Formative feedback on writing skills for international EAL student engineers

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CONTEXT
The undergraduate engineering communication curriculum at the University of Adelaide is designed to develop effective oral and written communication skills, which are among the professional and personal attributes for engineering graduates specified by Engineers Australia (2016) in its Stage One Competencies. Developing student proficiency in "comprehending critically and fairly the viewpoints of others", and "expressing information effectively and succinctly [and] presenting arguments and justification … to technical and non-technical audiences" (Engineers Australia, 2016) is an objective of the engineering communication curriculum, designed and taught by our communication specialists to both local and international students. The curriculum is grounded in the theory of systemic functional linguistics, which facilitates teaching of the effective use of language appropriate to particular contexts (in our case, academic and professional engineering). Effective use of language is developed in stages with students receiving diagnostic, formative feedback on several writing tasks prior to presentation of a final evidence-based discussion paper. According to the literature, the effect of formative feedback on students' skills in writing tasks varies in different situations (Heylen and Vander Sloten, 2013) and furthermore, several variables affect the relationship between formative feedback and students' learning (Shute, 2008).

PURPOSE
The purpose of this study is to investigate the effect of different types of formative feedback on the writing skill development of undergraduate international student engineers for whom English is an additional language (EAL).

APPROACH
Evidence of students' writing skills was collected from an engineering communication course conducted specifically for undergraduate international EAL student engineers. Students' writing skills were compared in two stages (a paragraph and the complete paper), where diagnostic formative feedback was provided in relation to stage 1 prior to submission of the complete paper. Writing skill levels across the two stages were compared in relation to the nature of the formative feedback given.

RESULTS
The majority of students' writing skills improved between stages 1 and 2. Those who did not improve were generally able to apply feedback to stage 1 material reused in stage 2, but were unable to transfer the feedback to new stage 2 material. A range of types of formative feedback was employed by the marking team. Writing skill improvement was positively correlated with receiving a high proportion of both corrective- and challenging-orientated elaborative feedback, and with student application of feedback.

CONCLUSIONS
The study demonstrated the effectiveness of feedback given in this course for facilitating improvement in and transfer of writing skills. Ensuring a significant proportion of feedback is elaborative, with both a corrective and challenging orientation appears to be an appropriate strategy to assist transfer of skills.

KEYWORDS
engineering communication, writing skills, formative feedback.

Introduction

The undergraduate engineering communication curriculum at the University of Adelaide is designed to develop effective oral and written communication skills, which are among the professional and personal attributes for engineering graduates specified by Engineers Australia (2016) in its Stage One Competencies, and are important for career readiness. Developing student proficiency in "comprehending critically and fairly the viewpoints of others" and "expressing information effectively and succinctly [and] presenting arguments and justification … to technical and non-technical audiences" (Engineers Australia, 2016) is an objective of the engineering communication curriculum, designed and taught by our communication specialists in a number of courses to both international and local student engineers. One of these courses: Engineering Communication EAL, is the focus of this paper. Acknowledging the particular needs of international students, the course is designed specifically for speakers of English as an additional language (EAL), whose English language skills have been cited as a reason for relatively poor employment outcomes in Australia (Arkoudis et al., 2009; Australian Education International, cited in Zevallos, 2012, p. 47). Students undertake this course at the beginning of their undergraduate study, and the course is intended to develop their critical thinking and writing to a level equivalent to that of their local colleagues at the same stage of study. Students who pass the course are in a position to continue developing towards Stage One Competency.

The curriculum in Engineering Communication EAL is based on the notion that integral to the enactment of critical thinking and interpretive skills is the development of academic writing skills as a means to represent and construct knowledge (Bakhtin, 1986) appropriate to engineering. Writing skill development in this course is seen as achieving a genre-specific, purpose-appropriate, logical discussion in an engineering style. To this end, the curriculum is grounded in the theory of systemic functional linguistics (Halliday, 1999), which facilitates teaching of the effective use of language appropriate to particular contexts (in our case, academic and professional engineering).

The specific pedagogic approach is both incremental and exponential, and involves scaffolding in the form of sequenced learning activities, assessment sub-tasks and formative feedback in relation to various stages of the writing process. A focus on moving through levels of learning such as those articulated by Bloom (1956) and Anderson and Krathwohl (2001) (e.g. from the concrete to the abstract) encourages transfer of learning and is facilitated by scaffolded assignments (McCahan and Romkey, 2014, pp. 1181-1182). The scaffolding in our course is designed to work with students' "zones of proximal development" (ZPD) (Vygotsky, 1978) and prompt their advance from their current level of development to the level they can potentially reach under guidance. Vygotsky argued that teaching ahead of development activates functions "that are in a stage of maturation lying in the zone of proximal development" (Vygotsky, 1987, p. 212). Accordingly, the sequenced learning activities and assessment sub-tasks in this course are staged progressively and formative feedback is tailored to an individual student's level of development.

Critical analysis and interpretation of evidence by the students is enacted through engaging via reliable source material with a topic of engineering concern, e.g. an engineering disaster, and effectively communicating an evidence-based logical discussion. Students receive formative feedback on several oral and written tasks prior to presentation of a final evidence-based discussion paper. The topic remains unchanged throughout the semester. The first substantial written assignment is a single paragraph research discussion on one aspect of the topic, selected by the student. This paragraph may also be used in the student's final written assignment, which is a research discussion paper on several aspects of the topic. The single paragraph of research discussion and the final paper are analysed in this study as stage 1 and stage 2 papers. Other tasks and assignments that occur between stage 1 and stage 2 papers are not included in this analysis. The topic of the papers analysed was the 2005 BP Texas City explosion, and the aspects were the various causes of the disaster.

The feedback provided on the single paragraph research discussion (stage 1 paper) is contextualised and tailored. It is contextualised within a particular possible cause of the explosion found in the literature (extracts from the United States Chemical Safety and Hazard Investigations Board report and journal article extracts) and tailored to each student's line of reasoning in relation to the evidence. The primary focus of commentary is on the execution of evidence-based discussion and its structural, logical and linguistic constituents. Handwritten comments relate to specific constituents in the student paper and may involve diagrams and advice to review explanations previously given in the course materials. Written feedback on their stage 1 paper allows students to retain an artefact they can refer to later, which has the potential to facilitate transfer of learning (Butler, Godbole and Marsh, 2013, p. 294) to other aspects and sections of the longer stage 2 assessment task.

The feedback on the stage 1 material (a single cause of the disaster) may be applied in several ways in composition of a stage 2 paper. The feedback may be applied by:

(a) extending the stage 1 discussion paragraph, and/or

(b) transforming the stage 1 discussion paragraph.

Furthermore, an expectation of the stage 2 assignment is that inferences from the feedback on stage 1 material will be applied in the composition of new material in stage 2 (wherein the discussion encompasses several causes of the disaster).

The application of feedback requires new understanding as illustrated in Figure 1 below. An extension of discussion of the stage 1 cause (Cause 1 to Cause 1') involving limited changes corresponding to corrective feedback at a concrete level, requires relatively minor expansion in depth and breadth of understanding of the evidence, whereas transformation of discussion of the stage 1 cause (Cause 1 to Cause 1'') requires an increased level of abstract thinking for a deeper and broader understanding of the evidence. The composition of new material in stage 2 (Causes 2 and 3), involving inference from the feedback on stage 1 material, requires relatively high levels of abstract thinking and understanding of the evidence in relation to the topic.

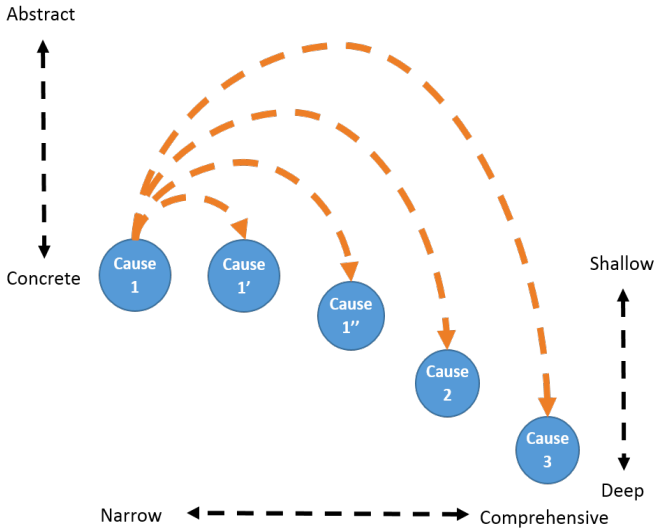

Figure 1. The nature of applying feedback to existing and new causes and its interaction with the depth and breadth of topic coverage

The nature of the feedback in our course complies with the research findings reviewed by Shute (2008) in terms of recommended ways to give feedback and practices to avoid. Findings reviewed by Shute (2008, p. 158) about how formative feedback may influence student learning indicate that generally, providing specific and clear feedback is good practice, although the learning outcomes may depend on learners' ability and motivation, as well as the type of outcome, e.g. retention or transfer tasks. Transfer of learning appears to

correlate with the nature of feedback. Explanatory feedback was found to be superior to corrective feedback alone for promoting transfer of learning by Butler et al. (2013), who concluded that explanation may enable learners to better comprehend concepts, thus facilitating the application of that knowledge to new contexts. Also, the effect of formative feedback on students' skills in writing tasks varies in different contexts (Heylen and Vander Sloten, 2013) and culture as a variable has been found to possibly affect feedback uptake (Warner and Miller, 2014).

However, little was known about how our students make sense of the feedback we provide on their stage 1 papers, and how their learning is influenced by the feedback. A systematic description of the nature of the stage 1 feedback, and a contextual account of the student use of the feedback evidenced by their stage 2 papers, could shed light on the effectiveness of feedback in this course. This study analyses the nature of feedback offered to stage 1 papers, and examines apparent uptake of feedback in stage 2 papers.

Approach

In order to minimise the variables to be considered, stage 1 and stage 2 papers written by one language group in one semester of the undergraduate Engineering Communication EAL course were collected for analysis. Since students from the People's Republic of China were the largest group, papers written by these students were selected for analysis.

Both stage 1 and stage 2 papers assess a range of skills required to produce a paper presenting an evidence-based argument. In order to focus on the skills relating to structural, logical and linguistic aspects of writing, comments and marks in relation to the 'discussion' section of the papers were separated for analysis from the marks for sentence level grammar, register and referencing. The discussion section marks are awarded on a number of criteria, including "presents a relevant and logically structured discussion", "all assertions and arguments are based on the source material" and "source material is well integrated". These criteria involve assessment of grammar choices that are critical to logic and argumentation, and are reflective of the "indicators of attainment" noted above for the Stage One communication competency. An independent systemic functional linguistic analysis of the stage 1 papers used in this study found that the stage 1 discussion marks were a valid indication of the level of student writing skills (Girn Baldev Singh, 2015).

Students' writing skills, as evidenced by the discussion section marks, were compared across the two stages. The discussion section marks were also compared with the mark given in stage 2 for application of feedback. This stage 2 feedback application mark (worth a maximum of 10% of the total mark possible) is awarded for applying feedback on all criteria, not just those associated with the discussion section. Feedback on individual papers was categorised quantitatively (marks awarded) and qualitatively. We categorised the feedback as 'rich', 'moderately-rich' and 'sparse', based on the amount of feedback given. We noted whether the feedback was clear, in manageable chunks, and specific according to the "Formative feedback guidelines to enhance learning" presented in Shute's (2008) review of formative feedback. We deemed feedback expressed by markers in terms of our assessment criteria for the stage 1 task to be specific. We also categorised the feedback as "corrective", "elaborative" and "challenging" (Shute, 2008). "Corrective" feedback describes comments that suggest alternatives, while "elaborative" feedback describes comments explaining why and how the weaknesses identified in the paper are problematic, or why and how the student needs to think more, e.g. re-organise aspects of the topic and make connections between issues. "Challenging" feedback describes comments that question student decisions, or prompt students to search for alternative perspectives and draw inferences.

Sample instances of the three feedbacks types are:

Corrective [C]: *Insert 'that contributed to the disaster' here.*
Elaborative [E]: *'Human error' usually refers to mistakes like pushing the wrong button.*
Challenging [Ch]: *What suggestions were these? / Why? / Any reason for this? / And so…?*

Feedback types often co-occur, and in different order, as in the following examples.

C + E: *Irrelevant* [text struck through] [C] – *your task was not about speculating how the disaster could have been avoided*. [E]

E + C: *'Poor conduct' means behaving inappropriately and is more associated with social errors than technical mistakes.* [E] *Maybe 'poor practice'* […] [C]

Ch + E: *You have only used one source here* [Ch]. *This made your discussion of training very shallow.* [E]

E + Ch: *3 issues are jumbled* [E]: *(1) […]; (2) […]; and (3) […]. Sentence structure needs to untangle this.* [Ch]

Results

Writing skill improvement

Overall, the majority of students' writing skills in the discussion section improved between stage 1 (paragraph) and stage 2 (complete research discussion paper) in both the entire class (n = 68) and the group whose papers were selected for analysis (n = 37). In the entire class 59% of students improved, and 62% of the selected group improved. The relative improvement in the papers selected for analysis is generally reflective of the relative improvement of all papers in the course. Relative improvement for the selected group is shown in Figure 2.

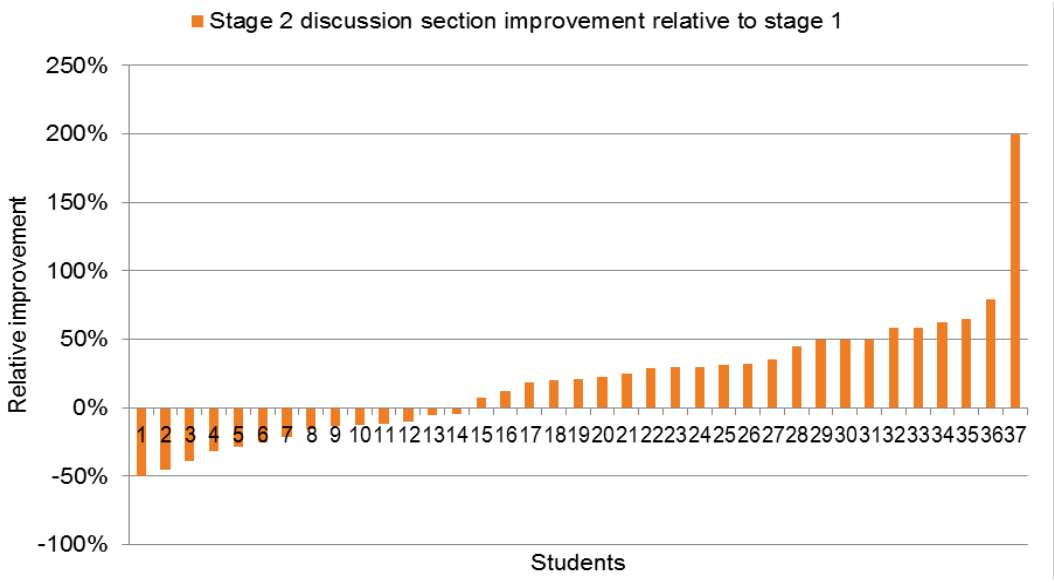

Figure 2. Selected students - relative improvement from stage 1 to stage 2

Performance in the selected group

In the selected group, of those whose discussion mark decreased, 9/14 had a stage 1 mark >60%; 6/14 moved from a pass to a fail (with two of these being distinction to fail) for the discussion section; 2/14 remained at fail level; and the other six students' discussion mark decreased but not below pass level. Of those whose mark increased, 3/23 had a stage 1 mark >60%, and 2/23 remained at fail level. Figure 3 shows the actual difference in discussion section marks between stages, with students numbered 1-14 being those whose mark decreased. While a significant proportion (14/37) of the selected students had lower discussion mark grades in stage 2, all of these students passed the course, as shown in Figure 4.

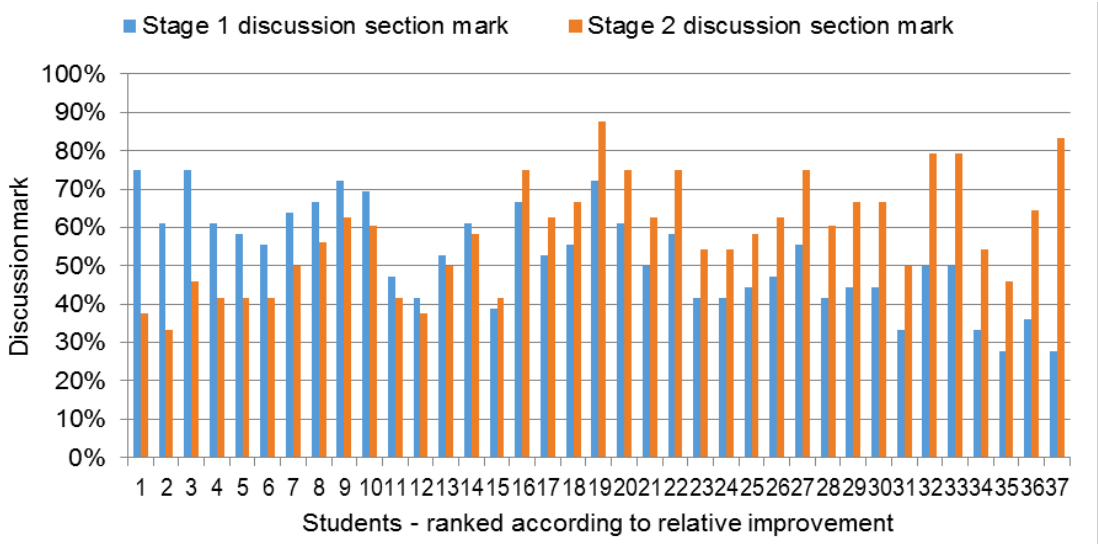

Figure 3. Selected students - stage 1 and stage 2 discussion marks

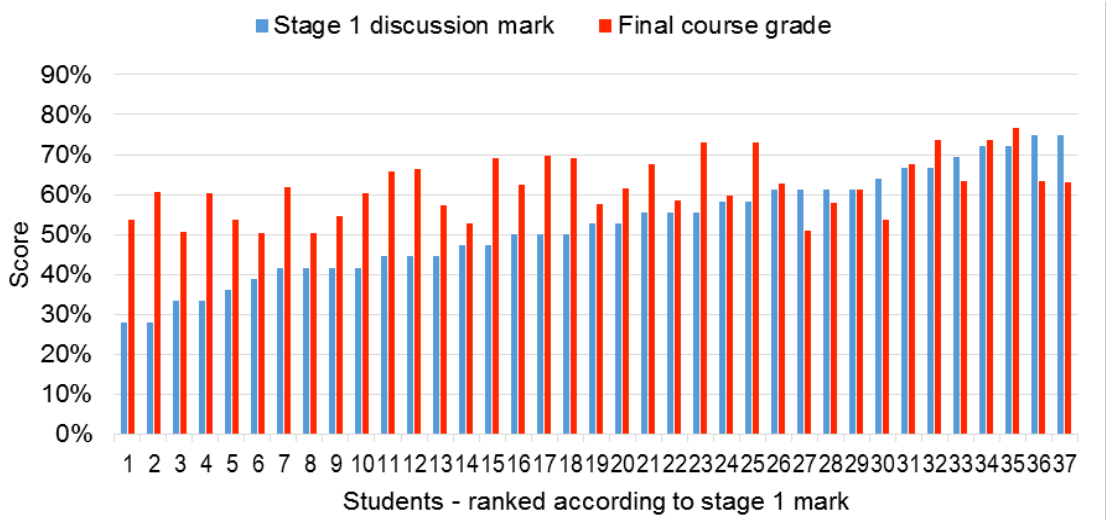

Figure 4. Selected students - stage 1 discussion mark and final course grade

Nature of feedback

The majority of the selected students received moderately-rich to rich amounts of feedback. Of the four students who received sparse feedback, three were in the non-improved group. All feedback was given in simple language and in manageable chunks. Feedback was related to specific text in terms of the assessment criteria.

Every stage 1 paper received a combination of corrective, elaborative and challenging types of feedback. Elaborative feedback in the stage 1 papers often co-occurred with corrective or challenging feedback, elaborating on either corrective feedback or on challenging feedback. It sometimes occurred as ‘stand alone’ feedback suggesting either correction or further thinking. As illustrated in Figure 5, the function of elaborative feedback had either a corrective or challenging orientation.

While all students received elaborative feedback, the choice of type of elaborative feedback differed from paper to paper, depending on the marker’s perception of the student’s level of development.

Figure 5. Explanatory function of elaborative feedback

Effect of feedback

Categorisation of feedback on individual papers showed that both the improved and non-improved groups received all three types of feedback, and that all students received elaborative feedback with corrective and challenging orientation. However, in the improved group, the proportion of elaborative feedback for each student was high, relative to other types of feedback. Interestingly, the proportion of elaborative feedback did not significantly correlate with the degree of improvement in the improved group. In the non-improved group the majority of students received relatively less elaborative feedback in relation to other types of feedback. Further analysis showed that, in the improved group, the orientation of the elaborative feedback was both corrective and challenging. In the non-improved group, the elaborative feedback was predominantly challenging.

Application of feedback

A positive correlation existed between the change in the discussion mark between stages 1 and 2 and the mark received in the stage 2 paper for applying the stage 1 feedback to all sections of their stage 2 paper. Of the 23 students whose discussion mark improved, 19 received 75% or more of the mark allocated for applying feedback, and four received 50% of the possible feedback mark. Of the 14 students whose stage 2 discussion mark was lower than in the stage 1 paper, 11 received a feedback application mark of 50% or less, one received 62.5% and two received 75%. These trends are illustrated below in Figure 6.

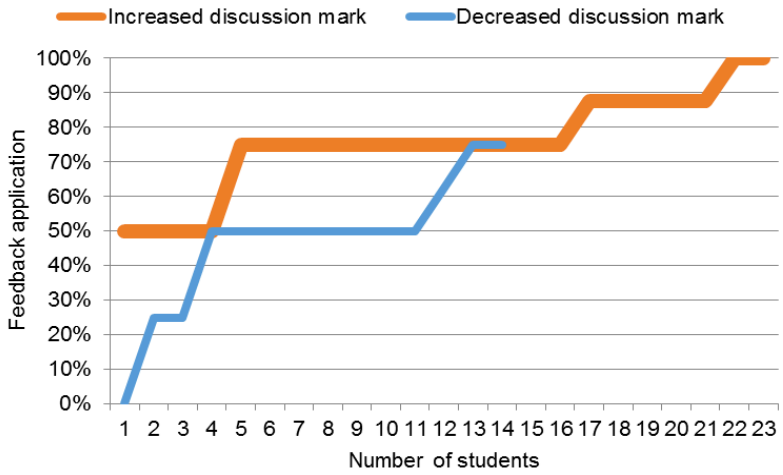

Figure 6: Comparison of the application of feedback mark in relation to stage 1 papers with an increased discussion mark and a decreased discussion mark

The general trend for students with an improved discussion mark was that they were able to apply all types of feedback and to transfer the stage 1 feedback on one paragraph to the new stage 2 paragraphs. This was the case even for the two students whose improved discussion mark remained a fail.

The four students with an improved discussion mark but with a score of 50% for applying feedback were all able to apply challenging feedback in relation to the discussion, and were all able to transfer the feedback on the single stage 1 paragraph to the additional stage 2 paragraphs. Feedback that was not applied was in relation to grammar in two cases, and referencing conventions in another, neither of which was a criterion in the discussion mark.

The fourth student was penalised for not applying feedback in relation to paragraph conclusions. While this criterion was included in the discussion mark, feedback on structure and content interpretation was applied, and significantly improved the student's discussion mark.

The general trend for students with a decreased discussion mark was that, while most students were able to apply all types of feedback (one student received a feedback application mark of zero) to the stage 1 paragraph, they did so inconsistently, and they were also unable to transfer the stage 1 feedback to the new stage 2 paragraphs.

Of the students with a lower discussion mark in stage 2 but with a feedback application mark greater than 50%, two were able to apply challenging feedback consistently in relation to the original stage 1 paragraph, and the third applied the more corrective and elaborated feedback, but did not apply the challenging feedback. None was able to transfer feedback to the new stage 2 paragraphs.

Discussion

As all students in the selected group passed the course, our perception of student writing skills had been that all students had improved. However, when we isolated the discussion marks as evidence of writing skill ability to represent and construct knowledge (Bakhtin, 1986), it appeared that a significant number of students had not developed their writing skills beyond developing their stage 1 paragraph.

The distinguishing feature of the improved group was that they transferred the feedback on their stage 1 work to the new paragraphs written for stage 2. In the non-improved group, all but one student applied the feedback given to the reworking (Figure 1 - Cause 1') or transformation (Figure 1 - Cause 1") of their stage 1 work, but not to the new paragraphs (Figure 1 - Cause 2/Cause 3).

The fact that none of the non-improved group transferred the feedback to the new stage 2 work may be linked to the fact that elaborative feedback predominantly had a challenging orientation. A possible reason for being given this type of feedback is, since they generally did well in their stage 1 discussion, the markers chose to 'push' these students further. It may be that these students were not invested in improving further for various reasons (e.g. Shute 2008 on self-efficacy, and potentially performance- versus learning-goal orientation). However, assuming an attempt was made to apply feedback, an alternative explanation is that such a 'push' may have resulted in the students needing to go beyond their ZPD. Feedback with a predominantly challenging orientation possibly required too great a shift into abstract thinking on the student's part.

The difficulty of transferring concepts to new material was seen in the two students who improved and were assessed as applying feedback well (75%) but still failed the discussion section. Both students received corrective- and challenging-oriented elaborative feedback. Analysis of their papers indicated application of challenging feedback, and some transfer of skills to new material. Despite this, they were unable to make the conceptual movement required to successfully compose additional paragraphs. The extent of reworking of stage 1 material these students had to do in stage 2 meant that the transfer process was complicated and complex.

The purpose of feedback is to assist students in navigating this process. The inclination of markers is to use challenging-oriented feedback, particularly because the assessment criteria require critical analysis and interpretation of evidence, and thus giving corrective-oriented feedback can seem counter-intuitive. Nonetheless, the results suggest even high achieving students need a combination of challenging- and corrective-oriented feedback to facilitate critical thinking.

Conclusion

Effective feedback (feedback that was applied and transferred) was moderately-rich to rich in amount, and a combination of three types: corrective, elaborative and challenging, with a high proportion of elaborative feedback with a corrective orientation. Feedback that was not transferred was characterised as including little elaborative feedback, with a challenging orientation. Markers provide feedback according to their judgement of a student's current level of development. However, in fine-tuning their feedback, they can find it difficult to identify accurately a student's potential level of development and the extent of conceptual shift required. Markers in the course, including the authors, will be encouraged to be aware of the extent of the conceptual shift needed to transfer skills, and to provide a high proportion of elaborative feedback, ensuring some corrective orientation.

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