

The Association of Formative Feedback with Engagement and Student Performance

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Abstract—Formative feedback is important to student experience and learning outcomes. However, little is known about how students engage with formative feedback and the specific impact it can have on assessment outcomes. The purpose of this study was to examine the impact of optional formative assessment feedback on learners' performance and behaviour. In total 135 Postgraduate students participated in this study. Students' profiles were created by an enrolment questionnaire covering the "Big 5" personality dimensions, the Situational Motivation Scale and demographic and background data. Learners' engagement with the LMS (Blackboard) was monitored using built-in reporting tools for activity in the main content areas over the module's ten weeks of teaching. Marks from both formative and summative assessments were used to gauge their relationship to engagement and performance. Results indicate that seeking formative feedback is associated with significantly higher course engagement. In terms of feedback uptake behaviour, there is a partial relationship between time spent on feedback content and mark improvement, but feedback visits across course weeks seems to be a better indication. Few student characteristics correlate with feedback-seeking, though we reinforce our earlier finding that conscientiousness is negatively associated, reflecting an over-confidence in expected performance in those who decline feedback opportunities.

Keywords—Higher Education, Feedback, formative assessment, Self Regulation, Learning Analytics

I. INTRODUCTION

Student engagement with feedback is important for effective learning and supports students to regulate their learning and reflect on the learning process to achieve the desired learning outcomes [1]. The uptake, processing and reuse of feedback have a significant impact on its effectiveness. [2]. Yet, little is known about how students engage with feedback once it is received and how it supports students self-regulated learning process that involves reflection on feedback, monitoring of progress and the planning of next steps [3]. Research mainly focuses on the provision of feedback and whether students opt into it [4], and only a few studies examine feedback access in terms of frequency and duration and how this relates to engagement, self-regulated learning and performance [5]. In addition, most of the research based on empirical studies is limited in sample sizes and concentrates mainly on task and content engagement [6] [7], rather than considering feedback access metrics to enable us to infer whether students engage with

feedback provided and integrate it into their learning. The aim of this study is therefore to examine feedback access behaviour across students and the associations of feedback seeking with overall engagement and improvements in performance. In particular, this study answers the following research questions:

1. Is engagement in terms of logins, time spent, and learning activities viewed different between students who seek feedback and those who do not?
2. What student characteristics are associated with seeking feedback and frequency of feedback?
3. For how long and how often do students who receive feedback access the feedback and does this vary across student performance?

Research question one and two dovetail with our previous study [8] but attempt to build upon it and to address its limitations related to the small sample size and provide exploration of these questions. By analyzing feedback usage and uptake the study is expected to contribute to a better understanding of formative assessment and feedback practices.

II. RELATED RESEARCH

Formative assessment is used to evaluate student learning throughout a course and enables students to improve their understanding, motivation and performance [9]. Feedback offered to students throughout the learning process is considered the most powerful intervention to optimize student learning and performance and is of key importance for student self-regulated learning [10]. Both formative assessment and feedback practices are used to guide student learning by helping them to monitor and evaluate their progress and adjust their approaches accordingly [11].

Feedback is considered as a catalyst for student learning in Zimmerman's self-regulated learning (SRL) framework, however for effective SRL, students need to access, use and reflect on the feedback [12]. Likewise, research advocates for a proactive student approach to enhance autonomy and develop lifelong learning skills [13]. Our initial research on engagement with optional formative feedback indicated a higher student engagement in the assessment area of Blackboard for students who seek feedback, although there was no significant difference in the final performance

between students who sought feedback and those who did not [8]. The study had a smaller sample size than the present paper and did not capture the time and frequency with which students accessed the feedback and whether they revisited it, leaving unexplored the behaviour of interacting with the feedback itself.

Given that feedback access behaviour is limited at trace level [15], there is a need for more granular analysis. Student engagement in the LMS in terms of time spent are predictors of academic performance and disengagement can be an indicator of poor academic performance [16]. Furthermore, educational data extracted from LMS can provide significant insights to mitigate undesirable student outcomes considering the demographic attributes of students [17]

To our knowledge there has been limited work on the provision of formative feedback and its usage to understand improvement in student marks and course engagement. Thus, by employing learning analytic techniques to understand feedback practices the study aims to address these gaps. Our previous study highlights the value of LMS interaction logs to understand the impact of optional formative feedback, but it falls short in capturing feedback access and duration. This study builds on our previous work by considering feedback access and duration, and by linking these behaviour metrics with student characteristics, LMS engagement and performance outcomes in a larger cohort.

III. RESEARCH PROCESS

A mixed-methods approach was employed involving psychometric survey data alongside learning interaction data from Blackboard to explore engagement patterns and student feedback access behaviour. The approach was designed to replicate and extend our previous study by incorporating additional metrics capturing feedback duration, access and frequency as well as feedback uptake behaviour to provide a more granular view of feedback use after it is made available to the student.

A. Research methods

As feedback engagement requires objective behavioural traces in addition to motivation and student views, the mixed method approach was selected. The study was conducted in a Digital Design and Development Computer Science postgraduate module in a UK University. The module delivered over ten weeks for two consecutive years. The assessment was designed to support iterative learning through portfolio-based coursework comprising four interrelated tasks that correspond to four design processes: empathize, define, ideate and prototype, each contributing 25% of the overall portfolio mark. Students had the option to submit drafts of their portfolio tasks for feedback. The design enabled tracking of feedback seeking behaviour from the submission of tasks and the feedback use behaviour from the engagement with returned feedback. Feedback was provided in the journal area of Blackboard in written comments and marks were available in the grade center area. Students could submit their work for feedback only once and could act upon the feedback received and improve their work before resubmitting the final version at the end of the module.

TABLE 1. TASKS' SCHEDULE AND DESCRIPTION.

Portfolio Tasks	Release Time	Description	Deadline	Feedback
Task 1 (Empathise) 25%	week 1	Create a mood board containing representative images, colours, fonts and reference design using Figma	week 2	week 3
Task 2 (Define) 25%	week 3	User Experience (UX) mapping, persona and an associated scenario represented as a design map and description of this process	week 4	week 5
Task 3 (Ideate) 25%	week 5	Capture the user interface as a wireframe and provide an Information Architecture analysis with blueprint diagram	week 6	week 7
Task 4 (Prototype) 25%	week 7	Construct an iterative functional prototype using HTML and CSS with scenario walkthrough	week 8	week 9

We followed a student-led engagement approach where the decision to engage with formative feedback was voluntary. Task design and feedback opportunities are summarized in Table 1 adapted from [8].

B. Data collection

In total 135 students enrolled in the study. The sample was diverse in terms of age, gender and educational experience reflecting the international composition of the MSc IT programme (Table 2). Participation was voluntary and ethical approval obtained from the university's research ethic committee. Student identifiers were removed before the analysis and data was only used for this research purpose.

Data was collected from the LMS, from survey responses and marks data. LMS data was extracted from Blackboard and included total feedback access time and duration. Overall engagement indicators included: total logins, number of items accessed, content area visited and time spent in content area weekly. The student ID was used to aggregate data and model engagement dynamics and compare behavioural patterns between students who sought feedback and those who did not. Marks data consisted of the formative marks submissions and the summative marks of the final portfolio submission. Increase in marks was calculated as the difference between summative and formative marks. This metric was used as an indicator of feedback uptake effectiveness to understand if students applied feedback to improve their marks. We grouped students into two groups a) Feedback Seekers: those who submit one or more drafts of their tasks for feedback and b) Non-feedback Seekers: those who do not submit any of their portfolio tasks for feedback and do not access the returned feedback.

C. Process

Students completed an enrolment and a retrospective survey to obtain demographic and psychological variables that might be associated with feedback engagement. The enrolment survey included demographic surveys of age,

gender, nationality, previous degree and previous experience with formative feedback. The retrospective survey was used to capture reflections on learning, self-reported engagement and use and satisfaction with feedback. Students were informed about the research purpose, feedback opportunities and were encouraged to submit each of their portfolio tasks for feedback only once.

Once formative tasks were submitted, instructors provided marks and written feedback after one week. Statistics on accesses of feedback and time spent were generated weekly from blackboard for a subset of students (N=91) and transferred in excel. Data allowed for computation of total feedback and number of accesses per student. After receiving feedback, students had the opportunity to use the feedback and improve their marks in the final summative tasks. Formative and summative submissions were graded based on the same marking criteria and rubrics.

D. Data analysis

To answer research question 1, whether there is a difference in engagement between students who seek feedback and those who do not, the total logins, time spent activities accesses and marks variables were used to compare the LMS engagement metrics of the two feedback groups. To answer research question 2, regression analysis was performed to identify which student personality and motivation traits were associated with feedback seeking behaviour. To answer research question 3 on how often and for how long students who receive feedback access it, we used correlation analysis to examine associations between feedback access, duration and revisit frequency with performance improvement in terms of formative to summative marks.

IV. RESULTS

Participant information is shown in Table 2. 38% of participants were female, which was considered quite a good proportion for a computing module. Most participants were aged between 21 and 40.

The mean overall mark for the Feedback Seekers was 65.2, compared to 58.8 for the non-Seekers. This was significantly different on a student's t-test (one-tailed $t = 4.8475$, $df=105$, $p<0.01$). Feedback Seekers increased their grades by 9-13% on average across the four portfolio tasks.

Formative feedback engagement was not uniform – more students requested feedback on the first two tasks compared to the second two, perhaps due to competition with other assessments later in the module (Table 3).

55 did not seek any feedback, with the remaining 75 seeking feedback on 1-4 occasions (Table 4)

Feedback Seekers spent more time overall on the LMS, viewed more items and logged in on more occasions. All of

these behaviours were significantly different from those of Non-Seekers (Figures 1-3, Table 5).

TABLE 2. PARTICIPANT DETAILS

Characteristic	Class	Number (%)
Gender	Male	83 (61%)
	Female	52 (38%)
	Other	1 (1%)
Age Group	21-30	76 (56%)
	31-40	53 (39%)
	41-50	6 (4%)

TABLE 3. NUMBER OF STUDENTS RECEIVING FORMATIVE FEEDBACK BY TASK (1-4)

Feedback?	1	2	3	4
Yes	67	65	47	33
No	68	70	88	102

TABLE 4. NO. OF FEEDBACK OPPORTUNITIES TAKEN UP PER STUDENT

Number of Formative Feedback Received	Count of Students
0	55
1	14
2	21
3	24
4	21

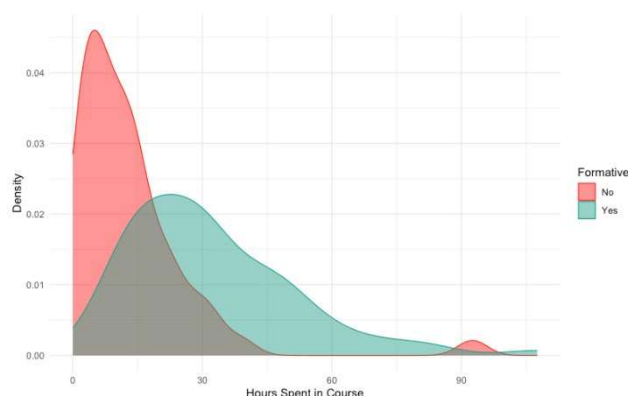


Figure 1. Total Hours in Course by Formative Seeking

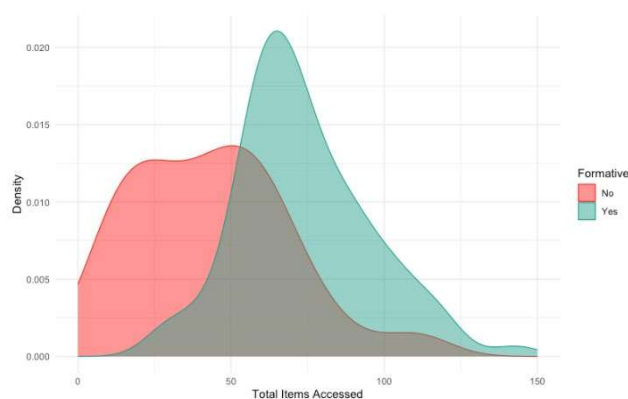


Figure 2. Total Items Accessed by Formative Seeking

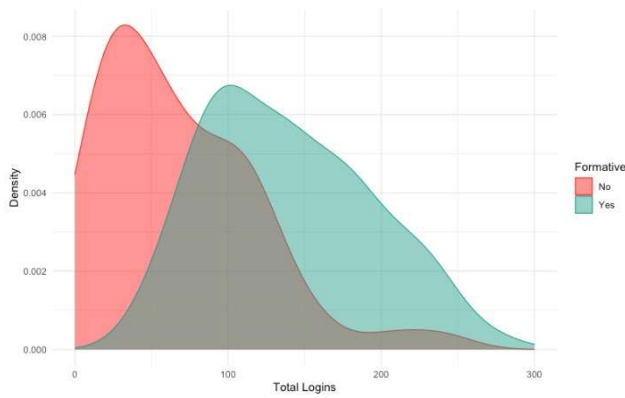


Figure 3: Total Logins by Formative Seeking

TABLE 5. SIGNIFICANCE TESTS FOR COURSE METRICS (UNMATCHED WILCOXON TWO-TAILED, FORMATIVE T V F)

Metric	W Statistic	P
Total Course Time	693	<0.01**
Total Items Accessed	749	<0.01**
Total Logins	693	<0.01**

In terms of gender, personality and situation-motivational profile, no variables were positively associated with feedback seeking. The largest effect came from conscientiousness on the personality scale, negatively associated with feedback seeking. This agrees with the finding of our earlier work using a smaller sample [8] and indicates that there is something about students who answer positively to the questions from this scale, who then go on to neglect feedback opportunities.

TABLE 6. LOGISTIC REGRESSION COEFFICIENTS FOR ASSOCIATION WITH FORMATIVE FEEDBACK SEEKING

Variable	Coefficient	p
(Intercept)	4.60	0.07
gender	-0.07	0.88
Intrinsic	0.00	0.94
Identified Regulation	-0.03	0.74
External Regulation	-0.04	0.28
Amotivation	-0.02	0.51
Agreeableness	0.07	0.50
Extroversion	0.09	0.42
Openness	-0.08	0.48
Conscientiousness	-0.24	0.05*

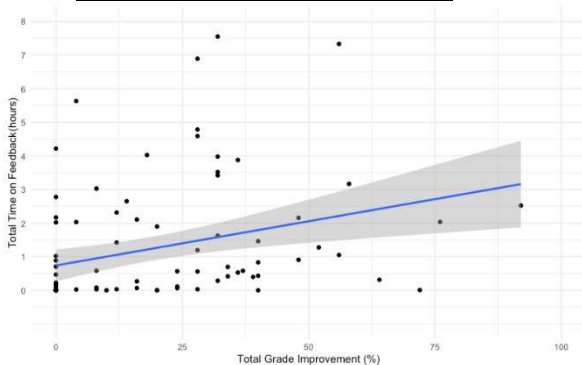


Figure 4. Relationship Between Time on Feedback and Grade Improvement (Sums of the Four Items), N=91

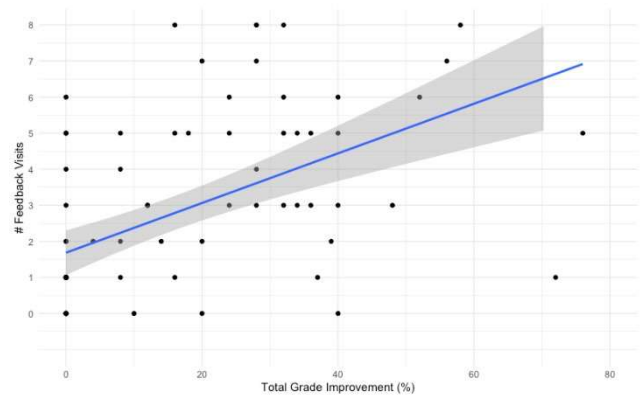


Figure 5. Cross-Week Feedback Visits and Grade Improvements, N=91

There was only a small, but statistically significant relationship between the time spent with the feedback text and the grade improvements between formative and summative (Figure 4; Pearson correlation was 0.34; $p = 0.01$; $df = 89$).

In contrast, the number of feedback visits seemed to be more strongly correlated with grade improvements (Figure 5; Pearson correlation 0.56; $p < 0.01$; $df = 89$).

V. DISCUSSION

In general, we see our findings as providing strong evidence of the benefits of seeking formative feedback during studies on a design-oriented module. This study also goes further in providing some insight into the different ways that students interact with feedback once received.

In terms of research question one, Feedback seekers showed significantly stronger behavioural engagement as evidenced by LMS time, item interactions and logins. Taken together, these signals reflect a deeper and longer lasting period of interaction with course materials, assessment and feedback. As discussed below, we are limited in being able to discern causal directions, but can hypothesise that formative feedback, if only partially, supports enhanced student engagement and performance.

Some possible support comes from our findings in relation to our second research question. Interestingly, our personality and motivational indicators show few strong linkages between self-reported motivational and character traits that link with feedback seeking. These instruments are either not accessing the underlying reasons for feedback-seeking, or those reasons are varied and do not correlate with any particular traits. The one factor that indicates toward Non-Feedback Seekers are those self-scoring highly on Conscientiousness. The two questions on this were: “I see myself as dependable, self-disciplined” and the inverse of “I see myself as disorganised, careless”. We believe that overconfidence on these answers is a reason why some students do not feel the need for external input that might improve their work [8].

In an important further part of the analysis, addressing research question three, we looked at two indicators of engagement with tutor-provided feedback text, and observed that repeated visits to feedback seems a better indicator of the ability to subsequently improve marks than overall time alone. A picture emerges of different behaviour around feedback: students who might refer to it in only one session (but perhaps still spending some time to go through it); and students who refer back to it more than once, perhaps while working directly on improvements.

VI. LIMITATIONS AND FURTHER WORK

Although we have combined LMS metrics to study and infer behaviour, there are still apparent limitations in these metric's ability to accurately capture attention and engagement. The time-on-content measures seems especially unreliable, not least as the way it is gathered is not well documented. We observed in our data some quite unrealistically long times for some students, that were perhaps sometimes showing the LMS item being open in a tab but not having the focus. One way to validate the metrics obtained might be to undertake observational studies for a subset of the students and compare actual desktop activity to the LMS data that is captured.

We also appreciate that it is challenging to posit a causal effect of formative feedback provision on improved performance. That is, adept students might have been able to improve marks on their own without feedback (the formative opportunity may come when submissions are only in draft format), but the same students also may have been more likely to seek feedback. While it is difficult and unethical to undertake a controlled design for this, it would be possible to use further pre- and post- aptitude and attitude tests which would support more robust causal modelling of this observational data.

VII. CONCLUSION

The study provides empirical evidence of an association between formative feedback seeking and higher student engagement suggesting that feedback is not only evaluative but also plays a crucial role in sustaining engagement. Moving beyond the usefulness of feedback, the study identifies that repeatedly revisiting tutor feedback is linked to improved marks—more so than simply spending more time viewing it once. The findings reveal distinct patterns of feedback use suggesting that students employ different learning strategies and levels of self-regulation around feedback. In addition, with regards to student characteristics and feedback seeking behaviour the study suggests that commonly used motivation and personality measures have limited predictive value except for high self-reported conscientious students who may be less likely to seek feedback due to overconfidence.

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