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IMPROVING STUDENT WRITING SKILLS USING A SCAFFOLDED APPROACH

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Abstract: Writing is a professional skill required by graduate engineers. Many students arrive at university with poor writing skills, partly stemming from a lack of experience. During an engineering degree, students are expected to produce written reports (e.g. describing practical laboratory exercises) but are often not taught how to.

We trialled a scaffolded approach with 1st year students, starting with an introductory seminar covering the basics of report writing (including contents, presentation, and examples). Students were provided with detailed supporting guidelines, and an overview of the mark scheme used in assessment. Over the course of two terms, five practical laboratories were carried out. After each laboratory, students completed a written report, building up from only a Results section, through to a full report. Feedback was given for each report before the next report was written, so that students could use the feedback to improve their future work. Students were also encouraged to ask for specific feedback on areas they identified at the end of each report.

We hypothesise that this approach will:

1. Help develop students as self-regulated learners, playing an active role in the feedback process by using a dialogic and feedforward approach.
2. Improve attainment by allowing students more opportunities to practice their writing skills.
3. Improve consistency in teaching and assessment across five key practical laboratory exercises.

Marks for each section and report have been monitored, and students have been surveyed throughout the process. The results will be presented in this paper.

Keywords; writing skills, scaffolded approach, engagement, feedback.

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1. INTRODUCTION

1.1 Writing skills

Professional engineers are required to be able to communicate effectively, including in written formats such as technical reports (Engineering Council 2014b). Universities aim to prepare

students for the professional environment, however, many new engineering graduates still lack the level of writing skills expected by their employers (Katz 1993, IET 2017).

Beer and McMurrey (2009) suggest that the problem arises in part because students who choose engineering wish to focus on mathematical and practical work instead of on written work. This innate preference contributes to a lack of interest in developing writing skills. Students may also underrate the importance of writing skills compared to professional engineers (Lievens 2012, Nguyen 1998), which could further reduce motivation to learn these skills (Ramsden and Entwistle 1981). However, other studies have shown that undergraduates do recognise the importance of communication skills in their future careers, albeit often to a lesser extent than technical skills (e.g. Direito *et al*. 2012, Itani and Srour 2016).

1.2 Definition of 'scaffolding'

Scaffolding is a process first described by Woods *et al.* (1976) as a tutoring approach which can work well to build new skills. They highlight several key aspects in the scaffolding process: 1) the student must understand what a finished piece of work will look like and be interested in reaching this standard; 2) the task should be broken down into smaller tasks against which the student can assess their performance; and 3) feedback should be given to help students understand how their work could be improved and should be constructive to avoid frustrating the students.

Lab report writing lends itself well to this scaffolded approach: 1) Exemplar reports can be shown to help students understand good/bad work. Although students are motivated by different factors, both performance and mastery goals can lead to high attainment (Mattern, 2005). 2) Lab reports can be broken down into multiple smaller tasks, by considering each section a sub-task (Abstract, Introduction, Results, etc). 3) Scheduling of the labs can allow feedback on one report to be provided to the student before the next report is due. This also moves feedback towards a feedforward approach, highlighting the transferrable nature of the skills students are learning and enabling students to develop their self-regulation (Nicol and Macfarlance-Dick, 2006).

1.3 Aims of the study

This study aimed to address poor writing skills in 1st year Mechanical Engineering students at the University of Bristol, by implementing a structured 'scaffolded' approach across a set of 5 labs. It was hypothesised that this would improve attainment; encourage students to become more self-regulated and engaged with the feedback process; and improve consistency between the 5 labs. Outcomes were evaluated by surveying students at multiple points during the process, and tracking marks and engagement with feedback through the online submission system. Reflections from the teaching staff involved were also collected. Details of the old approach, the new scaffolded approach, and results of evaluation of the process are presented in this paper.

2. BACKGROUND

This study involved 5 practical laboratories taught to 200 1st year Mechanical Engineering students at the University of Bristol. The 5 labs form part of 3 larger units, accounting for 10% of

the total assessment of each unit. Each lab involved a 2-3 hour practical exercise designed to demonstrate application of theoretical concepts covered during traditional lectures.

Before the changes made this year, labs were taught to groups of 10 or 20 students over the course of either 1 or 2 12-week teaching blocks (depending on the lab capacity and the timetabling of the associated larger unit). Labs consisted of a range of required assessments, as shown in **Table 1**. This range of assessment requirements limited the ability of students to feedforward their learning from one assessment to the next, and even for the labs requiring some form of report, the guidelines varied. This made it more difficult for students to appreciate the general structure and contents expected in a lab report. Mark schemes also varied across the labs, with some placing more emphasis on presentation and some on content. Overall, students were preoccupied with interpreting the varying assessment criteria, distracting their focus from the technical content, leading to surface level learning (Newstead, 2002)

Lab	**Assessment**
Balancing	Report including Introduction, Discussion and Conclusions.
Engines	Tables and figures of Results.
Inertia	Proforma requiring only numerical answers
Properties of Materials	Lab report with Abstract, Results, Discussion, and Conclusions. Introduction and Methods sections were pre-written by teachers and provided to students in the template, so the final submission was a full report.
Structures of Materials	800-word lab report with Abstract, Results, Discussion, and Conclusions.

Table 1: Previous assessment requirements for the five labs

3. SCAFFOLDED APPROACH

A scaffolded approach was implemented during the academic year 2017/18, incorporating the 5 labs previously described. Labs were scheduled to take place every 4 weeks during 2 teaching blocks, with 40 students taking each lab each week in either 2 or 4 scheduled lab sessions (depending on the lab capacity). Lab reports were submitted online 1 week after completion of the lab, with feedback from assessors returned 3 weeks after submission. This allowed students to access their feedback before writing and submitting their next reports. Requirements for the submitted reports increased from a single section (Results) to a full report over the course of the 5 labs (see **Table 2**), allowing students to focus on a new sub-task each time. Students were also expected to use a provided template, to allow them to focus on their technical content.

An additional section, which does not form part of the mark for the work was added: Reflective Comments. Based on literature (Nicol and Macfarlane-Dick, 2006) and previous experience within this department (Selwyn and Renaud-Assemat, 2018), students who reflect on their work generally achieve better outputs. Students were asked to consider how well they thought they had met the required contents and identify areas where they would like additional feedback. This also moved feedback towards a beneficial dialogic approach (Nicol, 2010).

Lab week	Submission week	Required contents
5	6	Results, Reflective Comments
9	10	Results, Discussion, Reflective Comments
13	14	Introduction, Results, Discussion, Conclusions, Reflective Comments
17	18	Abstract, Introduction, Results, Discussion, Conclusions, Reflective Comments
21	22	Abstract, Introduction, Experimental Methods, Results, Discussion, Conclusions, Reflective Comments

Table 2: Required contents of lab reports each week

To help students understand what a finished piece of work should look like, and motivate them to achieve it, a 2-hour seminar was delivered to groups of 20 students one week before the first lab was scheduled. The seminar introduced the lab teaching team to the students, and then moved on to interactive activities. Students were asked to discuss the importance of writing skills to their future careers; general structure of a report; and specific contents of each section of a report. After each discussion, the facilitator drew together their thoughts and discussed any uncertainties that they still had. By encouraging students to discuss these topics amongst themselves before the facilitator consolidated their ideas, peer learning was being encouraged (Boud, 2001).

The seminar attempted to clarify expectations, giving students copies of the report guidelines and template that they were expected to use, and providing exemplar reports to prompt discussion of better and worse practice. The guidelines summarised the contents that should be considered in each report section. After student discussion, the facilitators highlighted that neither exemplar was perfect, and both had better and worse aspects (emphasising a range of ‘good’ performance). Plagiarism and referencing were also discussed. The final part of the seminar covered logistical arrangements such as submission and feedback timelines and opportunities for accessing ongoing support while writing their reports.

Ongoing support was provided to students by: 1) in-lab discussions of report content; 2) support documents on Blackboard; 3) a drop-in session during each week a report was being written; and 4) the opportunity to ask for advice from lab teachers by email or ad-hoc face-to-face meetings.

This implementation of the scaffolded approach also came with several associated benefits. Firstly, the required assessments all used the same guidelines so that it was clear to students that they were being assessed on the same skills each time. Secondly, consistency in the mark scheme removed some of the assessment focus that students have (Newstead, 2002). Thirdly, this presented students with an obvious opportunity to use feedback in a feedforward manner (Nicol and Macfarlane-Dick, 2006).

4. EVALUATION

4.1 Understanding expectations

Two quick polls of students were taken before and after the seminar, asking the same question: "How do you feel about report writing?". This open question aimed to gauge student interest in and awareness of the importance of writing skills, and to see whether their views had changed during the seminar. Responses were classified into common themes. Pre-seminar, most responses suggested low enthusiasm for writing (43%), and concerns relating to a lack of previous experience (38%). Typical comments included "always difficult and long", "not my strongest skill" and "don't know what to expect". Only 12% of responses were positive, with example comments including "fine" and "good way to report what we have learnt in lab".

Post-seminar, comments were more encouraging, suggesting that the seminar had served its purpose of clarifying expectations for students, and helping them to picture a 'good' report. 54% of comments related to students feeling more confident (e.g. "not so daunting any more"), and 22% specifically related to improved understanding of the requirements (e.g. "have a clearer idea on the content of the report now").

Students particularly highlighted the usefulness of the provided template and guidelines during the mid-point survey (carried out after completion of 2 reports). 77% of students had used them to write the 1st report, and 82% used them for the 2nd report. The majority of those who used the guidelines found them helpful for determining the contents and structure of the expected report. Those who did not use them did not remember being made aware of their existence during the seminar. By the end-point survey, 67% of students believed they understood the requirements of the report well enough to be able to mark themselves fairly for a future report.

Overall, it appears that students arrived at a good understanding of what a report should look like, satisfying one of the components of the scaffolded approach outlined by Woods *et al.* (1976). The approach also improved consistency between labs, which enabled students to more easily use feedback from one report in their next submissions.

4.2 Feedback on assessments

88% of students had opened their marked submission before submitting their next report, suggesting a high engagement with feedback. (Similar report-based assessments in previous years, found around 55% of students viewed their feedback.) 45% of responses to the mid-point questionnaire indicated that feedback was used to improve specific aspects of the Results section, while 35% related to improving more general aspects of presentation (e.g. using the template correctly). The 12% of students who did not use the feedback in their 2nd report said they had not seen their feedback, either because they forgot or because they had not been able to access it.

Results of the end-point survey show that 88% of students understood how to use feedback to improve their next reports. 57% of students had discussed their feedback with another person, usually a course mate (60%) or a tutor (31%). As expected, students were positive about the Reflective Comment section as it allowed them to engage in a dialogue about their work (Selwyn and Renaud-Assemat, 2018). This demonstrates a high level of engagement with feedback and

indicates that students were trying to use it to improve their future work. This satisfies another key aspect of the scaffolded approach described by Woods *et al.* (1976).

4.3 Assessment marks

Marks awarded for each section of the report were recorded anonymously for each submission. Figure 1 shows the trend in marks awarded across the 5 submissions. The mean mark increased from 53% in the 1st submission to 64% in the 5th submission, while the spread of marks reduced noticeably. The scaffolded approach appeared to particularly benefit weaker students, as the minimum marks improved for each report. A similar pattern was identified when marks were broken down by report section as well, although it was less noticeable in the later sections to be added (e.g. the Introduction and Conclusions) as students had fewer attempts.

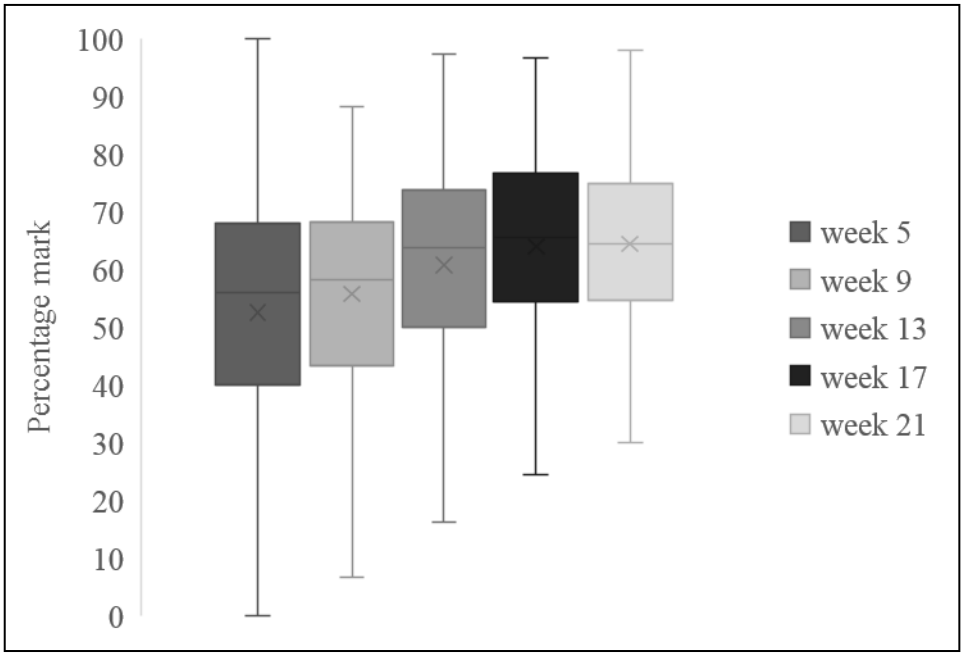

Figure 1: Boxplot of marks awarded for the 5 lab report submissions

Although the improvement in marks was not as substantial as had been hoped for, this can be attributed in part to the changing technical content of each lab. Students improved the general components of the report and better addressed relevant information in each section, but their performance was impeded by difficulties mastering technical contents.

4.4 Staff reflections

The scaffolded approach has overall been beneficial and will be continued in future academic years. The ability to track changes to report marks over multiple submissions will allow future improvements to the approach to give students more support writing the most challenging sections.

Some difficulties with the scaffolded approach were also identified and should also be addressed in future changes:

- Small numbers of students were unaware of the support available to them. As this was initially communicated to them verbally during the seminar and labs, other methods of communication should also be considered.
- Despite students saying that they understood how to use their feedback, some simple errors persisted through multiple submissions. Several students also used the drop-in sessions to ask why their mark was low, rather than focussing on what they could do to improve next time. This suggests that student interpretation and use of feedback should be further investigated.
- Each lab was marked by different assessors, which sometimes gave problems with inconsistency both between labs and between assessors for each lab. This was despite a common mark scheme being used, so further work is needed to train assessors.
- Students commented that they would appreciate seeing more exemplars of 'good' work to improve their understanding of what to do. As the labs do not generally change from year to year, it was not deemed sensible to provide exemplars of 'good' reports which may then be plagiarised (inadvertently or otherwise). However, further discussion on this topic should be considered, as students would clearly appreciate more support, especially with the Discussion section.

5. CONCLUSIONS

A scaffolded approach was successfully implemented across 5 1st year Mechanical Engineering labs at the University of Bristol, based on the key aspects of the approach as described by Woods *et al.* (1976). A consistent template, guidelines, and mark scheme were developed and used in all 5 labs. This enabled students to better understand the expectations, and the majority found it easy to use feedback on one report to improve their future work. A significant increase in student engagement with feedback was noted, suggesting this approach was developing students into more self-regulated learners. There was a small improvement in marks over the 5 labs, suggesting students were improving some aspects of their writing skills, but differing technical contents still presented difficulties. The scaffolded approach used was deemed to be beneficial overall, but some areas have been identified for further improvements. It will be interesting to track how this cohort perform in their 2nd year lab assessments, to see whether the scaffolded approach has any lasting effect after the scaffold is removed.

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