

EXPLORING THE IMPACT OF FORMATIVE FEEDBACK AND DRAFTS ON FINAL MARKS IN A DIPLOMA LEVEL SCIENCE REPORT ASSESSMENT

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ABSTRACT

The ability to communicate experimental findings in scientific report format is considered an essential skill for scientists but many undergraduate students struggle with mastering this skill. Many tertiary educators now provide science literacy resources and draft report feedback to support student success. Despite these efforts, it is often reported that students resist engaging with draft feedback. We investigated the impact of various formative draft feedback approaches to evaluate their outcomes on (i) student engagement and (ii) final report mark. It was hypothesised that embedding mandatory drafts and feedback interaction should lead to improved final report quality because students would be more engaged with a reflective feedback process. Draft and final report grades were analysed using *R Studio*. Data exploration and statistical testing were completed using *ggplot2* and base R functions. The results did not consistently support the hypothesis that draft submission increased final report score. The combined mean report score for students who submitted or did not submit a draft was found to be similar overall ($n = 640$, $t = 0.43$, $df = 639$, $p\text{-value} = 0.67$). These results suggest that draft feedback does not of itself lead to improved student engagement with supplementary help resources or final report grade.

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INTRODUCTION

The ability to accurately and logically communicate experimental findings in report form is an essential skill for working scientists (Robertson, 2011; Office of the Chief Scientist, 2014), yet it is a skill that many students find difficult to master. Thus, finding ways to enhance the reporting abilities of science students has become a focus at many universities (e.g. Brownell et al., 2013; Coil et al., 2010; Gopen and Swan, 1990; Lee, 2013).

It is known that one of the most effective ways to influence student grades is by providing quality feedback on performance (Hattie and Timperley, 2007), and that such feedback should be timely, informative and encouraging (Brearley and Cullen, 2012; Knauf 2015). Many guides now exist for improving the type of feedback given to students, including incorporating peer-review, connecting assessment with prior learning, and encouraging students to be better judges of their own scholarship (e.g., Nicol 2010, Carless et al. 2011; Boud and Molloy, 2013). However, student surveys in different countries including England, Wales (Higher Education Funding Council for England 2016) and Australia (Krause et al., 2009; Quality Indicators for Teaching and Learning, 2018), still consistently highlight that students remain unsatisfied with assessment feedback. In light of this, many tertiary educators continue to re-examine their feedback practices with the goal of improving feedback mechanisms and student uptake of these mechanisms within their courses.

The amount, type and worthiness of student feedback remains a confusing and contentious issue for many tertiary instructors (Boud and Molloy, 2013). Increasing teacher effort and the time, effort and execution of good student feedback increases teaching workloads but the outcomes on student learning can be highly variable (Crisp 2007; Hattie 2009; Bailey and Garner, 2010; Evans, 2013). It is therefore understandable that many tertiary educators resist changing their current assessment and feedback practices, even if they are not optimal, given the increased pressure in most current work environments where student numbers are increasing and per-capita funding is decreasing.

The relationship between student feedback during draft stages of written assessment and the resulting changes in assessment performance is one area that still remains unclear. Student complaints regarding draft feedback typically involve the technical nature of feedback, including content, timing, and lack of clarity about further requirements (Evans, 2013; Higgins, Hartley, & Skelton, 2001; Huxham, 2007). Lecturers and instructors have reported that many students do not provide complete drafts for feedback (Evans, 2013, Manske, 2010; Sturtridge, 2013), or do not even collect or use the written feedback that is provided to them (Sinclair and Cleland, 2007). A misalignment of expectations is apparent, and it has been suggested that students may not submit drafts for feedback or use provided feedback to improve their work because they do not have the skills to interpret what is needed (Furnborough and Truman, 2009). Providing quality feedback during the draft process is necessary to guide new undergraduate students towards desired outcomes, but it must be ensured that students understand how to interpret and use feedback to enable academic success.

The aim of this project was to explore the impact of drafts and formative feedback on final Science Report submission rates and marks in Diploma level first year students. Various science report feedback approaches were evaluated to determine which of them:

- (i) lead to better engagement with the draft writing process, and
- (ii) encouraged students to write reports of a high (rather than a satisfactory) standard.

It was hypothesised that

1. Requiring compulsory rather than optional report drafts followed by resubmission should improve student engagement.
2. Students who did submit drafts and resubmitted edited reports should have an improved final grade because they engaged with the reflective feedback process.

METHOD

CONTEXT OF THE STUDY

Essential Science is an open access, Diploma level, first-year science subject offered as a non-core subject within the Diploma of Higher Education (DHE) at James Cook University (JCU). It commenced in Semester 1, 2015 and is comprised over 13 weeks of one 2-hour lecture-tutorial and one 2-hour practical class. The subject is offered in both Semesters 1 and 2 at the Cairns and Townsville campuses, both of which are located in the Far North of Australia in rural constituencies. Student demographics are similar across both campuses in terms of age, socioeconomic and first-in-family background and prior education.

Most of the students enrolled in Essential Science report that they either did not study science at school or felt that they did not receive a good understanding of science at school (Newman, G., 2016, personal communication). Students are encouraged to enroll in Essential Science if their goal is to transition into a health, engineering or education degree after the successful completion of the DHE. Typically, only 20-30% of Essential Science students enroll in a science or engineering diploma stream. Hence, most students enroll in Essential Science because it forms part of their study plan, and not because they wish to become scientists.

One of the major challenges for this subject has been to engage students with the Science Report assignment so that they are able to master all sections of the report. Whilst many students do try to engage with the online tutorial resources, anonymous student feedback surveys suggest that a significant proportion hold the view that they only need to 'just pass' the assessment, particularly if they do not have intentions to study science in the future (Conway, C., 2017, personal communication). This is despite the explicit and repeatedly emphasised commonality between this task and other Diploma level assessments that students take – for example, critically synthesising previous research in a literature review (introduction), summarising literature or survey data (results), or analysing and commenting on data (discussion).

DRAFT ASSESSMENT APPROACHES

Whilst the Science Report assessment piece for Essential Science has varied slightly over the semesters it has remained at 25% of the overall course marks and has been comprised of the following parts:

- Students attend a content lecture-tutorial on the report content and report writing, complete background readings and pre-laboratory questions.
- Students conduct a simple experiment in laboratory class. They complete in and post class questions including graphing their data and summarizing the main findings.
- Students receive direct, annotated feedback on their pre, in and post class work within 2 weeks.
- They then write a comprehensive and complete science report in draft form (optional or compulsory, discussed below), using their feedback and online tutorials as a guide. Students are also offered extra face-to-face tutorial sessions (optional or compulsory) individually or in group settings.
- Students receive broad written and/or verbal feedback on their drafts, including an individual feedback sheet and a marked rubric with the overall grade withheld. If students receive a less than sound grading for any parts of the rubric they are asked to submit a second (final) report which is marked for their final grade. Students who do not resubmit a final report have their draft reports marked as their final piece.

Different approaches have been taken over the semesters with regards to the compulsory nature of these report drafts, tutorials and other scaffolding activities:

- In 2015, students were provided with an option to submit a report draft for feedback, but it was found that whilst high achieving students took this opportunity, threshold-pass students largely did not.
- In Semester 1, 2016 the approach was changed. Students were required to submit a draft report mid-way through the semester. They were given non-annotated feedback via a personalised checklist, and were only provided with an initial mark if they reached a sound grading for all sections of the report. They were also required to attend a 15-minute face to face meeting with an instructor to discuss their feedback, and finally asked to resubmit their report along with their marked checklist to indicate that they had indeed interacted with their initial feedback.
- In Semester 2, 2016 the face to face meeting was removed due to teaching time restraints. Students were offered optional verbal feedback in a group setting. This approach was continued for both semesters in 2017 and 2018.
- In Semester 1, 2019 students were also asked to bring a skeleton draft to a lecture tutorial for peer review. Students who engaged with this process were allocated 2 extra bonus points.

STATISTICAL ANALYSIS

Results from the Essential Science Blackboard learning management system site for Study Periods (SP) 1 and 2 from JCU Cairns and Townsville campuses were collated using *R Studio* (R Core Team, 2018). Data included 2016 SP1 (n = 128) and 2 (n = 78), 2017 SP1 (n = 94) and 2 (n = 109), 2018 SP 1 (n = 93) and 2 (n = 69), and 2019 SP 1 (n = 120).

Student scientific report results (Draft and Final result) from JCU Cairns and Townsville were aligned by semester and year to create a combined dataset. This was justified as student demographics (age, socio-economic and education background etc.) were known to be similar. A new variable (SubmittedDraft) was created with students defined as having either submitted a draft (Draft Result > 0) or failed to submit a draft (Draft Result = 0) before final submission of their Science Report. Data exploration and visualisation were completed using the *ggplot2* package. Independent sample two-tailed t-tests were selected for analysis to determine if a difference in final report grade was observed between students who had submitted a draft and those who had not. Semesters were analysed independently as large changes in cohort sizes (ranging from 69 in 2018 SP2 to 128 in 2016 SP1) resulted in large variance differences between teaching periods. T-tests were performed using the base R function to compare the mean final report grade of students who submitted a draft and those who had failed to submit a draft for each study period in the available dataset.

RESULTS

Student engagement with the draft process varied between Study Periods (Figure 1). Over 75% of students during Study Period (SP) 1 and 2 of 2016 and SP1 of 2019 submitted a draft of their Scientific Report assessment, while only 11-23% of students took this opportunity during all other semesters. When these data were broken down to final submissions and individual semesters, it was seen that across all semesters, final submission rates reached well above 80%. Not submitting a draft did not correlate with not submitting a final report (Figure 1).

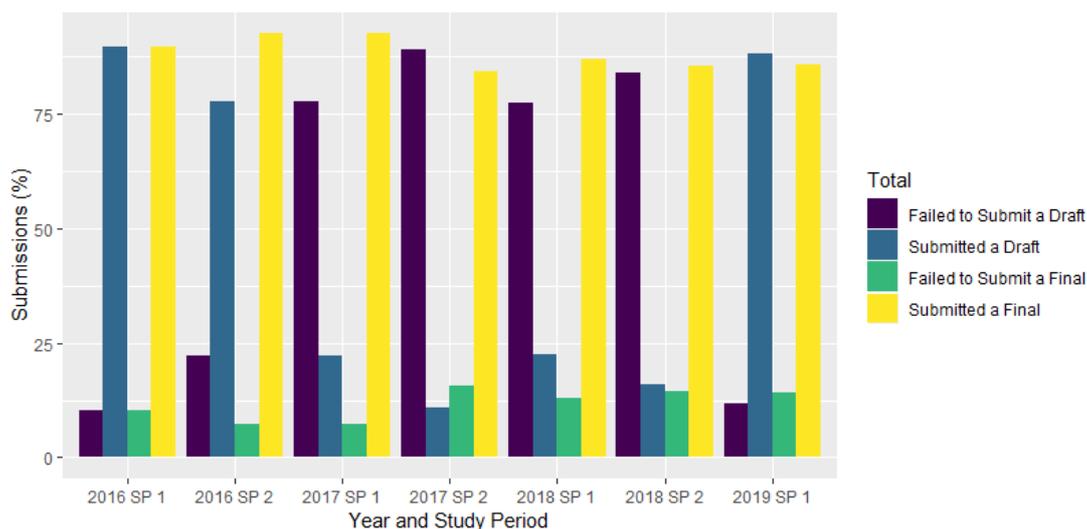


Figure 1. A comparison of the percentage of students in the Essential Science cohorts from S1 2016 through to S1 2019 who either (a) did not submit a draft (dark blue), (b) submitted a draft (light blue), (c) did not submit a final report (meaning, students did not submit any work or relied on a previous draft submission, green), (d) submitted a final report (yellow). Data shown are for Cairns and Townsville campuses combined.

The overall grade trend between students who submitted a draft and those who did not was also not consistent between semesters (Figure 2). It was found that the difference in final grade between students who submitted a draft and those who did not was significantly different in SP1 2016 ($t = -44.89$, $df = 114$, $p\text{-value} < 0.001$), SP2 2016 ($t = -3$, $df = 5.41$, $p = 0.03$), SP2 2018 ($t = 2.39$, $df = 34.51$, $p\text{-value} = 0.02$) and SP1 2019 ($t = -6.46$, $df = 14.6$, $p\text{-value} < 0.001$). There was no significant result difference between students who submitted a draft and those who did not in S1 2017 ($t = 0.13$, $df = 44.2$, $p\text{-value} = 0.89$), S2 2017 ($t = -0.15$, $df = 16.2$, $p\text{-value} = 0.88$) and S1 2018 ($t = 0.45$, $df = 50.2$, $p\text{-value} = 0.66$). Overall, the mean Science Report final grade for students who submitted a draft was found to be 64.2%, while the mean final Science Report grade for those who failed to submit was 55.5%.

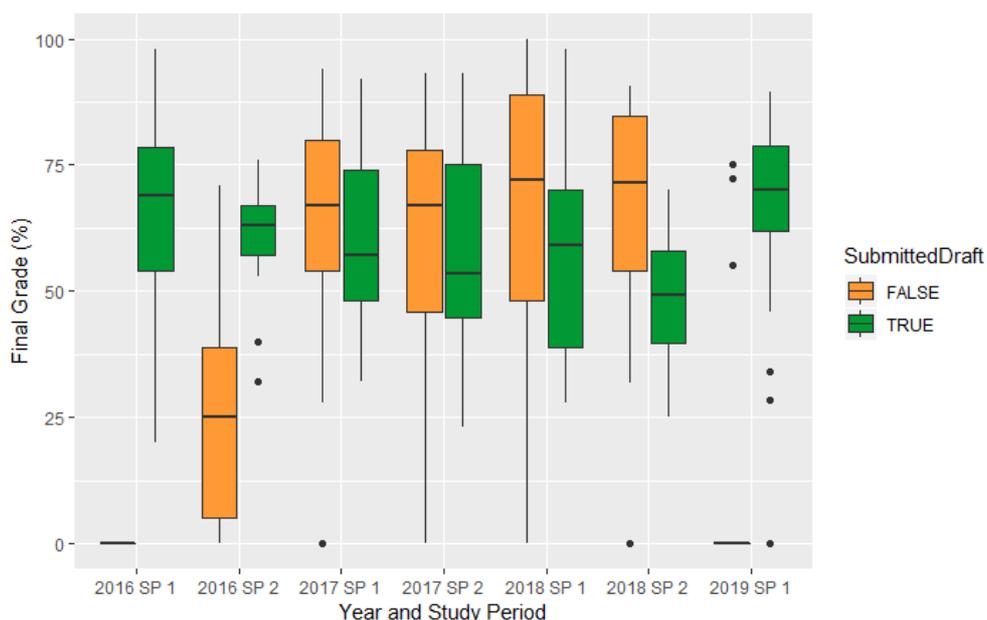


Figure 2. A box and whisker comparison (Min, Q1, Median, Q3, Max with outliers shown as dots) of final Science Report grade for students who did submit a draft report (true, shown in green) to those who did not submit a draft report (false, shown in orange). Data shown are Semester 1 2016 through to Semester 1 2019 for Cairns and Townsville campuses combined. Outliers represent individual student reports.

DISCUSSION

The inconsistency across semesters with regards to student engagement with the draft process – approximately 90% of students in Semester 1 for both 2016 and 2019 and only 10-25% in other semesters (Figure 1) did not correlate with any of the variables that were measured in this investigation. Furthermore, no trends were observed in the end of semester student evaluation surveys in terms of feedback, with students consistently reporting that they were more to extremely satisfied with the timely nature of their feedback in these reporting periods (Conway, C., 2017, personal communication.)

However, the change from autonomous to face-to face review interaction (with an instructor during Semester 1 2016, and with peers during lecture class during Semester 1 2019) could have been one explanation for the increase in draft submissions during these semesters. If this was the case, it would seem that class-based peer review was sufficient to prompt most students to at least attempt drafting a student report mid-way through the semester. This is consistent with the findings of others who have reported that teacher-only assessment restricted students from taking responsibility for their own learning (Haertel, 1993; Williams, 1996) and that peer feedback lead to enhanced performance (e.g., see Carillo-de-la-Pena et al., 2009; De Grez, Valcke, & Berings, 2010; Fund, 2010). For class-based peer review to work it is of course necessary for the majority of students to attend lectures, but it is commonly reported that this is often not the case (Vandehy et al., 2005). Since S1 2016, Essential Science lecture attendance has been enhanced by a compulsory 10 minute in-class test at the start of every lecture in lieu of an end of semester exam, however some students still choose to attend just for the purpose of completing the test after which they leave. Whilst we have not analysed these data, it has been our impression that full lecture attendance was particularly poor during 2017 and 2018. In S1 2019, test times during lecture were varied and this appeared to increase full lecture attendance, so that most students were present during the class-based report draft peer review. Nevertheless, further studies would need to be carried out in order to establish such a link between draft submission rates and face-to-face review interaction in this instance.

With regards to student submissions of drafts and final reports over the semesters there appears to be three distinct groups: Group 1 - S1 2016 and 2019 (>85.8% of students submitted a draft and final report), Group 2 - S2 2016 (77.8% of students submitted a draft, 92.6% submitted a final report), and Group 3 – S1 2017 to S2 2018 (only 11.0-22.6% of students submitted a draft, 84.4-92.6% submitted a final) (Figure 2). Figure 2 indicates a slightly higher science report grade in students who submitted

a draft in S1 2016 and 2019 SP1, a lower report grade in 2018 SP1 and no significant difference in other years. There was found to be a significant improvement in grade between student draft and report marks for S1 in 2016 ($t = -44.89$, $df = 114$, $p\text{-value} < 0.001$) and S1 2019 ($t = -4.67$, $df = 18.71$, $p\text{-value} < 0.01$), (Figure 3), but an opposite correlation was found for S2 2018 ($t = 2.39$, $df = 34.51$, $p\text{-value} = 0.02$), (Figure 3). The reasons for this are unclear from the data that were collected, but we propose two possible explanations:

(1) Students who submitted a draft mid-semester and received mostly positive feedback chose not to submit a final, improved report due to time and effort restraints. This is in line with previous findings by Lim (2009) who reported that students were reluctant to engage with a draft science report writing activity when they believed they already had a good writing style, or that the additional time commitment was not worth the effort in terms of potential increased marks. In other words, students in this category were content just to receive a pass for this assessment. In the future, this could be countered by withholding all mark related feedback (including rubrics) for the draft, and promoting more student-centred interactions through the provision of broad, self-directed tutorial linked instruction for those areas that need improvement.

(2) Students who did not submit a draft mid-semester but submitted a final report at the end of semester had a firmer grasp of science writing and other skills needed to complete the report to a higher standard by virtue of the extra time that they had spent mastering these skills throughout the semester.

We suggest further investigation of these proposals would be beneficial to carry out in the future.

Overall, students reported that they appreciated the draft report assessment process. The following report related comments were present in two separate end of semester student surveys as being positive features of the Essential Science subject:

“The structure of the assessment was really helpful because everything worked up to a larger goal, and was also structured in a way that first year students would settle into university well because our most difficult assessment task was started at the start of the semester, rather than at the end, and it tied in with other harder assessment pieces from the other subjects.”

“Resubmission of the science report, it was hard but well worth it.”

Whilst there is no doubt that timely, task-focussed feedback is important for enhancing student learning (e.g., see Black & Wiliam, 1998; Hattie & Timperley, 2007), this study agrees with the findings of Lew, Alwis, & Schmidt (2010) and Perera, Lee, Win, Perera, & Wijesuriya (2008) that written feedback alone or even written feedback and additional student practice is not always sufficient to improve student outcomes. However, this study does suggest that having students submit a science draft report is worthwhile if it is (i) a compulsory exercise and (ii) it includes some form of personalised, face-to-face feedback, even if this is only provided by peers. Whilst not formally analysed, it is also our impression that withholding all mark-related feedback for report drafts also encourages students to reflect and engage on their feedback and evaluating this further is suggested as a focus for future studies.

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