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Efficiency gains arising from the use of electronic-marking tools that allow tutors to select comments from a statement bank are well documented, but how students use this type of feedback for learning remains under-explored. In this study, Natural Science students (*N*=161) were emailed feedback reports on a spreadsheet assessment that included an invitation to reply placed at different positions. Outcomes suggest that students either read feedback completely, or not at all. Although mean marks for repliers (*M*=75.5%, *N*=39) and non-repliers (*M*=57.2%, *N*=68) were significantly different (p<.01), these two groups of students possessed equivalent attendance records and similar submission rates and performances in a contemporaneous formatively-assessed laboratory report. Notably, average marks for a follow-up summative laboratory report, using the same assessment criteria as the formative task, were 10% higher for students who replied to the original invite within feedback on the spreadsheet assessment. It is concluded that the repliers represent a group of assessment-literate students and that statement-bank feedback can foster learning under appropriate conditions: A simple 'fire' analogy for feedback is advanced that advocates high quality information on progress (fuel) and a curricular atmosphere conducive to learning (oxygen). However, only if students are assessment literate (ignition) will feedback illuminate.

Keywords: assessment, feedback, technology, self-regulation

Introduction

Feedback can be one of the most powerful influences on student learning and attainment (Black & Wiliam, 1998; Hattie & Timperley, 2007). However, it remains a troublesome issue in higher education (Nicol, Thomson & Breslin, 2014) and students' limited use and appreciation of feedback has been reported previously (Brown & Glover, 2006; MacLellan, 2001). Technology-enhanced approaches have been investigated and both tutors (Heinrich, Milne, & Moore, 2009; Buckley & Cowap, 2013) and students (Watkins et al, 2014; Denton et al, 2008) have reported positive experiences through the deployment of electronic marking assistants that can return feedback online. A common feature of these tools is a statement bank of frequently-used remarks that can be allocated to students by the assessor. This approach can provide timely, constructive and accessible information to students that can help to clarify mark schemes (Denton et al, 2008). The use of a statement bank negates the need for the same comment to be written out repeatedly (Buckley & Cowap, 2013), facilitating the ready return of comments with a level of detail that cannot readily be matched by oral or hand-written remarks. They also foster consistency and fairness in respect of the quality and quantity of feedback to students. These attributes present an attractive proposition in a higher education landscape of increasing student numbers and diminishing resources.

The need for statement-bank comments to be grounded in educational principles has been acknowledged (Nicol & Milligan, 2006) but it is arguable that the educational effectiveness of using this approach to synthesising feedback remains under-explored. While principles of good feedback practice (Nicol & Macfarlane-Dick, 2006) recognise the value of tutor and peer dialogues around feedback, for example, these are difficult to realise when students receive online feedback on their own at a home computer (Denton & Rowe, 2015). Moreover, constructive personal developments prompted by tutor comments and allied with learning, such as self-assessment and the enhancement of self-esteem, will be attenuated if students perceive statement-bank feedback to be generic and lacking individuality. A study by Huxham (2007), for example, has found that students prefer personal over generic feedback.

A recent study found little evidence for learning from statement-bank feedback, even when marks were initially hidden and students were invited to predict their performance, however, the appropriateness of the research instrument was questioned (Denton & Rowe, 2015). Boud (2000) has suggested that learning from assessment may be demonstrated by providing opportunities for students to use feedback on preparatory work to improve their performance in subsequent summative tasks with related assessment criteria. Such opportunities help students to close the gap between current and desired understanding by clarifying misconceptions and identifying deficiencies in their use of feedback (Sadler 1989). To determine the scale of associated learning gain, it is instructive to compare students’ performances in formative and follow-up summative assessments, evaluations of this type being reported (Dantas & Kemm, 2008; Seluakumaran et al, 2011; Siweya & Letsoalo, 2014). Studies in which assessment criteria are consistent throughout are relatively rare, however, and seemingly non-existent in respect of those where statement banks have been used to prepare feedback on essay-type work. Thus, while Dobson (2008) has studied the performances of Exercise Physiology students in linked formative and summative tasks, the assessment format was multiple-choice questions. Even when studies appear to suggest that learning from assessment occurred, it is not clear whether changes in assessment performance were a result of students' use of feedback, or a simple practice effect in formative tasks, and this area remains poorly understood (Zimbardi et al, 2016). It has been argued that academics can drive changes in feedback provision by shifting their focus away from how feedback is provided, towards understanding how students use feedback to improve their performance (Boud & Molloy, 2013). A line from a popular song (Morse, 1953) summarises this contemporary message to tutors, "T'ain't what you do, it's the way that you do it."

The human factors around students' use of feedback include those associated with transitions from high school into university (Gale & Parker, 2014), with challenges resulting from changes in assessment standards, systems and methods. The relationship between an undergraduate's perceived effort on a piece of work and the mark that they subsequently obtain, for example, is not as closely correlated within HE when compared to primary and secondary settings. It is argued that students must appreciate this for effective learning to take place, along with a range of other distinctions between high school and university education. The concept of 'assessment literacy' has emerged to encompass the suite of knowledge, skills and attributes that students require to understand both the purpose and systems of assessment within HE (Smith et al, 2013).

Price et al (2012) have adopted a pragmatic and scholarly approach to identify six competencies that contribute to assessment literacy. These range from simple attributes, such as understanding the terminologies used around assessment, to higher-level skills including self-assessment. The former may be inculcated in the same manner as subject-specific knowledge, whereas the latter set of skills is more conceptually challenging and is reliant on opportunities being provided in the curriculum, Boud (2000) and Nicol, Thomson and Breslin (2014) emphasising the importance of activities where the student acts as an assessor.

The aim of this study is to provide evidence of learning through the provision of statement-bank feedback to a large group of students and their reading of this information. In the manner suggested by Boud (2000), performances in a summative assessment will be compared with those in an accompanying preparatory exercise that uses the same assessment criteria. The investigation is mindful of the need to demonstrate that any recorded improvements in marks resulted from students engaging with returned feedback. Although the reading of comments by students has been the subject of previous studies (MacDonald, 1991; Sinclair & Cleland, 2007), this investigation uses a novel intervention to measure whether or not students inspected tutors' remarks. Accordingly, the outcomes of this study also provide further insights into how students use online feedback and how it impacts on students' performances across assessment tasks. There have been relatively few quantitative investigations of feedback use by large groups and it remains an area of contemporary interest (Zimbardi et al, 2016).

Methodology

This investigation involved Foundation Natural Science students (N = 161) within the Faculty of Science at Liverpool John Moores University. As a Foundation programme, these students are at level 3 within the Framework for Higher Education Qualifications (FHEQ). The research instruments used in the study included percentage measures of student attributes, most commonly student assessment performances. When pairs of data sets were compared to determine if differences where significant, the F test function of MS Excel was first used to determine whether variances were equivalent. The t test function of MS Excel was then used, assuming either equal or unequal variances based on the F test outcome.

MS Excel assessment

Over a period of eight weeks during the autumn semester, students had the opportunity to undertake a series of non-credit-bearing tasks during taught sessions on a skills module in order to prepare them for a summative MS Excel three-step calculation and graph assessment. Informal oral feedback was provided by the tutor during a series of IT workshops and students received brief emailed feedback on a calculation conducted in class. The credit-bearing task was worth 8% of students' overall level mark and was graded by a single tutor using the Electronic Feedback freeware (Denton, 2001). This program allows for statement-bank feedback to be synthesised and emailed to students, being used due to a dearth of commercially-available tools for the e-marking of files not produced by word processing software. Electronic Feedback's 'Automark' facility was activated so that students' marks (out of 60) were automatically calculated based on the comments selected from a statement bank. Feedback and % marks were returned via email in the form of reports consisting of around 700 words, comments being presented under subheadings relating to the four assessment criteria that had been published and discussed with the class in advance; (calculation) step 1, step 2, step 3, and graph. An example feedback report of this type has been published previously (Denton et al, 2008).

Emailed invite and revised data set

Before MS Excel assessment feedback reports were emailed to students by the assessor, students were divided into five test groups and one control group, average and median marks for each group being comparable. The five test groups all received the following invite within their feedback, "As part of an educational research project, could I please ask you to immediately reply to this email with a blank message. Please do not inform your fellow students that you have done this." This invite represents the principal research instrument used in this study and its position varied by group, being in the header region of feedback reports for group one: the first sentence of text after the student's mark. For the remaining test groups, the statement was inserted within the main body text of feedback reports, appearing at the end of each successive sub-headed paragraph and being the final words of text in feedback reports for students in group five. The control group contained students who received feedback that did not include the invite and this approach provided a means to detect students who emailed a reply to their feedback only after prompts from their peers. All test and control group students were given the opportunity to withdraw from the study when a participant debrief sheet was circulated ten days after feedback was returned. Ethical approval for the study was secured from the University on this basis.

Based on the analysis of the first data set, a revised data set was created by including only the 107 students from test groups receiving feedback where the invite to reply was incorporated within the main body of feedback text, groups two to five. Depending on whether participants replied or did not reply to the emailed invite, students were allocated into groups R and NR, respectively, and their % marks in the MS Excel assessment were recorded.

Chemistry Laboratory Report Assessment

Students submitted a credit-bearing laboratory report, undertaken as part of a chemistry module and their % marks in this exercise were collated. This report, worth 5% of each student's overall level mark, was handed in a few days before feedback on the MS Excel assessment was returned. The students' performances in a preparatory chemistry laboratory report were also recorded. This formative exercise was not credit-bearing and used the same assessment criteria as the subsequent summative laboratory report; introduction, method, results, calculation, conclusion and references. The intention was for students to enhance their laboratory report writing skills through reading formative feedback comments returned by email before the summative exercise was undertaken.

When marking both formative and summative laboratory reports, assessors once again selected comments from a statement bank and the Tweaktime e-marking software (Denton, 2012) was used. This program incorporates a toolbar that floats above the student's work, allowing feedback remarks from the statement bank to be chosen from drop-down menus. Selected comments then appear in balloons in the right-hand margin of students' work as if created using MS Word's in-built "New Comment" function. The program was configured to automatically calculate and present each student's mark in each of the six assessed criteria, based on the comments chosen. Laboratory report feedback prepared in this way was emailed to students and consisted of their electronically annotated work and a summary marks table. The formative and summative lab reports were both assessed by the three tutors, each grading over 40 scripts. During moderation, analysis of student performances across the three markers in both the formative and summative laboratory reports found that average marks were within 4% of each other. Second marking of a 10% sample of the summative laboratory reports resulted in no mark changes.

Level performance and attendance

Average level 3 marks for students in the revised data set were compiled, having been reported at an assessment board in the following June. Marks from modules that were deferred due to mitigating circumstances were ignored in this calculation of each student's overall mean level mark and whether or not they had completed the programme at this stage was also recorded. Data relating to attendance at lectures and workshops on the skills module were collected; during eight taught sessions throughout the first semester, students were invited to swipe their student cards against a portable reader and these data were converted into an attendance value expressed as a percentage.

Results and discussion

Responses to the emailed invite

Feedback on the MS Excel assignment was emailed to the level 3 Natural Science students ($N = 161$), the invite to reply being included for test group students, Table 1. No control group members replied and it is therefore reasonable to assume that replies from all participants in this study resulted from students acting on the written invite within their feedback, rather than peer prompting. No further analysis of the control group took place.

A dichotomous variable was used to further analyse email reply rates of the test groups, a value of 100 being accorded to students who replied to the email and a value of zero to those that did not. Ten F tests were used to establish that the variances in the email reply rates between each of the five test groups were equivalent, regardless of the pair compared. There is a clear consistency in the proportion of students replying to the email invite in test groups two to five. Six t-tests, assuming equal variances, established that there were no significant differences (p>.05) in reply rates between these four groups, irrespective of the pair chosen for comparison. Accordingly, groups two to five were combined into a single cohort representing all the test group students where the email reply request was inserted within the main body of feedback text, this accounting for more than 95% of the total feedback word count.

Table 1 Profile of the test and control groups used when returning online feedback on a summative Excel task to level 3 Natural Science students (*N* = 161).

	Test group						Control group
	1	2	3	4	5	2-5	
Number of students, *N*	27	27	26	27	27	107	27
% Mean mark, *M*	63	64	64	64	63	64	63
% Standard deviation in marks, *SD*	24	25	22	22	23	23	22
% Median mark	65	68	69	68	68	68	65
Number of emailed replies	17	10	10	10	9	39	0
% Mean email reply rate	63	37	38	37	33	36	0

The average email response rate of groups two to five was 36%, Table 1, and we conclude that this represents the minimum proportion of students in this study that definitely read their feedback, to some extent; some students will have seen the invite but then decided not to act on it for personal or technological reasons. However, it is reasonable to assume that once a participant read the invite within their feedback, their decision as to whether to respond was not influenced by the position of the invite within the feedback text. In contemporary email systems, for example, the reply button is visible and accessible regardless of how far one has scrolled through an email.

A *t* test was conducted and it was found that the mean reply rate among the cohort of students in groups two to five (*M* = 36%, *SD* = 38%, *N* = 107) was significantly lower (p=.012) than for the students in group one (*M* = 63%, *SD* = 49%, *N* = 27). This observation has a simple rationale; the response rate for group one includes some students who only replied because the email reply request was in the header region of their feedback. These students did not read the main body of their feedback and if the request had been in this region then they would not have seen it. We can therefore estimate that the minimum proportion of students who did not read their feedback is 27%, being the difference in the response rates of group one and groups two to five. This leaves 37% of students unaccounted for and these represent an undefined group; either they read the email invite and did not act upon it, or they did not read their feedback at all. Although no other study has used this method to determine students' interaction with feedback, these findings are not significantly misaligned with existing work. Sinclair and Cleland (2007) found, for example, that less than half of students collected feedback.

MS Excel assessment performances

Students in group one were excluded from further study and the remaining analysis concentrates on students in groups two to five (*N* = 107). These were divided into two groups, R and NR, depending on whether they replied or did not reply to the emailed invite, respectively. Analysis by *t* test found that group R attained significantly (p<.01) higher marks in the summative MS Excel task than group NR, Table 2, both groups exhibiting normal mark distributions, Figure 1. This same dichotomy in marks is apparent when each of the original four groups is analysed separately. Thus, while the mean marks of students in groups two to five who replied to the email ranged from 72 to 81%, those from students in the same groups who did not reply ranged from 53 to 60%.

Table 2 Profile of the level 3 Natural Science students (*N* = 107) in groups two to five who replied (R) and did not reply (NR) to the invite embedded within feedback on the summative Excel assessment.

	Group R			Group NR			*p* value	
Component	*M*	*SD*	*N*	*M*	*SD*	*N*	*F* test	*t* test[a]
% Summative Excel task mark	76	18	39	57	22	68	.081	<.01
% Attendance in skills module	88	17	39	82	19	67	.230	.150
% Attempted Formative lab report[b]	87	34	39	75	44	68	.047	.111
% Formative lab. report mark	60	16	34	54	15	51	.335	.120
% Summative lab. report mark	68	11	39	58	14	64	.060	<.01
% Level 3 overall mark	66	12	39	56	16	57	.041	<.01
% Completed level 3 (June 2015)[b]	90	31	39	68	47	68	.425	.010

[a]Assuming equal or unequal variances, depending on the significance of the *F* test. [b]Analysed using a dichotomous variable that could take the value zero or 100 for each student.

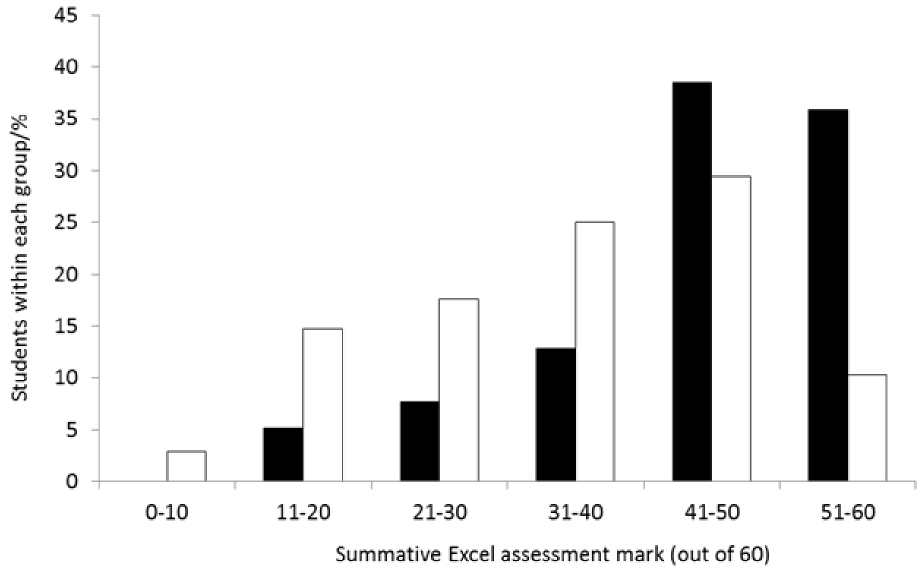

Figure 1 Distribution of summative MS Excel assessment marks for Level 3 Natural Science (*N* = 107) students in groups R (■) and NR (□).

Although there was an apparent distinction in the marks obtained for the summative MS Excel task between Groups R and NR, no significant (*p*=.150) difference was found in these students' attendances on the module that incorporated this assessment, Table 2. Both groups exhibited average attendances above 80% and, although group NR recorded a slightly lower mean attendance overall, in two out of the eight sessions their recorded attendance on the skills module was higher than group R.

Chemistry laboratory report performances

Performances of the same students on a contemporaneous chemistry module were also considered. All students were invited to prepare for a credit-bearing laboratory report by submitting a formative assessment that was graded against the same criteria as the subsequent summative task. Although 12% more R group students took up this opportunity compared to group NR, this was not found to be a significant (*p*=.111) difference, Table 2. Moreover, the marks that groups R and NR attained in this preparatory exercise were not significantly (*p*=.120) distinct. However, students' performances in the summative laboratory report that followed on from the formative task show that the marks attained by group R were significantly (*p*<.01) higher than those for group NR, being an average 10% greater, Table 2.

The disparity in formative and summative performances between the two groups is evident when assessment marks are plotted on a scatter graph, Figure 2. It is apparent that both groups R and NR exhibit a range of performances in these two assessments, marks for the formative assessment ranging over almost 70%. Correlated assessment data for the two sets of groups exhibit significant linear trends (*p*<.05) and the majority of students improved their performances from the formative exercise to the summative assessment. These gains were particularly evident for students who originally scored poorly in the formative exercise, but R group students consistently out-improved their NR group equivalents when aggregated data are correlated. The enduring nature of this enhancement is reflected in overall average marks for the entire academic year, these being significantly (p<.01) higher than group NR by an average of 10%, Table 2. Accordingly, group R students were also more likely to complete the year by the first assessment board in June, Table 2.

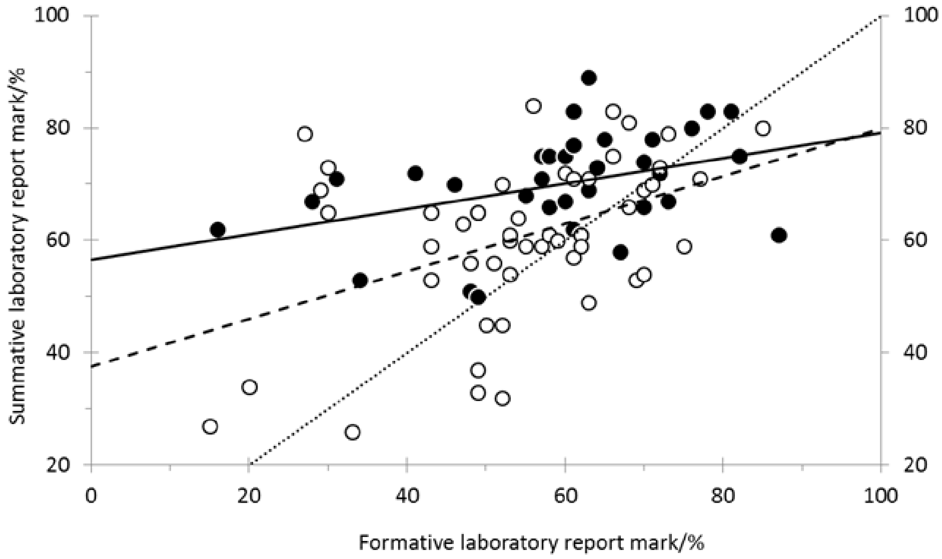

Figure 2 Comparison of level 3 Natural Science student (N = 84) performances in two linked assessments on a chemistry module for group R (●) and group NR (○), with respective lines of best fit (—) and (- -). For comparison, y = x (···) is shown.

It is noteworthy that 23 students performed worse in the summative assessment than the formative task, despite both having the same assessment criteria. Previous studies suggest this behaviour is not unusual (Dobson, 2008; Siweya & Letsoalo, 2014). It may arise because students found the summative laboratory report more conceptually challenging or because it was set later in the semester where deadlines tend to cluster, students then having less time available to devote to individual assessments. Those students who fared well in the formative laboratory report but did not go on to fully realise the expected educational gains in the summative task may of the type identified by Lipnevich & Smith (2009) and Vardi (2009); those who do not read their feedback because they are satisfied with the grade awarded. At the lower-end of the formative task achievement scale, students who submitted insubstantial reports as a token effort in order to receive some feedback would then have an enhanced capacity to improve, further influencing the correlations shown in Figure 2.

Conclusions

The observation that students who replied to the email request generally performed better in the MS Excel assessment has three possible explanations. It might be that high-achieving students were more likely to read their feedback because their marks were outside of expectation (Duncan, 2007). In a straw poll conducted before this summative task, students average mark predictions were more than 20% below the actual mean. This either indicates that students genuinely expected the task to be challenging, or it might instead represent a form of defensive posturing being employed by students to preserve self-esteem. It could be that the same proportions of low- and high-achieving students read the email invite, but that the latter were more inclined to act upon it and reply. Perhaps the former group did not wish to draw further attention to their low attainment by replying to the assessor out of misplaced embarrassment, the emotional investment that students make in their assessed work being well known (Higgins, Hartley & Skelton, 2001).

These explanations are redolent of a group of students whose responses to feedback depend only on the marks they attain on an assessment-by-assessment basis and who do not recognise the intrinsic connection between assessment and learning. A more attractive explanation is that the dichotomy in MS Excel assessment marks between repliers and non-repliers reflects improved attainment by students who habitually read their feedback and learn from assessment. It is suggested, therefore, that group R represent a cohort of assessment-literate students and this supposition is supported by the other outcomes of these investigations.

Given their significantly similar % attendances on the skills module, students in both groups R and NR had comparable in-class opportunities to help them prepare for the summative MS Excel assignment. However, the higher marks attained by group R in this task indicate that they made better use of these interactions and were able to select and appropriately apply the techniques that they had encountered during preparatory work. This is acknowledged as a key trait of assessment literate students (Price et al, 2012). Such students would also be expected to read returned feedback from beginning to end. Accordingly, there was no evidence to indicate a tail-off in email responses as the insertion point of the request for a reply was moved progressively further down the feedback, Table 1. This outcome provides novel quantitative evidence of an 'all-or-nothing' approach by students to reading information from tutors.

While it might be argued that group R simply reflect a group of academically-able students, it is noteworthy that these students' marks for the formative laboratory report were not significantly higher than those students in group NR. Beyond the published assessment criteria, no in-class guidance was provided as to how to write up laboratory work and this suggests that the intrinsic, scientific report-writing abilities of these two groups are not substantially dissimilar.

Assessment-literate students would be expected to be able to reprocess tutor comments from the preparatory laboratory report in order to realise their full potential in a linked summative exercise. This was observed to be the case and, alongside these self-assessment skills, it is implicit in these findings that group R students recognised the purpose of the formative assessment. Both groups exhibited comparable submission rates, although it is possible that the assessment literacy of some group NR students was so low that they did not recognise that the preparatory assessment was not credit bearing and was effectively optional. As this assessment were set relatively early in their academic careers, and anecdotal evidence suggests regular confusion between formative and summative tasks among the Foundation year group, this is a plausible assertion. Notwithstanding this, the outcomes of this study suggest that Group R students had a greater appreciation of the importance of reading through returned remarks.

Overall, the outcomes of this investigation satisfy the principal aim and it is concluded that feedback generated from statement banks can provide information that assessment-literate students can learn from. If this is to occur, then opportunities must be provided within the curriculum for students to use information from tutors in additional learning activities, further nurturing assessment literacy. Nicol, Thomson and Breslin (2014) have noted how HE staff have concentrated their efforts in enhancing the intrinsic quality of feedback information and there is a sense perhaps that the academy is out of kilter with contemporary pedagogic research in respect of feedback. This can be addressed by sharing models for learning from assessment and Yang and Carless's (2013) feedback triangle recognising the roles of feedback content (cognitive dimension), interpersonal negotiation (social-affective dimension) and the organisation of feedback provision (structural dimension). This model is restricted to dialogic feedback processes and an alternative treatment with a broader scope may be more accessible to the academy. Yeats famously remarked that, "education is not the filling of a pail, but the lighting of a fire". Accordingly, we advocate the popularisation of a 'fire' analogy for feedback that recognises that learning from assessment can be fostered through high quality information (fuel) and a curricular atmosphere that provides opportunities for students to use this information in future learning activities (oxygen). However, students must be assessment literate (ignition) if feedback is to illuminate.

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