Assessment and Feedback in Chemistry Laboratories

Dr. Blánaid White, Dr. Aoife Morrin and Dr. Teri Donaghy,
Dublin City University, School of Chemical Sciences

Class Size
Up to 48 students

Discipline
Chemistry

Feedback Approaches
Marking guides, Rubrics and Exemplars, Multi-stage assignment, online written feedback

Technologies
Moodle Assignment, Moodle Advanced Grading Rubric.

Challenge & Aim

In these labs students submitted written reports one week after completing the practical session. Reports were corrected within a week, and then students were given one-to-one feedback about how they got on in their report, to help inform the next submission. This was an iterative process, happening every week from week 3 to week 12. Feedback was exclusively verbal, apart from the notes the students took themselves, they had no record of feedback. Unfortunately, it was increasingly apparent as term progressed that student's versions of feedback did not always concur with what they had been advised.

The main aims for developing an online assessment and feedback strategy were two fold – to continue to provide the students with personalised feedback, but which the students can continue to access after the laboratory session to review, and to reduce the time during practical sessions that are devoted to giving students feedback.

Evidence from the Literature

It is paramount for our laboratory sessions that the practical skills of science students are assessed critically. Laboratory reports, which involve translating scientific insight and reasoning into scientific writing, have been shown by Timmerman, Strickland, Johnson and Payne (2011) to be a reasonable measure of these difficult to assess skills. They provide the first "universal rubric for assessing undergraduates' scientific reasoning skills using scientific writing"; the findings of this extensive project formed the basis for the rubric developed here. Currently, very little has been published in the area of maintaining individualised feedback within grading rubrics, though it is noted that appropriately developed rubrics can deliver such feedback (Taylor & Burke de Silva, 2013).

It has previously been shown that providing sample reports to students actually hindered students, with a greater improvement in assignments shown when only rubrics were provided to students (Lipnevich, McCallen, Miles & Smith, 2013). In that case, the authors concluded that students engaged more with the rubric when sample reports were not provided, and this resulted in the improvement noted. In that study however, very little formatting of the assignment, which was an essay, was required. For the laboratory reports required here, there is a specific and quite complicated format, and so it was felt that a sample report would greatly benefit the students. To encourage maximum engagement with the rubric, only one sample was provided (the earlier study provided three, across the spectrum from weak to average to good).

A number of features of effective feedback are being addressed here. This case study incorporates feedforward to future work; and is a dialogic process that ultimately supports learners to become self-regulating. Marking guides and rubrics were developed to enable students to understand what was expected of them. Multi-stage assignments encouraged students to engage with previous feedback from earlier reports.

Feedback Approach

During the introductory laboratory session, students were guided through each document and the process by which they would receive feedback throughout the module. It was explicitly stated during the introductory session that there would be dedicated time during each of the lab sessions for students to discuss this feedback or to ask questions about how their report was graded every week during the lab.

A detailed assessment rubric was provided. This assessment rubric mirrored the report correction guidelines, with each of the sections forming a row of the rubric.

Students submitted their report one week after completing their report, and received feedback on this report one week later. Therefore the students received their first feedback in Week 3, and so they had submitted 2 reports prior to receiving feedback.

Feedback Approach

Thereafter the student received feedback on a weekly basis for the duration of the module. In addition to this online feedback, students had the opportunity to discuss this feedback with the academic supervisors every week in the lab, during the practical session.

The following scaffolded feedback levels were used:

- Week 1-4: feedback online using assessment rubric, with comments and grades for each section and overall grade provided in annotated submitted lab report, opportunity for questions by students during the lab session;
- Week 5-8: feedback online using assessment rubric, now with grades for each section and overall grade provided in online rubric, opportunity for questions by students during the lab session;
- Week 9-12: overall grade only, provided online, though with opportunity for questions by students during the lab session.

However, if students were struggling, in the last weeks, they continued to receive feedback.

Additionally, the timeline of weekly submission of reports and feedback on these reports a week later, along with provision of report correction guidelines and assessment rubric, is designed to encourage students to self-assess their reports prior to submission. This has been successful to date in the face-to-face feedback in the lab.

Outcomes

The main benefits for students are their improved record of feedback, and increased understanding of what is required from labs and the lab reports, and their increased incorporation of feedback into subsequent reports. The main benefits for staff are the reduction of the time requirement to deliver feedback during the practical sessions themselves, freeing up their time to concentrate on students knowledge and use of the analytical instrumentation, and the enhanced consistency between demonstrators when grading the undergraduate lab reports.

The staff experience was overwhelmingly positive, with staff reporting that they can now allocate their time more equitably across their duties in the lab, and can more easily track students who are struggling.

Student Response

Student feedback was obtained informally throughout the process and at the end of the module via a short feedback survey on Loop.

High level summary:

- Students in general found the online feedback rubric very beneficial.
- Students liked the increased visibility of how marks were allocated.

- Students reported using the rubrics for subsequent write ups to self-inform on what to include in their reports.
- The comments at the end of the rubric highlighting to students one area to focus on for the following week was highlighted by students as really useful.

"The labs were interesting, I really liked the way you get feedback of the reports and how's it broken down (really helped to build up your grade)"

"Fair, and detailed and helpful"

Recommendations

Key point: The assessment rubric must be carefully designed and articulated, and tailored for each experiment.

Tips:

- Give more time than you anticipate to developing a detailed rubric.
- Tailor rubrics for each experiment, even though it's more time consuming.
- Highlight that the exemplar is a first class one, keep it as concise as possible, and choose a straightforward topic that students will understand, so that they don't get disheartened.
- Ensure rubric language is unambiguous.
- Scaffolding the feedback worked really well as students paid attention for the initial weeks.
- Remind students to bring pen and paper to take notes during the verbal feedback session!
- If possible, try to ensure that the feedback rubrics on loop are completed within the same timeframe for all students.

References

Lipnevich, A.A., McCallen, L.N., Miles, K.P. & Smith, J.K. (2013) Mind the gap! Students' use of exemplars and detailed rubrics as formative assessment. *Instructional Science*. DOI: 10.1007/s11251-013-9299-9.

Malini Reddy, Y.M. & Andrade, H. (2010) A review of rubric use in higher education, *Assessment & Evaluation in Higher Education*. 35(4), 435-448.

Taylor, C. & Burke da Silva, K. (2013) An analysis of the effectiveness of feedback to students on assessed work. *Higher Education Research & Development*. DOI: 10.1080/07294360.2013.863840.

Timmerman, B., Strickland, D. C., Johnson, R. L., & Payne, J. R. (2011) Development of a "universal" rubric for assessing undergraduates' scientific reasoning skills using scientific writing. *Assessment & Evaluation In Higher Education*. 36(5), 509-547.

White, B., Morrin, A. & Donaghy, T. 2017. Assessment and Feedback in Chemistry Laboratories IN: Technology-Enabled Feedback Approaches for First-Year: Y1 Feedback Case Studies in Practice: Y1Feedback. Available from: https://www.y1feedback.ie

Contact

If interested in finding out more about this approach or technology, please contact Blánaid White at blanaid.white@dcu.ie

Cite as;
White, B., Morrin, A. & Donaghy, T. 2017. Assessment and Feedback in Chemistry Laboratories IN: Technology-Enabled Feedback Approaches for First-Year: Y1 Feedback Case Studies in Practice: Y1Feedback. Available from: https://www.y1feedback.ie