A Whole-Class Self-Assessment Method to Enhance Engagement with Feedback in Low-stakes, High-value Assessments in the Physical Sciences

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Abstract

A readily implementable and effective whole-class face-to-face tutor-led student self-assessment method for enhancing engagement with feedback is described and discussed. Key features of the approach are the transfer of responsibility for writing feedback information from teachers to students within a tutor-led face-to-face dialogic feedback session, and students' self-penned feedback annotations being distinguished from their original work by use of a distinctly coloured pen. Results of a student evaluation are reported and reveal that students perceive this approach as beneficial to their engagement with feedback, their assessment literacy and learning of chemistry.

Introduction

In the physical sciences, regular high-value, low-stakes paper-based assessments (e.g. problem sheets, in-class tests, pre-laboratory exercises etc.) are common. Such assessments typically involve a range of problem-solving questions (e.g., calculations, analysis and interpretation of scientific information, diagrammatic and graphing skills), often serving a formative purpose in preparation for end of course examinations (for example) and contributing a small proportion of credit to final module grades. In an era of mass higher education and large class sizes, the provision of timely and sufficiently detailed written feedback on such assessments can be challenging, as is ensuring meaningful student engagement with the feedback. In our experience of marking and providing feedback on such assessments over many years, similar profiles of errors, omissions, misconceptions etc. are commonly repeated across a high proportion of the students' answers. The result is that much of the feedback teachers write on students' scripts is repeated again and again, which raises questions about the efficiency and sustainability of such feedback practices.

Student dissatisfaction with assessment and assessment feedback is widely acknowledged as a persistent challenge in higher education (e.g. UK NSS), reflecting entrenched and conflicting perceptions and misconceptions of effective assessment practice and feedback amongst students and educators (Weaver, 2006; Rand, 2017; Nash and Winstone, 2017; O'Donovan *et al.*, 2019). Indeed, Williams, Lo Fan Hin and Erlina (2019) report a decline over an academic year in the proportion of 1st year chemistry students who state they will read and act on feedback, pointing to possible evidence of early disengagement with feedback in higher education.

The reasons for student dissatisfaction with assessment and feedback are complex, but recent research and discourse on assessment in higher education (O'Donovan, Price & Rust, 2004; Beaumont, O'Doherty & Shannon, 2011; Nicol & MacFarlane-Dick, 2006, Nicol, 2010; Yang & Carless, 2013; Winstone *et al.*, 2017a, 2017b; Carless & Boud, 2018) has identified shortcomings in fundamental operational and design aspects of common assessment and feedback practices that help explain this dissatisfaction. Proposed solutions to address dissatisfaction with assessment and feedback emphasise '*assessment for learning*' through dialogic approaches incorporating formative elements that target students' assessment and feedback literacies (Smith *et al.*, 2013; Carless & Boud, 2018) and develop understandings of shared responsibilities between students and teachers for making feedback effective:

Assessment Literacy: '*students' understanding of the rules surrounding assessment in their course context, their use of assessment tasks to monitor or further their learning, and their ability to work with the guidelines on standards in their context to produce work of a predictable standard*' (Smith *et al.*, 2013, p. 46)

Feedback Literacy: '*the understandings, capacities and dispositions needed to make sense of information and use it to enhance work or learning strategies*' (Carless & Boud, 2018, p. 1315)

However, Nicol (2010) notes that the era of mass higher education has actually led to '*impoverished dialogue*' surrounding written assessment feedback, resulting in feedback becoming one-way communication that diminishes its effectiveness for learning. Consequently there is increasing recognition of the need for a cultural change in assessment feedback practice within higher education, particularly with regard to strategies to address the assessment and feedback literacies of students and educators, but also to establish shared understandings between educators and students of their respective responsibilities in sustainable assessment-feedback practices (Winstone *et al.*, 2017a, 2017b; Nash & Winstone, 2017).

These capacities and shared responsibilities are implicit in the seven principles of good feedback practice identified by Nicol and MacFarlane-Dick (2006):

1. Clarifies what good performance is (goals, criteria, expected standards);

2. Facilitates the development of self-assessment (reflection) in learning;

3. Delivers high quality information to students about their learning;

4. Encourages teacher and peer dialogue around learning;

5. Encourages positive motivational beliefs and self-esteem;

6. Provides opportunities to close the gap between current and desired performance;

7. Provides information to teachers that can be used to help shape the teaching.

In this article we present an evaluation of a whole-class face-to-face tutor-led dialogic self-assessment method (known locally as the Purple Pens technique), designed to enhance not only the timeliness and quality of feedback (principle 3, 7), but also students' uptake and engagement with feedback (principles 2-6) and their assessment literacy (principle 1). Through this method we have sought to overcome barriers to engagement with feedback by changing the nature of the feedback process and the environment within which it operates. Specifically, we have sought to improve feedback quality, timeliness and engagement with feedback through the active involvement of students in the feedback process. Thus tutor-written comments are replaced with more dialogic face-to-face spoken or illustrated feedback, and responsibility for writing feedback information is shifted from teachers to students. The face-to-face aspect facilitates richer, more detailed feedback that has the capacity to address assessment literacy by conveying, more effectively than tutor-written feedback can, the tacit knowledge and qualities associated with different standards of answers.

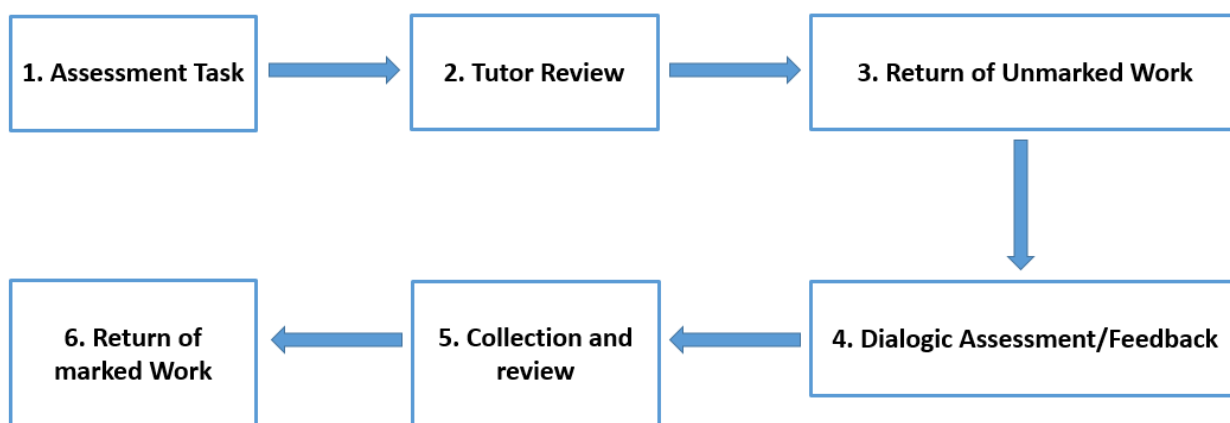The results of a student evaluation of the Purple Pens technique are reported and these

Figure 1 Sequence of events/activities for operation of the Purple Pens technique.

reveal some interesting insights into students' perceptions of the purpose and effectiveness of the approach and their own role in the assessment and feedback process.

Methodology

The Purple Pens technique described herein was introduced in an attempt to enhance the chemistry curriculum at Keele, and questionnaire responses obtained *via* service evaluation with options to grant or decline consent for use of quotations. Ethical approval was obtained from the Natural Sciences Faculty Research Ethics Committee at Keele University.

The questionnaire was deployed to FHEQ Level 4 (1st year Higher education in England) students studying chemistry or medicinal chemistry at Keele University in the 2015-16 academic year, with 72/105 responses obtained. The questionnaire comprised eight questions, with a combination of Likert-style and free text questions aiming to probe students' perceptions of the impact of the intervention on their learning of chemistry, their perceptions of the reasons for its introduction, the extent and use of their self-penned annotations and their confidence in marking their own work. It should be noted that none of the questions explicitly use the terms 'assessment' or 'feedback'. The free-text answers were analysed using an inductive thematic analysis approach as described by Braun and Clarke (2006).

Operational aspects
Figure 1 shows a flowchart illustrating the sequence of events or activities that underpin

the implementation of the Purple Pens technique, whilst figure 2 shows an indicative example of student self-penned annotations on part of a class test question following a Purple Pens feedback session (stage 4 of Figure 1).

1. **Assessment Task:** in the context of the Keele programmes, this is primarily low-stakes (<10% of module) 1-hour Class Tests comprising question styles and formats that are similar to the end of module examination (typically 3 hours). However, we have also used the Purple Pens technique for pre-laboratory exercises and formative assessments, which students complete in their own time and submit as hardcopy.

2. **Tutor Review:** Tutors survey the students' work to inform the feedback to be provided (Nicol and MacFarlane-Dick (2006), principle 7) in the face-to-face tutor-led student self-assessment session (see (4) below). Tutors do not mark the work or write feedback on the scripts, but make notes identifying common strengths, weaknesses, errors and misconceptions that are to be emphasised in the feedback session, as well as any alternative valid answers and approaches.

3. **Return of unmarked work to students:** Students have their work returned to them (unmarked and with no feedback) during the scheduled face-to-face tutor-led student self-assessment session (typically 2 hours for a 1 hour class test) that takes place within a few days of the assessment task. A seating plan facilitates the return of
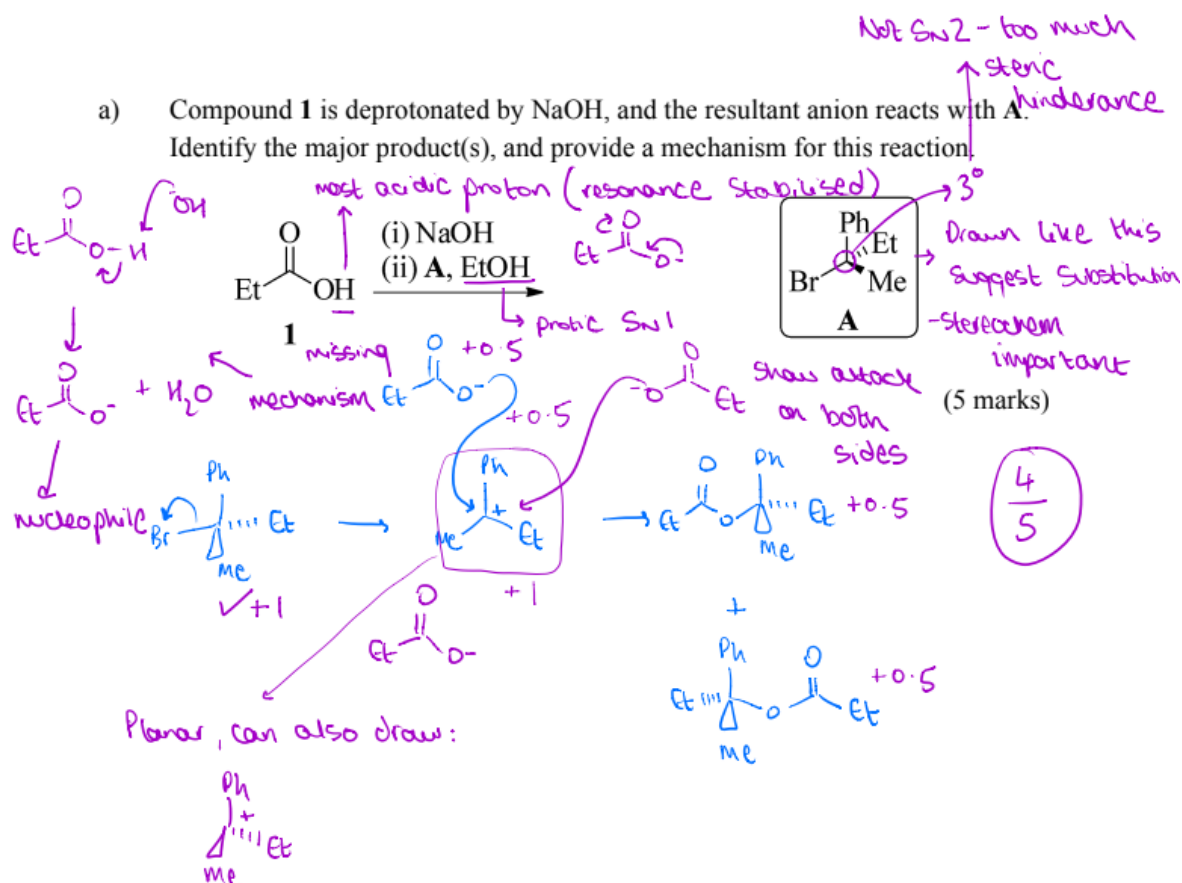
Figure 2 An indicative example of student annotations on part of a class test question following a Purple Pens feedback session. The blue ink is the original answer.

the unmarked work for large classes (~100 in our case) and students are instructed to put away any pens and pencils prior to return of their work. We have used both tiered lecture theatres and flat room spaces for these sessions.

4. **Face-to-face tutor-led student self-assessment:** Students are provided with a distinctly coloured pen (a purple pen is what we have used) to annotate and mark their work and write their own feedback comments (see Figure 2) as tutors review the questions. Tutors (dependent on the assessment, it may be one or more tutors) work and talk through the questions (using tablet computers, visualisers, or whiteboards), posing questions (e.g. assessment literacy: what is the question asking? what is the question not asking?), encouraging dialogue, highlighting strengths and weaknesses in answers, characteristics of high quality answers, common errors, misconceptions and

alternative valid answers. Tutor-led self-marking generally comes at the end of the discussion of each question, and at this stage the allocation of marks is explained and justified with opportunities for dialogue surrounding judgements to be made (e.g. partially correct answers, application of 'error carried forward', alternative valid answers). Students who are unable to attend for good cause (typically <10% of students) have their worked marked with tutor feedback comments.

5. **Collection and Review:** students return their marked, annotated work for recording and reviewing of marks. This is generally a rapid and efficient process with only minor adjustments/clarifications being required.

6. **Return of Marked Work:** students receive their marked, annotated work with confirmation of their final grade or slightly adjusted grade.
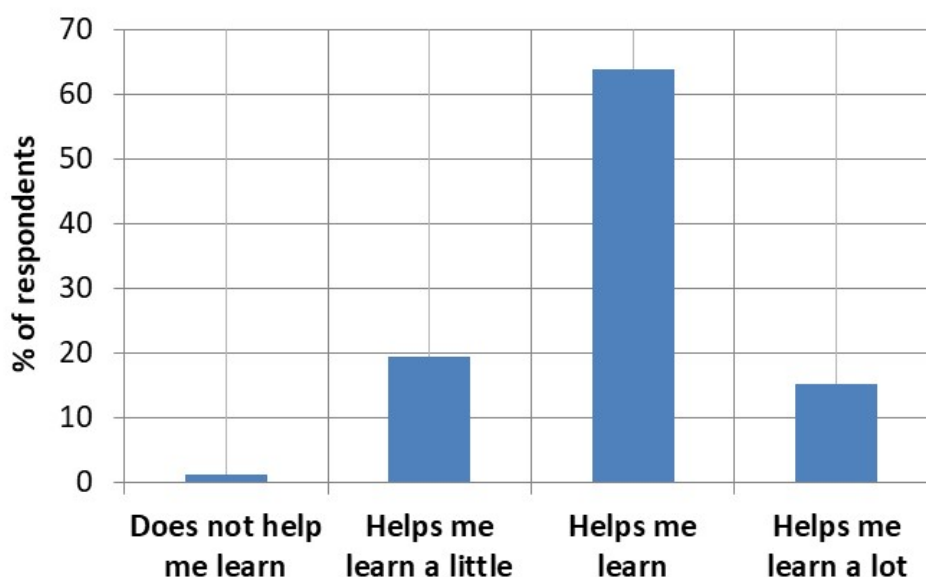
Figure 3 Profile of responses to '*Please rate the use of the purple pens technique in terms of its impact on your learning of chemistry*'.

Results and Discussion

The questionnaire sought insight into students' perceptions of various aspects of the Purple Pens technique via Likert-style responses and free-text responses. The forthcoming discussion of the students' responses focuses on the following question areas:

1. Students' ratings of the impact of the use of the purple pens technique on their learning of chemistry (Figure 3 and free-text responses).

2. Students' perceptions of the reasons why the purple pens technique has been used (free-text response).

3. Students' ratings of the extent of annotations they make on their work using the purple pens (Figure 4 and free-text responses).

4. Students' ratings of the usefulness of their annotations for revision (Figure 5 and free-text responses).

5. Students' rating of their confidence in marking their own work (Figure 6 and free-text responses).

Quantitative responses
Figures 3-6 summarise the Likert-style responses and reveal that over 75% of respondents perceive the purple pens technique as beneficial to their learning of chemistry, over 90% made notes or annotations on their work, over 90% perceived these self-penned annotations as useful/very useful for revision and over 85% felt quite confident/confident in marking their own work. Overall the quantitative responses suggest students perceive the intervention positively with only a very small proportion of respondents (less than 5%) holding negative perceptions. Deeper insight into the students' responses is revealed by the free-text responses.

Free-text responses
Analysis of the free text comments from the questionnaire resulted in the emergence of several interlinking themes: feedback engagement; assessment literacy; feedforward.
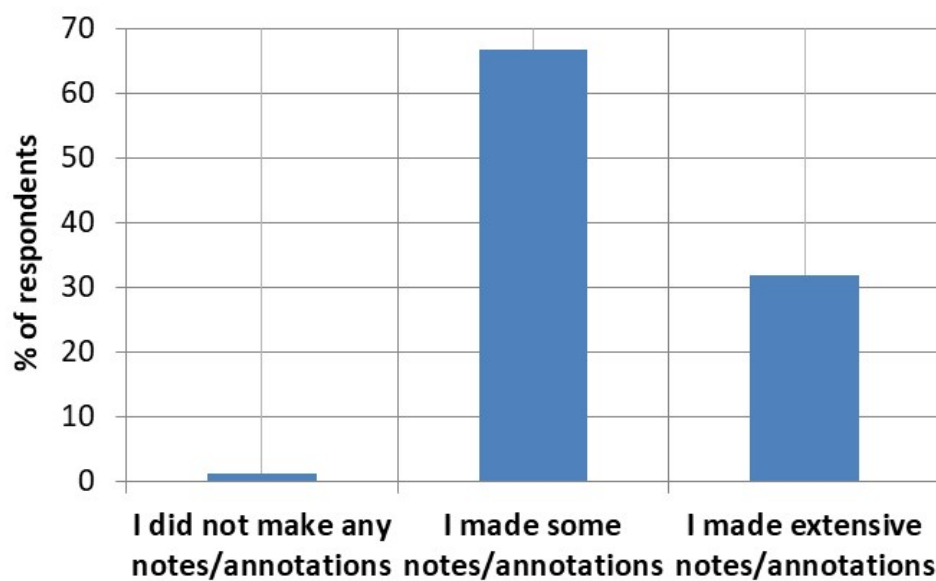
Figure 4 Profile of responses to '*Please indicate what best applies to you in terms of your notes or annotations using the purple pens*'.
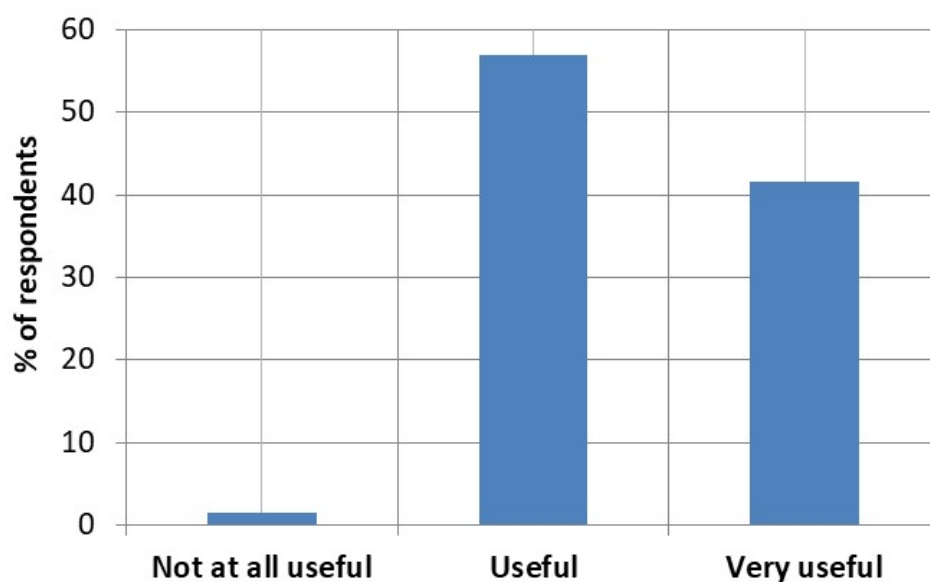

Figure 5 Profile of responses to '*Please rate the usefulness of your self-annotated (using purple pens) returned work for revision*'.
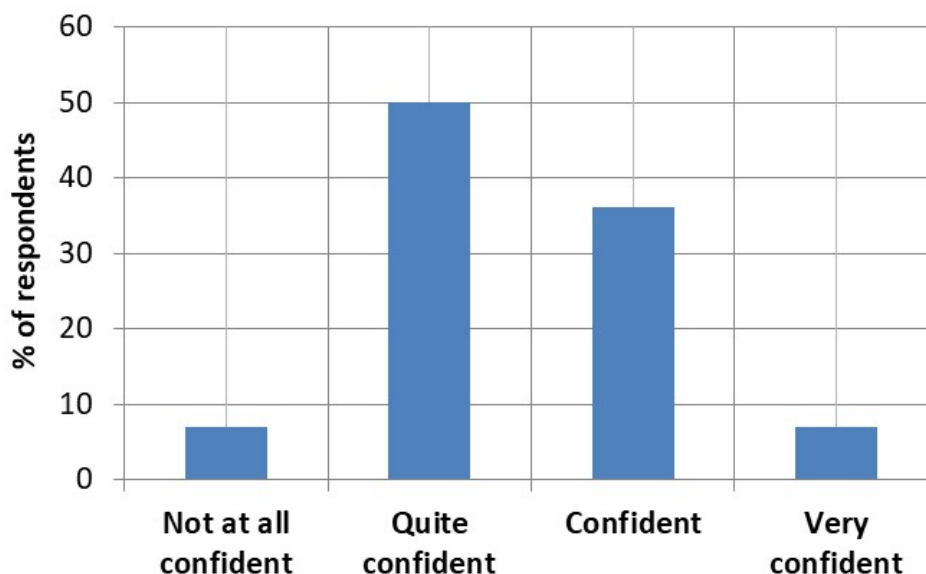
Figure 6 Profile of responses to '*Please indicate how confident you were in marking your own work using the purple pens*'.

Feedback Engagement: The lack of engagement with written feedback is a commonly reported problem in higher education, which can reflect students' difficulties with interpreting feedback comments from tutors (Chanock, 2000, Weaver, 2006, Rand, 2017, Nash and Winstone, 2017), but also the environment and context within which the feedback operates (Winstone *et al.*, 2017a). Molloy and Boud (2013) argue that students taking an active role in the feedback process is essential to its effectiveness. We present evidence that the purple pens approach, in which students actively participate in the feedback process, goes some way to erode the barriers (Winstone and Nash, 2017) that impede students' engagement with feedback. Nash and Winstone (2017) identify 'awareness' as a barrier to engagement with feedback and associate this with students' difficulties in understanding the purpose of feedback, recognising feedback and understanding feedback terminology and jargon. We argue that self-penned feedback allows students to be more aware that they are receiving feedback and may help them understand the feedback to a greater extent than written feedback received from a tutor. Students' awareness of feedback being received and their engagement with it is prominent in the free-text responses through the frequent explicit or implicit references to students' sense of understanding of the feedback information

and being able to identify areas for improvement; there is a strong sense that students perceive the feedback information to penetrate more effectively because they are engaging in self-assessment and have more autonomy over the feedback:

'*As, when you mark it yourself, you feel that you know what you've done and you are picking it out, compared to teacher feedback which you might not understand*'

'*Marking it myself made me look through it which I don't normally do when it has just been marked and handed back to me*'

'*Self-marking makes you actually think about your answers and where you went wrong. Just reading through a pre-marked script is incredibly passive and makes it easy to switch off, whereas going through your own work with a pen means you have to really focus on the areas you fell down on*'

'*Picking up on my own mistakes, and marking them, feels more effective than simply reading someone else's marking. It makes you think about it more*'

These free-text comments suggest students are reflecting more on their work through

engagement in self-assessment (Nicol & MacFarlane-Dick (2006), principle 2).

Higgins *et al.* (2001) have highlighted the lack of specific advice as being a key reason for student dissatisfaction with the feedback process. Satisfaction and effectiveness may be enhanced by the personalised (i.e. self-penned in relation to the student's own work) and targeted nature of the feedback received in the purple pens session. In our study, students recognised the value of receiving bespoke feedback ('*in my own words'*) to aid their understanding and this appears to have contributed positively to students' engagement with feedback:

> '*To allow us to make specified feedback in areas we find most difficult rather than generalised feedback*'

> '*I can make notes that make sense to me/explain things in the way that I understand them*'

> '*It's easier to understand when it's in my own words*'

Another well reported issue that hinders engagement with feedback is the time lapse between the assessment and when the feedback is received (Nicol & MacFarlane-Dick, 2006), recognising that engagement with feedback is likely to be greater if students receive it '*while it still matters to them*' (Gibbs & Simpson, 2004). The lack of timely feedback on assessment items is often cause for student dissatisfaction with assessment feedback (e.g. UK NSS). Using the purple pens technique in our curriculum has significantly reduced the assessment-feedback time lapse, with students typically receiving feedback within a few days of completing the assessment in the timetabled feedback session, and their final marks often less than a week after this. Students recognise the timely manner of the feedback received and cite it as one of the reasons to use the purple pens technique: '*faster feedback*'; '*feedback is immediate*'.

Assessment literacy
Winstone *et al.* (2017b) identify 'assessment literacy' as one of the categories of what they describe as 'feedback recipience/engagement-with-feedback' skills to be developed, which

goes hand-in-hand with the development of 'evaluative judgement', which Tai *et al.* (2018) define as the 'capability to make decisions about the quality of work of oneself and others'. Tai *et al.* (2018) argue that evaluative judgement should be a goal of higher education and identify 'feedback as dialogue' as one of several approaches to develop students' evaluative judgement. The free-text comments reveal students' perceptions of the benefits of the purple pens approach for developing their assessment literacy, but also suggest engagement in evaluative judgement about their answers.

> '*It is good as it means you can evaluate your own answer and see what an examiner would think of the answer, which means you can see where you need to improve*'

> '*Can see how an examiner would mark your work and where you need to improve*'

> '*Helps you think how the examiner marking you would think*'

> '*To enable you to critique your own work…as you understand the process/what examiners are looking for*'

Blair *et al.* (2014) have proposed that formal contact time is required to afford opportunities for dialogue relating to feedback, which is a key aspect of the purple pens technique. Whilst the dialogic aspect of the feedback sessions did not feature as strongly as we may have anticipated in the student evaluation, some students certainly identified this as an important feature:

> '*Allows time for students to ask questions on the topic*'

> '*If I didn't know something was right or wrong I could ask so I think I marked well*'

Much of the dialogue in these sessions relates to alternative approaches to answer a question which has been identified as beneficial by the students:

'*The sessions also show me other ways to answer the same question*'.

A very small minority of students (~2%) perceived the Purple Pens technique as a tool to reduce the workload of lecturers and teachers and questioned their ability to self-mark:

'*To make less work for lecturers*'

'*I have not had training as how to mark like a teacher/lecturer. Although it's nice to see where I went wrong I have paid uni fees for a reason*'.

Feedforward

Figure 5 shows students' self-reporting of the usefulness of their annotations for revision, revealing that a large majority of students state that they find their annotations useful or very useful. This was supported by the free-text comments where students identified the importance of learning from their mistakes and being able to understand how the correct answer was obtained when looking at their marked work in the future:

'*I made notes on the points/concepts I got wrong during the session and it aids in revising the topic'; Helped revise and not make the same mistakes twice*'

'*I circle what I've done wrong, I explain why, I write how it's correct and why*'

'*Helps with revision (annotated answers) means you can understand how an answer was reached when you look back at it after a long time*'.

'*During the exams I realised I might have made a few mistakes (especially with units and calculations) and the purple pen exercise helped me figure out where I went wrong and allowed me to think about my mistakes*'

'*Using the annotations I made on my work I can see where I have gone wrong or done well. Where I have gone wrong I can use my annotations to tell me why I'm wrong and what the correct answer is. I also use it for model answers even where I was right*'

Additional benefits of the approach

An additional aspect worthy of mention was the visual impact of using purple pens. Students value the use of the different colour pens when referring to their marked work during revision periods.

Finally, Figure 6 shows students' self-reporting of their confidence in actually marking their own work, where it is clear, and not unsurprising for 1st year undergraduates, that many students are tentative about their ability to grade their own work, and place more trust in the judgement of the 'expert' (i.e. the instructor) (Harris & Brown, 2013; Panadero, Brown & Courtney, 2014; Peterson & Irving, 2008).

In general, we have found the student self-marking to be accurate, which aligns with other studies into self-assessment in science subjects (Falchikov & Boud, 1989). In these types of assessment in the physical sciences, there is less ambiguity about the self-assessment process, therefore it is more likely to be a beneficial experience (Panadero, Brown & Strijbos, 2016). We have found, despite their relative inexperience, students (of all proficiencies) are generally realistic about the quality of their answers. The lack of student attempts to 'cheat' their way to a higher mark also indicates how seriously they take the exercise. If adjustments are required, these are often minor and often leads to the student obtaining a higher mark than the one that they awarded themselves. This is often due to nuances with the mark scheme relating to, for example, error carried forward marks, the scope of which may be difficult to fully explain during the timetabled feedback session. In summary, the purple pens approach is a feedback method that aligns with the seven principles of good feedback practice identified by Nicol and MacFarlane-Dick (2006). The approach supports development of students' assessment literacy (principle 1, 2), enhances engagement with feedback and self-assessment and reflection (principles 2-6), provides richer, more detailed and nuanced face-to-face feedback (principle 3), provides useful and useable feedback (principle 6) and informs teachers about the teaching during the feedback session (principle 7).

Conclusions

The results of the student evaluation show that students value this method of feedback for a variety of reasons, not least that it is prompt, they have autonomy over the feedback and it enhances their assessment literacy and engagement with feedback. Its strength and value is in the richness of the feedback, the transfer of responsibility for writing feedback from teacher to student, the teaching power of assessment feedback and the ability to provide high-quality feedback to a large class within a dialogic environment. The Purple Pens approach has been widely used in Chemistry at Keele for four years involving about ten lecturers and is starting to be adapted for use by other disciplines such as forensic science and physics.

In summary, the Purple Pens technique:

- Is useful for low-stakes, high-value problem-based assessments involving large classes.
- Facilitates rapid, rich and detailed feedback with opportunities for dialogue.
- Engages students with feedback in relation to their own work and has the capacity to develop their assessment literacy and engagement with feedback.
- Avoids teachers having to write the same feedback repeatedly.

Adoption is straightforward, economical and transferable to other disciplines within the physical and life sciences, engineering and other disciplines where the application of similar problem-solving skills is required. Adopters need to explain the pedagogical rationale and operational aspects of the approach to students and be able and prepared to allocate timetable slots for the assessment and feedback workshops.

Acknowledgements

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