Feedback to Students on Soil Mechanics Laboratory Reports – Why Use Virtual Technology if you Can Have a Productive Real Dialogue?

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ABSTRACT: Soil mechanics is often perceived by undergraduate students as difficult. This paper describes an approach (method and rationale) to providing individual feedback on laboratory test reports based on small (one instructor to two students) groups. Changes in response to student comments are discussed, and the benefits to students and instructors assessed. It is concluded that this is an effective, efficient, and rewarding way of encouraging learning, engagement and developing understanding.

Keywords: Soil mechanics, Assessment for learning, Feedback, Laboratory work, Student-instructor interaction

1 Introduction

Soil mechanics courses can be challenging for students. Conceptual difficulty is often associated with the two- or three- phase nature of soils, and the requirement for (and linkages between) three state variables of shear stress, normal effective stress and specific volume. Understanding and deep learning are essential if students are to achieve the intended learning outcomes.

Assessment design should focus on promoting student learning at various levels, including discipline and subject level, professional competencies, generic literacies and skills (HEA, 2016). Assessment tends to shape what students study, when they study, how much work they do and their approach to learning (HEA, 2012). Thus improving assessment is a key factor for improving student learning. However, according to Price et al. (2011), assessment often does not support learning because of ineffective feedback. Hence feedback is one of the most powerful strategies to improve learning and achievement (Hattie, 2009). More importantly, the quality (rather than the quantity) of feedback is essential for feedback to be received and used by the learner (Brooks et al., 2019). Assessment tasks and assessment feedback should focus on engaging students in an effective learning experience.

Good (1978) suggested marking examination scripts with the student present, but this approach is rarely adopted. More recently, Chalmers et al. (2018) investigated whether a one-to-one meeting between an instructor and a student would be a better use of time than the instructor marking and writing feedback on a short essay. Chalmers et al. (2018) report that both instructors and students considered the face-to-face feedback positive and beneficial, enabling a feedback dialogue and that the marks given could be explained and justified by the instructors. This paper reports on the use of face to face, small group feedback sessions to promote learning in soil mechanics at the University of Southampton (UK).

2 Assessment and feedback in Higher Education

2.1 Assessment and feedback

In their review of literature on assessment and feedback in higher education, Jackel et al. (2017) identify the following fundamental principles and subject categories: assessment for learning; aligned and fit-for-purpose assessment; collaborative construction of standards; integrating assessment literacy with learning; defensibility of professional judgments; and the limits of assessment.

Traditionally, assessment *for* learning has been associated with formative, and assessment *of* learning with summative assessment. HEA (2012) highlights the formative and diagnostic characteristics of assessment for learning, which allow adjustment of teaching and learning activities to the needs of students. This leads to dialogic feedback processes that can be highly beneficial, particularly when regularly embedded in learning activities. Nonetheless, assessment can be simultaneously summative and formative. For example, Bennett (2011) suggests that a piece of coursework and a final examination both have strong formative components, as they drive learning during the course (what and how it is learned), and feed forward into future learning. While the primary focus of a summative assessment is what students know and can do, a properly designed summative assessment will also support learning.

Assessment and feedback should be in constructive alignment, linking the learning objectives, the teaching and learning strategies and valid, relevant and authentic tasks, and thus fit for purpose (Jackel et al., 2017). However, defining learning outcomes, assessment criteria and providing written feedback cannot replace instructor-student interaction, and some groups of students will need such contact more than others (HEA, 2012).

Clearly articulated assessment and feedback standards contribute to improving transparency of assessment and student learning, particularly when students engage with setting those standards (Hendri et al., 2012; Jackel et al., 2017). Such engagement can be promoted by integrating assessment literacy into course design (HEA, 2016); developing assessment literacy amongst academics is also key (Price et al., 2011). Marking assessment tasks requires professional judgment, and creating opportunities for critical reflection within a collaborative setting can contribute to improving the transparency and fairness of these (Bloxham et al., 2016). In any case, assessment has limitations and lacks precision. Some aspects of learning cannot be reasonably assessed; the scope of assessment tasks may go beyond and above the intended learning outcomes; and any attempt to define and list all important competencies or learning outcomes is reductive (Jackel et al., 2017).

What exactly is feedback? Willis and Webb (2010) define it as “the range of processes whereby a student or group of students receives information about how well they understand concepts and are progressing with their studies”. But feedback should also include advice for action (Whitelock, 2010), allowing students to adjust and improve to meet the intended learning outcomes (Cowan, 2003). Evans (2013) reports different definitions of assessment feedback and distinguishes between a cognitivist view (feedback is seen as corrective) and a socio-constructivist view (feedback is facilitative by providing comments and suggestions and using dialogue to promote new understandings, which can lead to the development of communities of practice).

Student dissatisfaction with feedback in higher education has been widely reported, related to timing, content, organisation of assignment activities, and lack of clarity about requirements (Evans, 2013). There is also evidence (Gibbs and Simpson, 2005) that a significant number of students do not check their written assignment feedback upon receiving their marks.

Gibbs and Simpson (2005) presented 10 "conditions under which assessment supports students’ learning", seven of which refer to feedback:

1. “Sufficient feedback is provided, both often enough and in enough detail.
2. The feedback focuses on students’ performance, on their learning and on actions under the students’ control, rather than on the students themselves and on their characteristics.
3. The feedback is timely in that it is received by students while it still matters to them and in time for them to pay attention to further learning or receive further assistance.
4. Feedback is appropriate to the purpose of the assignment and to its criteria for success.
5. Feedback is appropriate in relation to students’ understanding of what they are meant to be doing.
6. Feedback is received and attended to.
7. Feedback is acted upon by the student”.

2.2 Effective feedback

Nicol and Macfarlane-Dick (2006) define good feedback practice as that which strengthens students' capacity to self-regulate their performance and put forward seven principles for good feedback practice:

1. Helps clarify what good performance is (goals, criteria, and expected standards).
2. Facilitates the development of self-assessment (reflection) in learning.
3. Delivers high quality information to students about their learning.
4. Encourages instructor 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 instructors that can be used to help shape the teaching.

However, some authors point out that these principles emphasise one side of the feedback process, with the main focus on the instructor (Dunworth and Sanchez, 2016). Hattie and Timperley (2007) proposed a model of feedback that includes the learner's perspective, posing three questions that need to be answered for effective feedback:

1. Where am I going (the goals) – "Feed up".
2. How am I going? – "Feed back".
3. Where to next? – "Feed forward".

Each feedback question may work at four different levels (Hattie and Timperley, 2007): task (how well tasks are understood or performed); process (the main processes needed to understand or perform the tasks); self-regulation (self-monitoring, directing and regulating of actions); self (personal evaluations and, usually, positive effect on the learner).

Feedback is an interactive process (Dunworth and Sanchez, 2016) of learning in a context of social interaction, hence dialogic. However, De Nisi and Kluger (2000) point out that feedback is received differently depending on the affective dimension of feedback, emphasising that feedback should focus on the task assessed and task performance. Neither the process nor the content should threaten the ego of the recipient, and guidance on how performance may be improved should not denigrate the performance of others. To make good use of feedback, students need to learn how to interpret feedback, how to link it to their own work, and how to improve their work in the future (Boud and Molloy, 2013).

Effective feedback needs an 'orientational' and a 'transformational' purpose, and an 'interpersonal' dimension (HEA, 2016). To meet these requirements, feedback should make student performance and achievement clear; feed forward by creating opportunities for reflection, improvement and increased student autonomy; promote student confidence and motivation; and build strong instructor-student relationships. Thus the learner should be at the centre of the feedback process and feedback comments should be (Ryan et al., 2019) detailed, i.e., sufficiently comprehensive for learners to know how their future work can be improved; personalised, i.e., responding directly to the individual student and the piece of work being assessed; and usable.

2.3 Feedback practices

Evans (2013) summarises practices from the literature to promote effective feedback, relating to the delivery, form and context of feedback. These include varying the mode of feedback, adapted to the task in hand and addressing the individual needs of the student. Immediate and delayed feedback can both be useful. Group discussions are beneficial, but students seem to like individual feedback. The purpose and the challenges associated with different feedback modes, including face-to-face dialogue, handwritten notes, rubrics and digital recordings, are varied and can influence the level of detail, personalisation and usability of feedback information (Ryan et al., 2019).

Face-to-face feedback is considered the best mode of feedback (Ryan et al., 2019). Synchronous feedback dialogues allow students to engage in conversation with the instructor, co-creating meaning and learning while representing and justifying their knowledge on a topic. However, these dialogues are ephemeral and may be difficult to set up for large cohorts (Ryan et al., 2019). Instructor-student dialogue is important in helping students to understand assessment expectations and learn how to use feedback (HEA, 2012). Nonetheless, while evidence from the literature indicates that replacing instructor-student dialogue with greater guidance or more detailed written feedback has limited impact on learning and achievement, many students expect written comments on their assessment tasks (HEA, 2012).

Feedback using audio, video or screencast recordings has been presented as an alternative to face-to-face feedback and to written comments: Ryan et al. (2019) cite authors who consider face-to-face feedback more efficient than written comments. Recordings can be revisited by students many times and may include a range of indications (e.g. tone, pace, body language, expression) perceived by students to be better at promoting understanding than written comments (Ryan et al., 2019). On the other hand, automated feedback is mostly a monologue with a focus on content delivery (Evans, 2013). Several authors report the use of technology-enhanced approaches to improve assessment and feedback. Suitable tools can help provide automated or speedier feedback, student-student and instructor-student dialogue, and support for peer and group assessment (HEA, 2012). However, technology is just an enabler and the pedagogy and the design adopted are essential for the success of assessment and feedback with technology enhancement (Gilbert et al., 2011).

Feedback can be delivered in different ways including individually, in a small group or a lecture class (HEA, 2012). Although students seem to prefer individual to group feedback, some studies highlight the benefits of group discussion (Evans, 2013). Immediate feedback seems to be more effective than delayed feedback (Morgan et al., 2014). However, tasks well within the learner's capability and where transfer to other contexts is important may benefit from delayed feedback (Evans, 2013). Either way, feedback should be given when there is still time for the student to act on it to improve their performance (Nicol and MacFarlane-Dick, 2006; Sadler, 1989). To improve students' satisfaction with assessment, better and more inclusive assessment methods are needed. These should be combined with strategies to promote instructor-student and student-student dialogue, ensuring that the timing, form and delivery mode of feedback allows students to learn from it and use it in their future work (HEA, 2012).

2.4 Face-to-face feedback

Race (2004) summarised key features of face-to-face feedback, highlighting its memorable and transformational nature for students. Body language, facial expression, tone of voice and the emphasis given by the instructor are additional dimensions of face-to-face feedback that complement verbal explanations. Race (2004) also discussed the advantages and disadvantages of this mode of feedback from the instructor perspective. The main advantages are: the personal, intimate and authoritative character of feedback; it enables addressing the students' needs, strengths and weaknesses individually; usually it is quicker than to write or type; it is a feedback mechanism appreciated by external reviewers (although it needs to be supported by evidence from the students).

According to Race (2004), the main disadvantages of individual face-to-face feedback include some students feeling threatened by critical feedback, which may lead to defensive attitude from students and a consequent harder reaction from the instructor; some students being embarrassed by praise and thus not fully benefiting from it; the time spent organising appointments, which with a large cohort can be high; instructor time wasted through missed appointments; students' confidence may be shaken by criticisms in a face-to-face session and they may tend to remember only such criticisms; the impracticality of keeping track of the feedback given to individual students (although this is arguably the students' responsibility).

3 Case study

This paper reports a feedback strategy implemented in a soil mechanics course at the University of Southampton (UK) since 2016/2017. The following sections include information on the course, the traditional feedback practices used and the changes implemented, as well as the methods used to assess the students' opinions and perceptions of the changes described herein.

3.1 Soil mechanics at the University of Southampton

The soil mechanics course forming the case study is followed by all second year students on the BEng and MEng programmes in Civil Engineering, MEng in Civil and Environmental Engineering, and MEng in Civil Engineering and Architecture. In the first year of these programmes, students take a course on civil engineering fundamentals that includes a Semester 2 module on geology for engineers. Geology for engineers is a pre-requisite for the second year soil mechanics course, and covers:

1. The structure of the earth, plate tectonics, continental drift and their engineering implications.

2. Geohazards and geotechnical risks.
3. The origins, distribution and variability of a range of geomaterials.
4. Properties of geomaterials with importance for construction.
5. Groundwater.
6. Effective stress and Mohr's circles.
7. Laboratory classes: Engineering description of soils and rocks; Classification of soils.

In Semester 2 of the second year, students take the soil mechanics course, which covers:

1. Revision and application of basic concepts, such as phase relationships and effective stress.
2. Groundwater, permeability and seepage: Darcy's law and concept of permeability; permeability measurement; flownet sketching, application of flownets.
3. Compression and consolidation: the oedometer test; one-dimensional compression and consolidation; application to field problems.
4. Soil strength and soil behaviour: soil as a frictional material; shear box tests; critical states; peak strengths and dilation; undrained shear strength of clay soils; the triaxial test apparatus; stress parameters; isotropic compression and swelling; shear tests; the Cam Clay model framework.
5. Calculation of soil settlement: selection of "elastic" parameters, Newmark's chart.
6. Retaining walls: concepts of engineering plasticity; active and passive pressures; stress field (Rankine) solutions for embedded walls; limit equilibrium (Coulomb) solutions for gravity walls; simple practical applications assuming frictionless and dry (no porewater pressures) conditions.
7. Foundations: stress field and mechanism solutions for idealised strip footings; bearing capacity factors for simple strip footing.
8. Slopes: the infinite slope; Taylor's charts.

Each semester has 12 teaching weeks. The contact time in soil mechanics comprises 36 hours of lectures and 2 laboratory sessions (3 hours each). All students must attend the laboratory sessions. Working in groups of 2 (occasionally 3), students carry out an oedometer test in the first session and a triaxial test in the second. Students prepare and submit an individual report for each laboratory test. The reports combined contribute 20% of the final mark for the course (10% per report); there is also a final exam (contributing 80% of the final mark). The laboratory sheets, made available to students at the start of the semester, include a description of the experiment and questions to be answered in the report.

The laboratory sessions and reports have several objectives: to carry out the experiment; to derive relevant information from the laboratory test data; to analyse and interpret the results and apply them to a real problem; to write up the report; and to develop and be able to demonstrate understanding.

3.2 Previous model

Before the changes reported in this paper, students submitted a hard copy of each of the two laboratory reports, prepared individually. Students were expected to write a description of the experiment, present their raw data, carry out and present calculations to evaluate relevant parameters, plot appropriate graphs, and answer various questions by way of analysis and discussion. On one day each week, students went in groups of about 10 to the geotechnical laboratory for a 3 hour laboratory session. Often 3 or more weeks were necessary for all students to complete one laboratory session. Marking only started after all of the laboratory reports had been submitted. The second laboratory session (triaxial test) was often affected by the Easter break (4 weeks), and some of the groups had their laboratory session after that break (near the end of the teaching period and coinciding with summative assessment tasks for other courses). This was a frequent cause of dissatisfaction amongst students.

After all of the individual reports for a particular laboratory experiment had been submitted, they were marked (by the laboratory demonstrators, supervised by one of the instructors who also moderated the marks); individual comments and feedback were included on the hard copy of each report. A marking *proforma* listing common mistakes was filled in by the markers, identifying areas where students in general lost marks. After marking all the reports, the marks were moderated. Only then were the final marks and corresponding individual feedback made available, by returning the hard copies of the report and the marking *proforma* to the students. In addition, generic feedback on the coursework was made available to all students, via the University's e-learning platform. For classes of 50-75 students, the whole process usually took 3-5 weeks for each of the two laboratory experiments.

3.3 New model

The strategy implemented and reported herein attempted to address students' concerns about the time lag between submission of coursework and the availability of the marks and feedback, as well as the lateness of some of the laboratory sessions (taking place after the Easter break). At the same time and probably more importantly, the authors aimed to promote effective feedback through assessment and feedback *for*, rather than *of*, learning. Thus in 2016/2017, the authors changed the timings of the laboratory sessions, implemented a new feedback strategy and took on the marking. As before, students were divided into groups (~10 students) and attended two laboratory sessions: the first on the oedometer test and the second on the triaxial test. Students carried out the experiment generally in pairs. They collected their own data, and where necessary (e.g. for the triaxial test, in which each pair of students carried out the test at a single cell pressure but data from tests at three cell pressures were needed for the write-up), the data were shared within each main laboratory group. Students then had two weeks to analyse the data, answer the questions on the laboratory sheet and prepare an individual report.

Two significant changes were implemented at this stage. First, on the day of submission (two weeks after the corresponding laboratory session), students submitted a soft copy of their report via the e-learning system. Secondly, and usually on the day of submission, students met one of the instructors in small groups of one instructor and usually two students for a face-to-face feedback session. During that session, students answered questions on the coursework, explained how they had addressed the different questions on the laboratory sheet and discussed their main conclusions. The instructor could identify knowledge gaps and point out areas for further study, and link the results to realistic contexts. Feedback was verbal, although the instructors sometimes wrote short comments on the reports.

Reports were marked to the nearest 10% against a published list of objective benchmarks, as follows:

- missing the laboratory session, 0%
- attendance at the laboratory session and no report submission, 20%
- data are presented and processed but no discussion is included, 40%
- minor mistakes, inconsistencies or incompleteness (e.g., a significant error in the calculations, or an element of the write up missing or wrong), 60%
- complete and substantially correct and well presented report, 80%
- exemplary in every way, 100%.

The criteria were defined to ensure that students doing the minimum, i.e., attending the lab and submitting data and most calculations would receive the pass mark (40%).

To ensure that all laboratory sessions took place before the Easter break, it was necessary to schedule more sessions each week. This had to be managed to avoid scheduling conflicts with the engineering geology laboratory sessions for Year 1 students, which took place in the same laboratory. It was also necessary to start the oedometer laboratory sessions before the lectures on the topic. To ensure students would go into the laboratory adequately prepared, introductory videos were created and made available to students to explain the experiment, familiarise students with the equipment and give an overview of the whole experiment and its objectives.

The feedback sessions were timetabled to ensure all students could attend them. Each feedback session was allocated a 15 minute slot. In 2016/2017, owing to the timing of Easter, students carried out the triaxial test before the Easter break; the report was submitted within two weeks (during the Easter break) and the feedback sessions took place when teaching resumed. The motivation for the changes and the process as a whole were explained in detail to students at the start of the semester.

3.4 Assessment of the model implemented

Different approaches were used to assess the impact of these changes on students and their perceptions on the course. These included the staff-student liaison committee of the Civil and Environmental programmes at the University of Southampton that meets regularly, and is attended by the Director of Programmes and Programme Leads as well as by student representatives. The student representatives (at least one per year of the programme) collect their peers' perceptions on the courses in that year; good features of the courses are highlighted and areas for improvement are discussed. That information was used by the authors to assess the satisfaction of students with the new model.

In addition, for each course a short mid-semester evaluation (typically during the sixth week of teaching) was carried out. During a lecture, students were asked to fill in three open questions on the course:

- "STOP. Tell us what you don't like about the current course (and WHY).
- START. Tell us what improvements you would like to see made to the course (and WHY).
- CARRY ON. Tell us what you like best about the course (and WHY)."

Students wrote their answers on the forms distributed, which were then analysed by one instructor. During the subsequent lecture, the instructor summarised the comments received and explained how the issues raised would be addressed during the second part of the semester or the following year.

4 Discussion

The face-to-face feedback sessions have been used over the last three years (between 2016/2017 and 2018/2019) both to mark and give feedback on the laboratory reports. In 2016/2017, after the oedometer test feedback session, some students raised issues and suggested improvements. Where possible, those issues were addressed in the second laboratory experiment and its feedback session. The remaining issues were addressed in the following year. Section 4.1 discusses some of the points raised by students during the first year of implementation and the improvements made to address them. Section 4.2 discusses how students have reacted to the improved version of the approach.

4.1 First year of implementation

As mentioned earlier, the face-to-face feedback sessions were implemented for the first time in 2016/2017 and the motivation for the change was explained to the whole class at the start. After the oedometer test feedback session, it was clear that most students liked the new mode of feedback. Some students felt that the two instructors marked the reports differently. Although that was not the case, to ensure that the published criteria were adhered to, students were given an indicative mark for their report during the face-to-face feedback sessions. Later, the instructors met to review and agree the final marks. This process, termed "moderation", involved comparison of the indicative marks across the range of students and both instructors, to ensure consistency in that similar reports and outcomes were given the same final mark. Marks were not scaled to fit any pre-determined distribution.

In 2016/2017, 74 students took the soil mechanics course, of which 39 answered the mid-semester course evaluation form. Some responses were related to the laboratory classes and feedback sessions: 15 students found the face-to-face feedback sessions positive; 6 students asked for the content to be covered in lectures before the corresponding laboratory session; 4 students indicated they would prefer the instructors to take more time to mark the reports; 1 student reported feeling intimidated during the feedback session. Although very few students were unhappy with the face-to-face feedback sessions, the instructors wanted to address their concerns; hence the causes of dissatisfaction were investigated.

Owing to the timing of the sessions and the order of the syllabus, students had to carry out the oedometer laboratory test before the lectures on that topic. Some feedback sessions occurred after a week of lectures on the topic, which other students felt was unfair as the lectures had included application exercises. For the second laboratory test, timing relative to lectures was not an issue.

Some students disregarded the instructions on how to prepare the laboratory report and included – unnecessarily – long descriptions of the test procedure. These were not marked as students had been asked specifically not to include them. The allocated time per face-to-face feedback session (15 minutes per group of two students) was clearly not enough, as many sessions over-ran. Nonetheless, the instructors were able to identify mistakes rapidly during the feedback sessions, without having to check all the calculations in detail. This seemed to faze some students, who perceived that the instructors were not giving their reports "full attention". The atmosphere of the face-to-face feedback sessions was informal and constructive, similar to a conversation, but one student interpreted the feedback session as a *viva voce* and felt intimidated.

After the first round of face-to-face feedback sessions and during one of the lectures, one of the instructors explained again the goal of these sessions and how they were organised. The face-to-face feedback sessions aimed to give students quick, personal feedback on their work, identifying areas where more revision was necessary and promoting the ability to critically analyse the results and link theory and practice. In addition, the instructor showed some anonymised excerpts from laboratory reports, explaining how some mistakes were easily spotted and how students could easily adopt similar strategies when reviewing their work, revising for the exams and later in professional practice. It was highlighted that the instructors could usually rapidly check a student's work without having to repeat the calculations in detail. In addition, each face-to-face feedback session was extended to 30 minutes per group of two students. These discussions and changes seemed to satisfy most students.

During the second round of face-to-face feedback sessions, it was clear that students had read the coursework brief and addressed it, eliminating unnecessary work. At the start of each feedback session, the instructor summarised the main objectives of the session, pointing out its informal character. The main goals of the feedback session were emphasised as consolidating knowledge and addressing misconceptions, and linking the theory covered in the lectures with the practical aspects of the triaxial test. By that point, students were more familiar with the instructors and their teaching style.

As mentioned previously, in 2016/2017 the triaxial test laboratory sessions took place before the Easter break. Feedback sessions all took place after the Easter break (up to a month after the coursework submission), by which time some students could not remember the experiment or how they had processed the data to produce the report. To overcome this problem, the order of the syllabus and the timing of the laboratory sessions were reviewed and in 2017/2018 some changes were implemented. After the revision of concepts from the first year module geology for engineers, the lectures covered the topic of consolidation. This ensured that all students had received all the lectures and solved problems on the topic before submitting the oedometer test report. The second topic was the shear strength of soils; again, the re-ordering of material enabled all students to attend all relevant lectures and practice solving problems in class and individually before submitting the triaxial test report.

The order of the syllabus, particularly topics 1 to 4 (Section 3.1), from 2017/2018 became:

1. Introduction: revision and application of basic concepts - phase relationships, effective stress.
2. Compression and consolidation: the oedometer test; one-dimensional compression and consolidation; application to field problems.
3. Soil strength and soil behaviour: soil as a frictional material; shear box tests; critical states; peak strengths and dilation; undrained shear strength of clay soils; the triaxial test apparatus; stress parameters; isotropic compression and swelling; shear tests; the Cam Clay model framework.
4. Groundwater, permeability and seepage: Darcy's law and concept of permeability; permeability measurement; flownet sketching, application of flownets.

These changes allowed all laboratory sessions and all face-to-face feedback sessions to take place before the Easter break.

Overall, and despite the issues discussed above, in 2016/2017 the face-to-face feedback sessions seemed to be working well and well received by students. Some of the positive comments collected during the mid-semester course evaluation were very encouraging. For example:

- "the laboratory report feedback session was very helpful – I understand the laboratory fully and feedback was quick and relevant rather than late and unhelpful".
- "what I like best about the module is the quick and comprehensive marking and discussion of laboratory reports."
- "verbal feedback of coursework marking is good to discuss your report and boost understanding."
- "1:2 feedback is excellent, the most useful / personal feedback received at university so far."
- "I thought the face to face marking of the labs was really useful and helpful. I'd like to see that across all modules."

4.2 New improved model

After the improvements implemented in 2017/2018, there have been few if any problems with the process. Students have some lectures on the topics before attending the laboratory session, and all lectures on a topic have been delivered before submission of the laboratory report. Students are encouraged to prepare for the laboratory session by watching the introductory video and reading the laboratory sheets, so they can make the most of the time in the laboratory.

Part of the success is due to the management of student expectations and benefits by the instructors. For example, the face-to-face feedback sessions are explained in detail during the lectures, to avoid any misplaced feeling of pressure. The informality of the sessions is pointed out as an advantage, while students are also encouraged to come and ask questions during the semester. At the start of each face-to-face feedback session, the instructor describes the objectives of the session, highlighting that, more importantly than marking the coursework, the session aims to promote understanding and learning. The informal character of the discussion is pointed out and the students seem content with it.

During the face-to-face feedback sessions, it is possible to identify gaps in knowledge, misconceptions and areas for improvement. Those are discussed with the students, identifying areas for further revision and study. At the end of the face-to-face feedback session the instructor concludes by pointing out the best feature of each report and how it could be improved further. The positive and constructive nature of the feedback seems to be very well received by students. The session usually ends by the student and instructor agreeing an indicative mark, with reference to the published list of objective benchmarks. The instructor explains that marks will be moderated after all the feedback sessions on that report have taken place, and thus may change slightly. For borderline reports, an indicative mark range is agreed.

All comments made during the mid-semester course evaluation being positive (e.g. see Table 1).

Table 1. Some of the students' comments on the feedback sessions

2017/2018	2018/2019
• I like the feedback. • What I like best about the course is the feedback sessions for the laboratory reports. • Carry on with the feedback session for laboratory reports. Is good to see straight away what is right about the coursework and to know whether our understanding is correct. • I like the feedback sessions. • What I like best about the module is the feedback. • Good laboratory feedback that really helps understanding. • Verbal feedback for coursework is amazingly useful. Gives meaning and better understanding of assignments. I feel like I'm learning. • I like the feedback sessions.	• Feedback sessions after the labs are very helpful. • The laboratory report oral feedback sessions are really useful. • The laboratory feedback sessions are extremely helpful. • The feedback sessions two weeks after each laboratory are personal and a good place to ask questions. • I like the laboratory feedback session as individual feedback. • What I like best about the module is the laboratory report feedback. • Carry on with the one to one laboratory feedback session. • Feedback sessions after the labs are very helpful.

4.3 Feedback practice adopted and its link to the literature

The design of the face-to-face feedback sessions addresses many of the fundamental principles of feedback. The mode of feedback promotes assessment *for* (rather than *of*) learning, as it helps define what and when students learn and in identifying gaps in knowledge and areas for further study. The assessment is *aligned*, linking many of the learning objectives of the course, the teaching and learning strategies and the assessment tasks. The reports include tasks and processes that are used in geotechnical engineering and are as authentic as possible. The reports are marked against the published list of benchmark criteria, described in Section 3.3. Interpolation between the narrative benchmark scale points enables reports to be marked to an integer number out of ten (nearest 10%). The indicative mark is set during the feedback session in consultation with the student, with reference to the published list of objective benchmarks. To ensure consistency, the instructors review all reports jointly before finalising the marks. The approach engages students in implementing standards, develops the assessment literacy of instructors, and provides defensibility of professional judgement.

The face-to-face feedback provided to students is *interactive* (a dialogue and an informal discussion), *timely* (provided on day of submission) and *integrated* (summative feedback has a role in enhancing learning). The feedback described herein includes a dialogue and is truly a two-way process. The feedback provided is not a list of what is wrong with the coursework, but a discussion on why some aspects (calculations, interpretations, etc.) are not correct and how the coursework could have been improved, as well as a discussion on the implications of the results for geotechnical engineering practice. The face-to-face feedback sessions were designed to allow for effective feedback, following Hattie and Timperley's (2007) model of feedback, as follows:

FEED UP (Where am I going?): The goals of the assessment are made clear, by making clear the learning intent and criteria for success. These are put forward in lectures at the start of the semester and before the feedback sessions start, as well as at the beginning of each feedback session. In addition, the laboratory sheet and the marking criteria are made available through the e-learning system.

FEED BACK (How am I doing?): During the feedback sessions, students can gauge and are guided into realising how they are doing relative to the intended learning objectives. Students agree on an indicative mark, assigned against the published list of objective benchmarks.

FEED FORWARD (Where to next?): During and after the feedback sessions, if and when students engage in a reflective analysis, they can gauge and are guided into realising which areas of the topic need further or deeper study. At the end of the feedback session, areas for improvement are discussed.

The three purposes of feedback as defined by HEA (2016) are addressed by the face-to-face feedback sessions, and they are all appreciated and recognised by students, as illustrated by the comments included in Sections 4.1 and 4.2. Specifically, the purpose of the feedback is

- 'orientational' ("[it] is good to see straight away what is right about the coursework and to know whether our understanding is correct")
- 'transformational' ("verbal feedback for coursework is amazingly useful. Gives meaning and better understanding of assignments. I feel like I'm learning")
- is effective with an 'interpersonal' dimension ("1:2 feedback is excellent, the most useful / personal feedback received at university so far.").

4.4 Face-to-face feedback and complex concepts in soil mechanics

The soil mechanics course follows the set textbook *Soil Mechanics: Concepts and Applications* (Powrie, 2013). As support materials, students have the book, handouts from the lectures, exercises for application of concepts with different levels of difficulty and complexity and some videos to illustrate simple concepts (such as seepage in soils). Most of these resources are available through the University's e-learning platform. Some videos are shown in class and referred to when visiting the relevant theoretical concepts; most lectures include time for problem-solving exercises and the students tackle them independently with support from the instructor. All lectures are recorded (video and audio), and students can revisit them when needed. This is particularly useful for students with special learning needs and for international students, as well as for revision.

During the laboratory sessions, students handle soil samples and face the constraints of a real test, rather than simply processing "ideal" test results. This helps students understand the limitations of the tests and how factors such as poor sample preparation can influence results. In linking the test results to field problems, the limitations associated with sampling and defining representative parameters for soils are also discussed. Face-to-face feedback closes the learning loop by clearing up misconceptions, identifying areas for further study and helping students self-regulate their learning needs.

The face-to-face feedback sessions have been particularly useful in reinforcing learning on topics that students tend to find more complex, particularly the two phase nature of saturated soils and the concepts of critical state soil mechanics, including the requirement for and linkages between the three state variables of shear stress, normal effective stress and specific , v (defined as the actual volume occupied by a unit volume of soil solids, $v = 1 + e$, where e is void ratio). In this course, when dealing with one-dimensional compression and consolidation of soils, the response of a soil is expressed as a function of the specific volume of the soil (rather than the void ratio, as often seen in the literature). This links one-dimensional compression to topics on soil strength and soil behaviour, namely isotropic consolidation in a triaxial cell and critical states, all also addressed in the face-to-face feedback sessions.

For the oedometer test report, students use the test results and the quantities derived from the data to estimate settlement and heave for real problems at field scale. Those values and the methodologies used to estimate them are critically discussed during the face-to-face feedback sessions.

In the triaxial test report, students use data from their tests to derive and interpret critical state parameters for the soil. During the face-to-face feedback session, students are guided to link the responses of the specimens tested to the failure mechanisms observed. While some students are able to link the theory to the test results and apply the concepts adequately, others struggle with those tasks and processes. The face-to-face feedback sessions help to clarify the theory and how it relates to the actual data collected. In addition, the dialogue helps to identify areas for further study and some misconceptions. When students act on that feedback they expand their knowledge of the topics and deep learning is promoted. All these processes have helped to promote deep understanding of topics such as critical state soil mechanics, and enabled students to tackle exercises that to some educators seem complex for such a course and level of study.

The face-to-face feedback sessions allowed identification of gaps in knowledge, misconceptions and areas for improvement. The instructors were able to emphasise the importance of exposing students to real data obtained from laboratory tests, rather than the idealised responses often presented in lectures, textbooks and exercises. Although idealised responses are helpful to introduce topics and concepts, students need to be exposed to real data to understand the variability and actual response of real soils.

In the face-to-face feedback sessions on the oedometer test, it became clear that some students had difficulties in scaling laboratory test results up to a field problem, using equations without understanding how to apply them differently in the two situations. The instructors had to point out those differences and explain how the consolidation settlement and the time for 90% of the consolidation to occur are scaled up from the laboratory data to field problems, even though this had been addressed specifically in lectures. Some students also had difficulties in interpreting the initial response of a soil sample during reinstatement of the *in situ* stress state, and the concept of pre-consolidation pressure.

The discussion of the triaxial test report helped clear up several misconceptions. For example, in plotting and determining the Mohr-Coulomb failure envelope for peak strengths, some students had defined an effective cohesion intercept. The lack of physical meaning of this parameter and the curved failure envelope for peak strengths at low stresses were discussed. Conventional plots of shear stress and volumetric strain against axial or shear strain were compared and linked to the state paths on graphs of deviator stress, q, against mean principal effective stress, p′ (the three-dimensional stress invariants), and specific volume, v, against the natural logarithm of p′. The transitory nature of the peak shear strength, its inherent link to dilation and the contrast in both respects with the critical state strength were discussed. For some students, such discussions brought on a lightbulb moment, when concepts suddenly linked and made sense.

4.5 Face-to-face feedback and other feedback modes

The face-to-face feedback sessions have advantages and disadvantages from both the instructors' and the students' perspectives.

For the students, the feedback is quick and timely (on the day of submission) and personalised; the dialogue promotes interaction with the instructors, includes advice for action and promotes opportunities for reflection. As the feedback sessions are timetabled, students are gently compelled to engage with the feedback process. Initially, some students felt that their work was not given sufficient time and attention, while others felt under pressure during the session. Both concerns were successfully addressed through minor changes and explaining the process and expectations to students in advance.

Instructors can mark all reports quickly and the one-to-two contact with the students can be very rewarding, particularly if students truly engage with the learning process. The instructor can use questions to promote critical thinking and development of engineering judgement. In addition, the face-to-face feedback sessions allow students not engaging with the course to be identified and prompted to do better and, when necessary, to seek additional support within the university. Nonetheless, the instructors need to be available for a significant number of hours for the feedback sessions. Some of the comments made and questions answered during the feedback sessions are common to many students, hence some of the feedback is repetitive. However, that is a small price to pay for giving the feedback individually.

The face-to-face feedback sessions are synchronous, interactive and a true dialogue between students and instructor. Communication is two-way and includes verbal and non-verbal communication (gestures, facial expression, body language, tone, etc.). During the sessions, the instructor can adjust the comments and the questions to the students present and their reaction to the conversation. Most students feel valued and supported, both as a person and as a learner. The most common feedback mode in higher education is a set of written comments on the coursework. Such comments take time to produce are often not used by the students. Other modes, such as video and audio feedback, are non-synchronous and provide a one-way communication with the student in most cases a passive receiver.

5 Conclusions

In this paper the implementation of one-to-two feedback sessions in a soil mechanics course has been described and analysed. The opinions and perceptions of students have been presented and the main advantages and disadvantages of this feedback practice discussed, particularly when compared with impersonal, technology-based feedback approaches.

Based on their experience, the authors recommend face-to-face small group feedback in preference to remote technology-based feedback. Such feedback sessions are effective conversations, where students and instructors engage in a productive dialogue. Students feel valued and appreciated, and that they are in fact learning.

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