journal entry.

Best wishes,

Morag

Sample Lab report

Highlighting appropriate layout, and common mistakes

MATERIAL AND METHODS

Reagents:

The chemical used in this experiment was acetylsalicylic acid. Four commercial aspirin tablet samples, two coated and two non-coated, each with a concentration of 300 mg, were provided for this experiment.

Table 1: Masses of acetylsalicylic acid standard weighed for practical

Comment [BW6]: tables are always labelled above the table

Comment [BW7]: always include units

Standard Concentration (mg/100 mL)	Mass required (mg)	Amount weighed out (mg)
100	50	50.0122
200	100	100.1041
250	125	125.0455
300	150	149.989
350	175	175.1102
400	200	200.0342

Updated sample lab report

- Help or hindrance to students? (Lipnevich *et al.* 2013 Instr. Sci.)
- Needs to be accessible to students, but not an existing report

Highlighting sections as per guidelines and rubric

As shown in Figure 4, sampling at 5 minute intervals over a 60 minute timeframe was appropriate to capture dissolution profile. While the solubility of aspirin in water was approximately 50 mg/mL; therefore, a total of 25 g of aspirin should be able to dissolve 500 mL of water (the volume used in this experiment). Figure 4 indicates that even though aspirin is soluble, it did not dissolve instantly. This was also found to be the case when preparing the acetylsalicylic acid standards, which took a significant length of time to fully dissolve, even with extensive stirring and heating to 50 °C.

Comment [BW13]: discussion of validity of experiment

All 4 commercial aspirin tablets dissolved as expected in distilled water, and the dissolution profiles were similar for all 4 tablets. However, Tablet #4 was the slowest dissolving tablet, with only 86% of its active ingredient released within 60 minutes, as compared to Tablet #2, which was 98% dissolved within the same timeframe.

Comment [BW14]: discussion of results

Coated aspirin tablets have previously been shown to dissolve more completely than uncoated tablets, [9] which was also shown to be the case in this practical, where the two coated tablets, #1 and #2, dissolved more completely in 60 minutes than the uncoated tablets #3 and #4. However, while the profiles of #1 and #2 started to plateau in Figure 4, the profiles of #3 and #4 continued to rise to 60 minutes. Therefore this experiment should be continued beyond 60 minutes to examine if these two tablets dissolved to the same extent as the coated tablets, albeit requiring longer than 60 minutes.

Comment [BW15]: discussion of if results agree with what was expected

Comment [BW16]: discussion of limitations of experiment

Additionally, the difference in dissolution profiles between the two coated tablets was significantly less than the difference between the two uncoated tablets.

2014 - 2015

- 2014/2015 (online):
  - Week 1: explanation and demonstration to students
  - Week 3-6: feedback online using assessment rubric, comments and grades for each section, overall grade provided in *annotated submitted lab report*, opportunity for questions by students during the lab session
  - Week 7-9: feedback online using assessment rubric, *grades for each section*, overall grade provided in online rubric, opportunity for questions from students during the lab session
  - Week 10-12: online provision of overall grade, opportunity for questions from students during the lab session

Analysis of module delivery 2014/2015

- Advantages
  - Consistent feedback and feed forward
  - Written record of feedback
  - Optimised academic time management (academics available to input into practical sessions)
  - Reduction in tutor variance
  - Relevant sample report annotated to match the rubric
- Comments
  - Engagement of students with moodle and online rubric and feedback is critical
  - Measurement and monitoring effectiveness of feedback strategy

Thankyou!