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STUDENT CONCEPTIONS OF FEEDBACK: IMPACT ON SELF-REGULATION, SELF EFFICACY, AND ACADEMIC ACHIEVEMENT

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Abstract

Background: Lecturers give feedback on assessed work in the hope that students will take it on board and use it to help regulate their learning for the next assessment. However, little is known about how students' conceptions of feedback relate to students' self-regulated learning and self-efficacy beliefs and academic performance.
Aims: This study explores student beliefs about the role and purpose of feedback and the relationship of those beliefs to self-reported self-regulation and self-efficacy, and achievement.
Sample: A total of 278 university students in a general education course on learning theory and approaches in a research intensive university.
Methods: Self-reported survey responses for students' conceptions of feedback (SCoF), self-regulation (SRL), academic self-efficacy (ASE), and Grade Point Average (GPA) were evaluated first with confirmatory factor analysis and then interlinked in a structural equation model.
Results and Conclusions: Three SCoF factors predicted SRL and/or GPA. The SCoF factor 'I use feedback' had positive associations with SRL (β=.44), GPA (β=.45), and ASE (β=.15). The SCoF factors 'tutor/marker comments' and 'peers help' both had negative relations to GPA (β=-.41 and -.16 respectively). 'Peers help' had a positive connection to SRL (β=.21). ASE itself made a small contribution to overall GPA (β=.16), while SRL had no statistically significant relation to GPA. The model indicates the centrality of believing that feedback exists to guide next steps in learning and thus contributes to SRL, ASE, and increased GPA.

Keywords: feedback; self-regulated learning; academic self-efficacy; beliefs and attitudes; higher education students

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1.0 Introduction

To date self-regulation of learning research has focused mostly on the studying and learning processes, while devoting much less attention to the adaptive and maladaptive responses and attitudes students might have toward assessment and external feedback. Hence, while it might be expected that self-regulating students make active use of the insights available about their learning from assessment and feedback, this is not a well-attested assumption.

Teachers, tutors, and instructors generate external feedback (e.g., grades, scores, comments, etc.) in the hope, oftentimes vain, that students will use feedback in an adaptive way to improve their future performance. Despite this core assumption, little is known about how student conceptions of feedback interact with self-reported metacognitive learning strategies, self-reported academic self-efficacy, and overall academic performance. That is, what the student learns from feedback may not be relevant and hence may not lead to the adoption of regulatory strategies that will raise subsequent achievement. A study that seeks to identify potentially adaptive beliefs about feedback and how these relate to self-regulation is therefore needed.

Among studies of self-regulation it would seem only Panadero and colleagues (Panadero, Alonso-Tapia, & Huertas, 2012; Panadero, Alonso-Tapia, & Reche, 2013) have examined the impact of feedback derived from rubrics, scripts, and exemplars upon performance, self-efficacy, and self-regulation. They reported that feedback had no meaningful impact on self-regulation and only process-oriented feedback (as opposed to performance-oriented) increased self-efficacy. They did not however investigate students' conceptions of feedback and the association of those perceptions with self-regulation. Some research has been done linking conceptions of assessment to self-regulation. A variety of studies (summarised in Brown, 2011) have shown that students who endorsed the conceptions that assessment is for improvement exhibited adaptive self-regulatory responses (e.g., greater achievement, greater effort in test-taking, and greater attendance at a voluntary test day) while students who viewed assessment as something to be ignored had maladaptive responses.

1.1 Self-Regulation

Formal schooling involves a sequential process in which instruction of content takes place, students study and learn the material, and formal assessments (e.g., tests) are conducted to establish learning success and needs, or to certify student proficiency. The formal evaluative event generates feedback about the quality and success of learning (Evaluation Process in Figure 1). However, this linear schooling process interacts with interactive and cyclical processes students use as they learn and study. Zimmerman's (2008) model of self-regulation of learning involves a cycle of planning, monitoring, and reflection around learning and studying (box at top of Figure 1). Feedback arises through multiple mechanisms including internal processes (i.e., physical and psychological responses) (Butler & Winne, 1995) and external assessment appraisals. Feedback within Zimmerman's model occurs in a reflective process which can take place during the preparatory study, the assessment process itself, and upon completion of the assessment process. Consequently, self-regulation of learning weaves itself around the complete studying, assessment, and follow-up stages of schooling.

Feedback based on assessed performance contributes to academic self-efficacy and the self-regulation processes, and ultimately future learning and achievement. While this general cycle of learning is portrayed in a linear fashion in Figure 1, these processes are interactive and reciprocal such that academic self-efficacy and self-regulation processes both arise from and contribute to academic performance. Nonetheless, given the chronological sequencing of school processes, linear flows are all that can be observed.

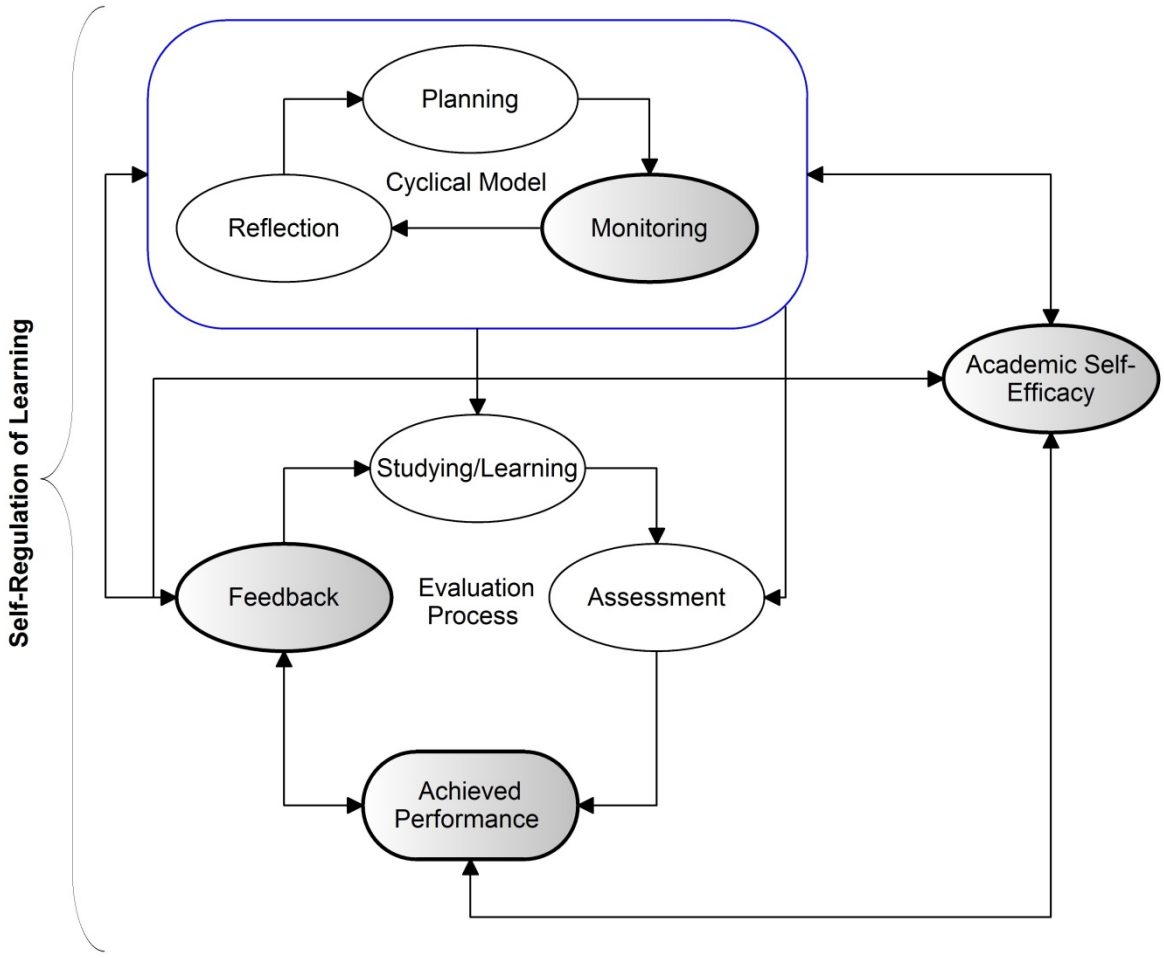


Figure 1. Schematic relationships of Self-regulated Learning, Evaluation, and Academic Self-efficacy. Constructs used in this study shown in shaded ellipses.

1.2 Feedback

Feedback is "information given by an agent … regarding aspects of one's performance or understanding" (Hattie & Timperley, 2007, p. 102). While feedback can be internally self-generated, it is commonly externally generated by the teacher or other people (Butler & Winne, 1995). Four levels of feedback have been identified to do with task, process, self-regulation, and self (Hattie & Timperley, 2007). Task, process, and self-regulation feedback all contribute to gains in learning outcomes, while self-oriented or ego-enhancing/protecting feedback generally does not (Boekaerts & Corno, 2005; Hattie & Timperley, 2007).

Feedback can also be formative or summative depending on its timing within a course of study, with the former happening early enough to allow improvement, while the latter happens at the end of study and involves an evaluation of performance. In its most summative form, feedback is restricted to evaluative marks, grades, or scores at the end of study. Such feedback, even if provided formatively earlier in a course, has been found not to be as effective as descriptive feedback commentaries that identify strengths and weaknesses, diagnose problems, and recommend strategies for improvement (Smith & Lipnevich, 2009).

Higher education assessment is rarely just summative (i.e., 100% final examination). Coursework completed prior to or instead of a terminal examination is both summative (i.e., counts towards the final grade) and formative (i.e., indicates quality of performance and potentially diagnoses strengths and weaknesses with recommendations for future actions).

Hence, feedback from assessments early in a course can be both evaluative and descriptive while having formative potential.

1.3 Feedback, Self-Regulation, Self-Efficacy, and Achievement

As illustrated by Figure 1, effective feedback results in students implementing learning strategies that contribute to greater learning (Nicol & Macfarlane-Dick, 2006). Students who act on feedback are considered self-regulating because they take responsibility for their learning processes by reflecting on the quality of their work, and make adjustments to their learning in light of feedback (Zimmerman, 2008). However, while feedback may generate learning effects, these may not be automatically translated into better performance on future assessments. Future assessments generally align with course goals rather the student's personal goals, meaning that what the student learns from feedback may not be relevant for a future assessment (Bourke, 2014). Further, feedback from performance on one assessment (e.g., multiple-choice test) may not be useful for performance on another type of assessment (e.g., essay). Hence, the relationship of feedback from a specific task to overall academic performance may not be very strong. Nonetheless, it is expected that a self-regulating response to feedback should result in greater outcomes overall.

Taking time to engage with the feedback and self-regulate subsequent learning is likely to be associated with a sense of academic self-efficacy. That is, after receiving feedback, students who do not believe they have capability to achieve on the next assessment would be unlikely to engage in self-regulation, further reducing future performance; unsurprisingly, greater self-regulation is expected when feedback confirms successful learning. Butler and Winne (1995) proposed that learners integrate external feedback with their own internal perceptions and feelings about the quality of their work to generate a response that ought to lead to better performance. Feedback from successful performance on assessments is likely to contribute to a student's sense of self-efficacy and greater self-efficacy reciprocally leads to greater performance (Bandura, 1986, 1997).

Greater academic self-efficacy is also positively related to effective self-regulated learning processes (Pintrich & Zusho, 2007; Robbins et al., 2004; Richardson, Abraham, & Peterson, 2012). Thus, academic self-efficacy and self-regulated learning are related to competence and control beliefs (Schunk & Zimmerman, 2006) that contribute to greater achievement and which probably depend, in part, on the quality of feedback. Thus, if feedback is meant to improve performance, raise self-efficacy, and trigger self-regulatory processes, it matters how students perceive it.

1.4 Conceptions of Feedback

Students' conceptions of feedback and its purposes matter since the provision of formative feedback does not guarantee that learners believe that the feedback can help them implement appropriate learning strategies and achieve better outcomes (Hattie, 1999). Instead, it is likely that beliefs about academic self-efficacy and self-regulation and previous performance interact with how students interpret and use feedback (Bandura, 1986; Hattie & Timperley, 2007). For example, after experiencing positive feedback, students with high and low self-efficacy might differ in their response to negative feedback on a later assessment; high self-efficacy students may cope better, while low self-efficacy students might seek to avoid critical but constructive feedback (Hattie & Timperley, 2007).

While not directly investigating student conceptions, it has been found that higher achieving students actively used tutor feedback to facilitate self-regulatory tasks, though they were not dependent on external sources of feedback, while lower achieving students engaged in little self-regulation, being regulated externally by the feedback they received (Orsmond & Merry, 2012). In a similar vein, among high school students in New Zealand, the belief that

that assessment guided students as to the next things they had to learn predicted greater achievement (Brown, Peterson, & Irving, 2009).These suggest that there may be adaptive and maladaptive ways of thinking about what feedback is and what it is for.

Differing perceptions of feedback have also been identified between the giver of and receiver of feedback (Carless, 2006; MacLellan, 2001). Tutors and staff perceived their feedback as giving detail and being useful, while students perceived it as being much less so. Further, there is evidence that students believed feedback was general, vague, negative, or unrelated to assessment criteria (Weaver, 2006). Thus, although assessment feedback should contribute to improved learning outcomes, and increased self-regulation, its effectiveness appears to depend on students' conceptions.

1.5 Conceptions of Feedback Inventory

A series of studies with New Zealand secondary school students (Grades 9-10, ages 13-14) developed the Student Conceptions of Feedback (SCoF) inventory concerning beliefs about the nature and purpose of feedback (Irving, Peterson, & Brown, 2007, 2008). New Zealand secondary schooling has no high-stakes external certification assessment until Grade 11 (nominally age 15) and a strong policy of formative, school-based assessment, which relies predominantly on teacher observation and interaction rather than formal testing, intended to provide feedback to learners concerning their progress and needs (Crooks, 2010). In these circumstances, it has been found that students strongly endorse the idea that feedback leads to better learning outcomes (Harris, Brown, & Harnett, 2014).

Seven inter-correlated factors, six of which deemed adaptive to achievement, were found; adaptive factors included: (1) parental feedback helps (e.g., my parents provide constructive feedback about my learning), (2) feedback is enjoyable (e.g., I enjoy getting feedback), (3) feedback tells me how well I have done relative to standards (e.g., I know I have done well when the result is better than last time), (4) teacher feedback helps (e.g., teachers give me trustworthy and honest feedback), (5) feedback motivates (e.g., feedback makes me try harder), and (6) peer feedback helps (e.g., feedback from my classmates really helps me). The one maladaptive factor was feedback is ignored (e.g., I ignore bad comments/grades).

A study with younger students (55% in primary school) found just three factors: (1) feedback is ignored or negative, (2) feedback is from peers, and (3) feedback is teacher comments (Harris, Brown, & Harnett, 2014). The students gave most agreement to teacher comments about improvement. This factor had a positive but weak correlation with drawings of feedback that contained teachers giving feedback. Simultaneously, all three feedback factors were negatively correlated with drawings of feedback that showed student-led feedback, suggesting that peer and self-generated feedback were distinguished from teacher-based feedback.

However, the applicability of the SCoF inventory to university age students is uncertain. The majority of the SCoF factors found in secondary school students seem broadly relevant to the university setting; hence it is likely university student responses will recover some of the SCoF factors. That is, the university assessment systems typically require (a) descriptive commentary from tutors or professors on assessed student work, (b) grading relative to assessment criteria or standards, (c) students to interact with each other in group work or peer interaction around formal criteria and standards, and (d) students to improve their performance over time.

The SCoF factor that seems most likely to differ in a tertiary sample is parental feedback which may work differently for adults in non-compulsory higher education than for adolescents and children in compulsory schooling. While becoming independent is a key developmental task for university-aged students (Arnett, 2000; Erikson, 1968), parents may

still be involved in higher education students' lives, partly through their financial dependence on parents, the ease of communicating, and contemporary emphases on active parenting (NSSE, 2007; Wartman & Savage, 2008). Awareness of parental expectations for academic achievement certainly characterises Asian higher education students (Brown & Wang, 2013), especially those on international student visas being subsidised by their families (Lee, Farruggia, & Brown, 2013). There may be an optimal level of parental support, since excessive parental involvement is correlated with lower achievement (Harper, Sax, & Wolf, 2012; NSSE, 2007).

The goal of the current study was to gain insights into university students' conceptions of feedback and to explore how those conceptions related to self-regulation and self-efficacy beliefs and how they mutually contributed to academic performance.

1.6 Research Questions

Given that previous studies among school-age students with the SCoF inventory have not returned stable factoral structures, and that this study was among university age students, the first goal of the study was to identify a well-fitting factoral structure. Second, although the reciprocal relationship of self-regulated learning and academic self-efficacy has been studied (Hodges & Kim, 2010), less is known about how student conceptions of feedback relate to those beliefs and achievement. It is plausible that students who actively seek out and make use of feedback to identify their learning needs, and use this information to guide their subsequent learning behaviour, will have greater academic self-efficacy, self-regulated learning, and overall academic performance. However, without a true longitudinal design, a cross-sectional snapshot cannot capture this cyclical and reciprocal process. Hence, multiple models are needed to establish where in the process the data lie. As seen in Figure 1, the shaded areas represent the constructs available in this study (i.e., academic score, academic self-efficacy, self-regulated learning, and conceptions of feedback).

In order to test possible causal pathways, a systematic testing of plausible sources of influence upon all other constructs was carried out (Table 1). An assumption is made that students have had previous experience with educational study, feedback, and assessment and that such experiences are the origin of their self-rated evaluations of feedback, self-regulated learning, and academic self-efficacy. This assumption is necessary since the survey was administered at the start of the course and students would not have had experience with the course itself. In order to establish where in the cycle the data has been collected, six logically plausible models were tested.

Table 1. Models tested.

Model	Description	Rationale
M1	SCoF factors predict ASE, SRL, and GPA	Conceptions of Feedback are the source of responses to all other constructs
M2	SRL factor predicts ASE, GPA, and SCoF.	Self-Regulation of Learning is source of all other constructs
M3	GPA score predicts ASE, SCoF, and SRL	Overall academic ability is the source of self-beliefs
M4	ASE factor predicts SCoF, SRL, and GPA	Academic Self-Efficacy is the source of all other constructs
M5	no paths between constructs	Null hypothesis that there are no causal or correlational relationships among constructs
M6	All constructs are inter-correlated	Counterfactual model that there all relations are inter-correlations not causal

However, although Models M1 to M4 are causal in design, fit of such models to the data does not constitute proof of causation; rather they only suggest causal relations that require testing under proper experimental and/or longitudinal conditions. Thus, the current study first establishes a measurement model for the SCoF inventory and then examines structural relations among the three constructs and academic achievement. Differences in fit were used to identify the most appropriate model for the data.

2.0 Method

2.1 Participants

The participants were enrolled in an undergraduate General Education course at a large ($N \approx 42{,}000$), publically-funded, research-intensive, and selective university. The participants in the current study were undertaking a General Education course. General Education courses are elective, introductory-level courses designed for students from outside the faculty offering the course. All students are required to take two such courses for their degree. Data were collected in a General Education course on how people learn. Students completed the questionnaire in the first week as a required ungraded coursework activity. Individual results for each scale were emailed to students and class results were discussed in a lecture after the mid-term test.

Of the 362 enrolled students, 300 (83%) gave permission for their questionnaire data to be used, while 278 gave permission to access their GPA (response rate = 76%). Hence, SCoF analyses used 300 students, while structural relations used 278. While a ratio of 10:1 cases to manifest variables is generally recommended in analytic studies, a number of considerations can modify this standard (Bandalos & Finney, 2010; Costello & Osborne, 2005; Marsh, Hau, Balla, & Grayson, 1998). For example, if (a) there are enough items per factor (p/f) relative to the sample size (i.e., ≥3 when n=200), (b) each item has strong loadings on its own factor (i.e., $\lambda > .40$), and (c) items have weak (i.e., $\lambda \leq .30$) loadings on other factors, then successful estimation can be achieved. These recommendations suggest that the sample size is sufficient in this study because the ratio of cases to items was 6.18, only one item had a loading under .40, and only one factor had fewer than three items.

The majority of participants (Table 2) were female. The mean age was 20.49 (SD = 4.12), and the mean years of completed tertiary study was 2.60 (SD = 1.33). The majority were studying towards a Bachelor of Science, a Bachelor of Commerce, or a Bachelor of Arts. In terms of ethnicity, most participants were either white or Asian.

Table 2 *Participant Demographics*

Demographic	*n*	%
Sex		
Male	97	34.9
Female	181	65.1
Years of completed tertiary study		
0	63	22.7
1	86	30.9
2	64	23.0
3	42	15.1
4	11	4.0
5+	12	4.3
Degree		
Bachelor of Science	116	41.7
Bachelor of Commerce	55	19.8
Bachelor of Arts	47	16.9

Demographic	*n*	%
Bachelor of Engineering	3	1.1
LLB	3	1.1
Conjoint	22	7.9
Other	32	11.5
Ethnicity		
NZ European/Pakeha	110	39.6
Asian	130	46.8
Confucian Heritage Culture (e.g., Chinese, Japanese, Korean, Taiwanese)	63	22.7
Other (e.g., Bangladeshi, Filipino, Indian, Sri Lankan, Thai)	67	24.1
Pasifika	20	7.2
Maori	3	1.1
Middle Eastern	2	.7
Other	13	4.7
Were you born in New Zealand?		
Yes	137	49.3
No	141	50.7
Is English your first language?		
Yes	172	61.9
No	106	38.1
Did you complete your secondary school education in English?		
Yes	260	93.5
No	18	6.5

Note. $N = 278$

2.2 Instruments

2.2.1 Student Conceptions of Feedback (SCoF) inventory. The 32-item Student Conceptions of Feedback Questionnaire-II (SCoF-II; Irving & Peterson, 2006) was adapted for the tertiary context (e.g., "teacher" was changed to "tutor" and/or "marker"). Participants rated how much they agreed or disagreed with the items using a six-point, positively-packed rating scale (Lam & Klockars, 1982) with two negative options (*strongly disagree* and *mostly disagree*) and four positive options (*slightly agree, moderately agree*, *mostly agree*, and *strongly agree*). Because most students were likely to agree with all the conceptions of feedback, positive-packing generates greater variance in the positive space (Brown, 2004). This scale has been effectively used with higher education students in Hong Kong with robust psychometric properties (Deneen, Brown, Shroff, & Bond, 2013).

2.2.2 Term Grade Point Average (GPA). Participants' general academic performance was taken from the current term's grade point average (GPA). This was the participants' average grade achieved over all courses in the same semester of the survey. GPA is considered a good predictor of academic performance (Kuncel, Credé, & Thomas, 2005; Robbins et al., 2004). GPA ranged from 0 (all fail) to 9 (A+ average) and had a stronger correlation with the course final grade than mid-term test ($r = .77$ vs. $r = .69$ respectively). This approach was taken since the survey was administered at the start of the course, meaning that conceptions had to have been developed on a more general basis than could be attributed to the content of this specific course. Furthermore, subsequent analyses of the proposed models found that using the final course score out of 100 as dependent variable instead of the term GPA produced much worse fit (i.e., ΔAIC values were greater by 120 to 300 points).

2.2.3 Self-regulated learning (SRL). The Metacognitive Self-Regulation subscale from the Motivated Strategies for Learning Questionnaire (MLSQ) was used (Pintrich, Smith,

Garcia, & McKeachie, 1991). The subscale was chosen as it focuses on the control of cognition around three key self-regulatory learning strategies shown in Figure 1 (i.e., planning, monitoring, and regulating/reflecting). Planning involves setting goals and analysing the task. This helps activate prior knowledge that will assist with task understanding and comprehension (e.g., before I study new course material thoroughly, I often skim it to see how it is organised). Monitoring strategies, help integrate study material with prior knowledge to further understanding. This is done through the regulation of attention, self-testing and questioning, (e.g., if course materials are difficult to understand, I change the way I read the material). Regulating strategies involve continual checking and correcting of behaviours while studying to improve learning (e.g., I ask myself questions to make sure I understand the material I have been studying in class). The Metacognitive Self-Regulation subscale has 12 items, two of which (i.e., SRLQ 1 & 8) were reverse-scored. The items were rated with a six-point, balanced agreement scale (1=*strongly disagree*, 2=*disagree*, 3=*slightly disagree*, 4=*slightly agree*, 5=*agree*, and 6=*strongly agree*). The items were modified so that students were asked to consider how they would regulate their learning for 'this course' instead of all courses. This was done deliberately, as part of the curricular goals of the course, to give students a basis for comparing their espoused strategies with their actual learning strategies. This was done in tutorial sessions after the mid-term test in which students were given their self-reported scale scores and asked to consider whether they ought to change any of their behaviours or approaches.

We were unable to include the other cognitive subscales in the MLSQ (i.e., rehearsal, elaboration, organisation, and critical thinking) due to concerns about participant fatigue. Given that the other cognitive subscales are moderately to strongly correlated with the broader metacognitive self-regulation subscale (range r=.58- .73; Pintrich et al., 1991) it seems that by selecting the metacognitive scale we would at least capture some aspects of these more specific cognitive scales. We did not include the MLSQ Resource Management Strategies scales because our study was primarily focused on how cognitive conceptions of feedback relate to other cognitive beliefs and achievement outcomes, rather than the influence of more contextual factors such as the study environments.

2.2.4 Academic self-efficacy inventory (ASE). The five-item Academic Efficacy (ASE) subscale from the Patterns of Adaptive Learning Scales (Midgley et al., 2000) was used. ASE has been used effectively in studies with university students (Elliot, Maruyama, & Pekrun, 2011). The items were modified to focus participants' perceptions of their competence to complete work specific to their academic major (e.g., I'm certain I can figure out how to do the most difficult class work *in my major*). The items were rated using a five-point, ordinal, truthfulness rating scale (1=*not at all true*, 2=*slightly true*, 3=*moderately true*, 4=*mostly true*, and 5=*very true*).

2.3 Data Analysis

Missing values analysis, using the expectation-maximisation procedure, was conducted to calculate missing values for participants with less than 10% missing data.

2.3.1 SCoF measurement model. Because the previously developed measurement model for the SCoF had not been well attested to, exploratory approaches were used. The number of dimensions was determined using Velicer's Minimum Average Partial Test (MAP^2) and Comparison Data using Spearman correlations (Courtney, 2013). Exploratory factor analysis using maximum likelihood estimation and oblique minimisation rotation (Costello & Osborne, 2013) was used to examine dimensionality. Items with low-loading ($\lambda < .30$) and high cross-loading ($\lambda > .30$) items were removed (Bandalos & Finney, 2010). The exploratory solution was validated with confirmatory factor analysis, though this is better

construed as restrictive factor analysis (Anderson & Gerbing, 1988) since no new data were available to test the solution.

2.3.2. ASE and SRL Measurement Models. These two scales were tested directly with confirmatory factor analysis to establish the validity of the factors for these participants. Special attention was paid to negatively-worded items, because such items do not automatically conform to intended factors even after reverse-scoring (Brown, 2004; Distefano & Motl, 2006). Likewise, items with loadings $\lambda<.30$ or with statistically non-significant weights were removed.

2.3.3 Structural relations among constructs. Structural equation modelling was used to investigate the relationships among constructs. The five models specified above were tested and the best fitting model was selected. Once identified, the model was trimmed by removing statistically non-significant regression paths and items not exhibiting simple structure.

2.3.4 Model fit standards. Multiple measures of fit (i.e., χ^2, χ^2/df, Comparative Fit Index [CFI], gamma hat; root mean squared error of approximation [RMSEA], and standardised root mean squared residual [SRMR]) were inspected (Hu & Bentler, 1999; Fan & Sivo, 2005). The χ^2 per *df* ratio, SRMR, and gamma hat indices are considered robust against sample size, model complexity, and model mis-specification (Fan & Sivo, 2007; Marsh, Hau, & Wen, 2004). Models with χ^2 per $df < 3.80$, CFI and gamma hat > .90, RMSEA < .08 and SRMR < .08 were interpreted as having acceptable fit; while those with χ^2 per $df < 3.00$, CFI and gamma hat > .95, RMSEA < .05 and SRMR < .06 were considered as having good fit.

Selection between models can rest on statistically significant differences in fit. Difference in the Akaike Information Criterion ($\Delta AIC>2.00$) and proportion of AIC weight ($w_i>.95$) indicate superior fit (Burnham & Anderson, 2004). The *z*-standardised difference in χ^2 between models minus the *z*-standardised difference in *df* also indicates a non-equivalent model when $p<.05$ (Wilson & Hilferty, 1931).

3.0 Results

3.1. SCoF Measurement Model

Exploratory analysis identified between five and six dimensions. The only difference between the five- and six-factor solutions was a two-item factor (I enjoy feedback) which separated from Factor 1 (I learn from Feedback) in the six-factor solution. The solution with six factors fit considerably better than the five-factor solution ($\Delta AIC=49.36$). Consequently, that Enjoyment factor was treated as a subordinate factor of Factor 1, rather than as a separate factor. The revised SCoF (five inter-correlated factors with a sub-factor for Factor 1) had sufficient fit to be used ($\chi^2=793.45$; $df=313$; $\chi^2/df=2.54$, $p=.11$; CFI=.91; gamma hat=.91; RMSEA=.065; SRMR=.070). Note, evaluation of the SCoF model comparing responses between the 278 versus 22 who did not have GPA showed that the differences in χ^2 for the difference in *df* for the measurement weights ($p=.022$) and intercepts ($p=.96$) varied within chance, supporting the conclusion that using the larger sample size for the SCoF analysis produced invariant responses to those given by the participants in the structural model.

The five inter-correlated factors were labelled: (a) I actively use feedback which contained the sub-factor I enjoy feedback, (b) peer feedback helps, (c) I ignore feedback, (d) feedback tells me if I am meeting or exceeding expectations, and (e) tutor/marker comments are helpful and clear feedback. Table 3 provides the scale and item statistics. Most positively evaluated were feedback tells me I am meeting or exceeding expected standards, active seeking and using of feedback, and trusting tutor/marker comments. Ignoring feedback was rejected, while feedback from peers was moderately endorsed. Inter-correlations among the factors were weak to moderate, except between active use and tutor/marker comments

(r = .78), perhaps due in part because of two items within active use that refer to a tutor or markers (i.e., cofq13 and cofq7). This overlap suggests that students who actively used feedback especially relied on tutor/marker commentaries because it was clear, formative, and dependable. The ignore factor was inversely correlated with all other factors and mostly strongly negative to the active use and tutor/marker comments factors, indicating internal coherence in how students perceived feedback.

Table 2. Conceptions of Feedback Factors, items, and scale descriptive statistics.

code	CoFB Factor and Item	λ
	Active Use of Feedback (*M*=4.57, *SD*=0.96, α=.92)	
cofq32	I actively use feedback to help me improve.	.88
cofq13	I make active use of feedback from my tutors and/or makers.	.85
cofq7	I pay attention to feedback from my tutors and/or markers	.83
cofq9	I use feedback to set goals/targets for the next assessment	.80
cofq28	I look at feedback to see what I did wrong.	.79
cofq18	Feedback makes me try harder.	.79
cofq23	Feedback changes the way I learn and study.	.66
	Enjoyment Sub-factor (*M*=4.58, *SD*=1.10, α=.78)	.81
cofq11	I look forward to feedback from the markers.	.84
cofq3	I enjoy getting feedback	.76
	Peer Help (*M*=3.73, *SD*=0.95, α=.89)	
cofq20	Feedback from my classmates helps my learning.	.89
cofq30	Feedback from my classmates really helps me.	.84
cofq17	I make active use of the feedback I get from classmates.	.85
cofq12	I can trust feedback from my peers.	.71
cofq22	I learn better when my friends comment on my works.	.71
cofq5	I look forward to getting feedback from peers	.62
	Ignore (*M*=1.93, *SD*=0.75, α=.77)	
cofq31	I ignore comments the markers make about my work.	.67
cofq19	I ignore bad grades or comments.	.65
cofq25	Feedback is not necessary as I know how well I'm doing.	.65
cofq6	Feedback does not tell me anything new	.61
cofq2	Feedback on my work doesn't tell me anything useful	.57
	Expectations (*M*=4.67, *SD*=0.88, α=.62)	
cofq27	I know I have done well if the result is better than last time.	.75
cofq26	Doing better than my parents expect is doing well.	.61
cofq16	Doing better than the expected or required standard is a good result.	.52
cofq4	Good grades will help me get the job I want	.32
	Marker Comments (*M*=4.33, *SD*=0.90, α=.74)	
cofq21	Feedback from my markers makes it clear how to improve.	.77
cofq29	Tutors and/or markers give me trustworthy and honest feedback.	.75
cofq8	Markers of my work give me clear feedback	.59

	Inter-factor correlations			
CoFB Factors	II	III	IV	V
I. Active Use of Feedback	.50	-.65	.39	.78
II. Peers Help	—	-.20	.27	.50
III. Ignore		—	-.16	-.46

IV. Meet Expectations	—	.46
V. Marker Comments		—

Note. Loading values are standardised weights.

3.2. SRL and ASE measurement models

Because of the conceptual linking between ASE and SRL, a correlated two factor model was proposed. After removing two reversed-scored SRL items (i.e., SRLQ 1 and 8) with poor loading, and SRLQ9 with low loading, the two-factor correlated model (r=.33) had nine SRL and five ASE items. The fit to the data was acceptable (χ^2 = 297.49, df = 76; χ^2/df = 3.91, p=.048; CFI = .81; gamma hat = .90; RMSEA = .103; SRMR = .075). Only two of the SRL items had loadings <.50, while all the items for the ASE had loadings >.60 and the scale reliability estimates were sufficiently large (α≥.80) to warrant further use of the scales (Table 4).

Table 4. Self-Regulated Learning and Academic Self-Efficacy Item Loadings and Scale Descriptive Statistics

Factor & Item	Item Loading
Self-regulated learning (M=4.16, SD=0.68; α=.80)	
SRLQ11. When I study for this class, I set goals for myself in order to direct my activities in each study period.	.66
SRLQ12. If I get confused taking notes in class, I make sure I sort it out afterwards.	.64
*SRLQ10. When studying for this course I try to determine which concepts I don't understand well.	.57
SRLQ6. I ask myself questions to make sure I understand the material I have been studying in this class.	.56
SRLQ7. I try to change the way I study in order to fit the course requirements and instructor's teaching style.	.54
SRLQ3. When I become confused about something I'm reading for this class, I go back and try to figure it out.	.53
SRLQ2. When reading for this course, I make up questions to help focus my reading.	.50
SRLQ4. If course materials are difficult to understand, I change the way I read the material.	.47
*SRLQ5. Before I study new course material thoroughly, I change the way I read the material.	.44
Academic self-efficacy (M=3.78, SD=0.74, α=.84)	
ASEQ5. I'm certain I can master the skills taught in my major this year	.75
ASEQ7. I can do even the hardest work in my classes for my major if I try	.75
ASEQ1. I'm certain I can figure out how to do the most difficult class work in my major	.74
ASEQ13. Even if the work for my major is hard, I can learn it	.71
ASEQ8. I can do almost all the work in class for my major if I don't give up	.62

Note. *=item removed in final structural model; loading values are standardised β weights.

3.3 Structural model among constructs.

Each of the specified models was tested without deletion of non-significant paths and without cross-construct paths. Table 5 provides the model fit indices and comparative fit results. Model M1 originating from the SCoF factors was best fitting to the data, although

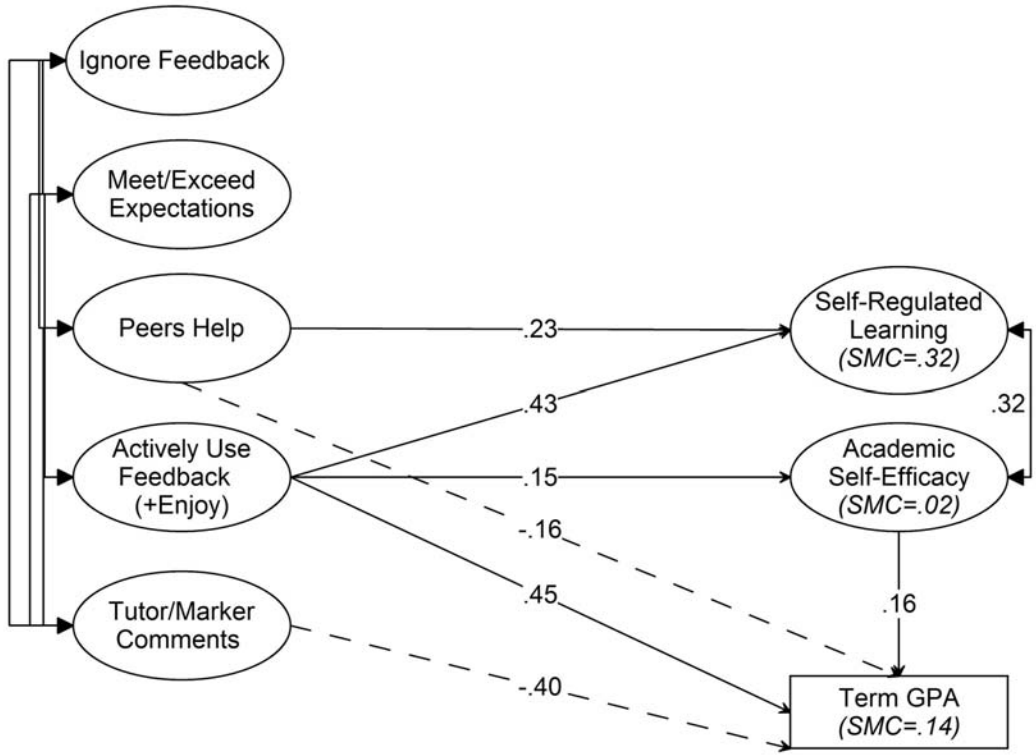
this was only marginally better than the fully inter-correlated model (Model M6). It may be that M1 fits better because it has more between-construct paths (i.e., 3 paths per SCoF factor to SRL, ASE, and GPA) than Models M2-M4, inclusive. Nonetheless, Model 1 did not meet conventions for acceptable fit and necessitated further trimming.

Table 5. Model fit indices

				Fit Indices						Difference Tests		
Model	χ^2	*df*	χ^2/df	CFI	gamma	RMSEA	SRMR	AIC	AIC w*i*	Sum of w*i*	χ^2 zdiff	*p* (zdiff)
1. FB source	1509.386	792	1.906	0.865	0.891	0.057	0.070	1731.39	0.9976	0.9976		
2. SRL source	1541.428	802	1.922	0.861	0.886	0.058	0.072	1743.43	0.0024	1.0000	3.64	<.001
3. GPA source	1601.362	801	1.999	0.849	0.879	0.060	0.121	1805.36	0.0000	1.0000	9.49	<.001
4. ASE Source	1612.981	802	2.011	0.847	0.879	0.060	0.111	1814.98	0.0000	1.0000	10.08	<.001
5. no paths	1650.171	809	2.040	0.842	0.875	0.061	0.125	1838.17	0.0000	1.0000	11.06	<.001
Model 1 trimmed	1323.688	722	1.833	0.881	0.902	0.055	0.068	1519.69				

Note. CFI=comparative fit index; RMSEA=root mean square error of approximation; SRMR=standardised root mean residual; AIC=Akaike information criterion; wi=proportion of AIC weight; zdiff=z score for difference in χ^2 minus difference in *df*; na=not estimable.

All statistically non-significant paths were removed. Then, two items in the SRL factor (i.e., SRLQ10 and SRLQ5) were removed for having multiple modification indices to SCoF items or factors. The trimmed SCoF Source Model 1 (Figure 2) had acceptable fit, with a number of indices suggesting good fit (see last row of Table 5).



Note. Values are standardised β weights; negative values in dashed lines; SMC=squared multiple correlate or R^2; SCoFB inter-correlation values removed for simplicity.
Figure 2. Schematic model of structural relations among self-regulated learning, academic self-efficacy, and conceptions of feedback to term GPA. Standardised regression weights shown.

The model shown in Figure 2 indicates that the self-regulatory conception of feedback factor (i.e., I actively use feedback) had a positive and substantial contribution to both SRL and overall academic achievement and a small contribution to ASE. Two other SCoF factors (Peers Help and Tutor Marker Comments) had a negative contribution to GPA suggesting reliance on external sources of feedback reduced overall academic performance. Nonetheless, the Peers Help SCoF factor had a small positive contribution to SRL, suggesting that active interaction with peers contributed to clarifying confusing and difficult materials and developing new ways of learning. As expected there was a small positive correlation between SRL and ASE, but only ASE had a small but positive contribution to GPA, suggesting that self-efficacy rather than self-regulation of learning was related to overall achievement. It is worth remembering that the analytic framework used here does not prove causality, especially since the inter-correlated model fit nearly equally as well.

4.0 Discussion

4.1 SCoF Measurement Model

This study partially replicated the previously reported factor structure of the SCoF. The substantial structural difference is the absence of the factor concerning parental feedback. This difference seems plausible given the relative independence of university students vis-à-vis their families and that nearly four-fifths of the sample had already completed one or more years of higher education. Feedback from parents, with their

relatively weak understanding of the discipline knowledge students acquire at university, might not be very useful. A second clear difference is the subordination of enjoyment to the self-regulatory Use Feedback factor instead of its previous status as a stand-alone factor. It seems that enjoyment of feedback that guides and improves study behaviours is a positive thing (Pekrun, Elliot, & Maier, 2006).

Another difference has to do with the somewhat weaker endorsement of feedback as coming from peers relative to mostly primary age students (d = .36) (Harris et al., 2014) but almost identical to secondary students (d = .05) (Irving et al., 2008). The weaker value for older school and university students seems consistent with the greater anonymity and independence students experience in secondary and higher education. Without knowing one's classmates personally or knowing how competent they might be, it may be difficult to believe valuable feedback could come from them. It is also interesting that the Peers Help factor is quite different in make-up to the Tutor/Marker Comments factor. The latter only focuses on the quality of the feedback (i.e., clarity, formative, and dependable), while the Peers Help factor contains notions of help, active use, enjoyment, and trustworthiness. Interestingly, in contrast to the Peers Help Factor, the active use of feedback from my tutors/and or markers comments is embedded within the Active Use of Feedback factor and not the Tutor/Marker Comments factor; whereas the active use of feedback from peers remains in the Peers help factor. It may be that, as argued by New Zealand secondary students (Harris & Brown, 2013; Peterson & Irving, 2008), feedback from teachers is reliable because the teacher knows what quality looks like within the material being learned and hence it is actively used, while peer feedback is less authoritative and may be based on social attraction or animosity. The separation of active use from tutors, but not active use from peers, seems to reinforce the expert role that teachers have in providing dependable and authoritative feedback, relative to the possibly well-intentioned but relatively novice capacity of peers.

The mean scores indicated a strong commitment to using feedback to identify learning needs and to guide efforts to address those weaknesses so as to meet or exceed expectations. These results are indicative of a self-regulating response to information generated by evaluations and assessments.

4.2 SCoF as a predictor of structural relations

The supposition of this study was that conceptions of feedback would be consistent with self-regulation of learning and this study has confirmed this claim. The core SCoF factor that related to SRL, ASE, and GPA was the construct Use Feedback. The core distinction between SRL and this SCoF factor seems to be more one of timing (using feedback after an assessment or using feedback during studying) than concept, since both factors point to actions taken to improve learning and understanding. Thus, there is a strong conceptual alignment between SRL and SCoF Use Feedback. The model shows that students who report actively taking up feedback, both in general and from markers/tutors, also report taking up self-regulated approaches to studying and have high self-reported academic self-efficacy. A key contributor to greater academic performance seems to lie in believing that feedback should be used to inform and guide next steps in learning. It is also adaptive to achievement that students actively use external feedback to diagnose and guide improvements, and this is seen in the positive relationships to both GPA and SRL.

We have chosen to represent the relationships among these constructs as one in which conceptions of feedback causes increases in ASE, SRL, and GPA. However, the literature reviewed earlier shows that ASE, SRL, and GPA have cyclical intercorrelated relationships that are inherently multi-directional and interactive over time. Thus, the apparent causal nature of those paths, despite fitting better than a correlated model, is simply a plausible but

tentative hypothesis of how feedback influences self-regulation, self-efficacy, and academic performance. This model has possible advantages over an inter-correlated model in that it generates testable claims within longitudinal and/or experimental designs.

However, there was no direct path from SRL to GPA, suggesting that conventional planning and monitoring processes did not discriminate between higher and lower achievers. This result is consistent with the large meta-analysis of correlates of achievement among university students which showed academic self-efficacy rather than metacognition predicted GPA (Richardson, Abraham, & Bond, 2012).

The lack of relationship between SRL and GPA may also be related to the different formats of university assessment (e.g., multiple choice test vs. essays) or because feedback in the current course, being a general education topic, does not transfer to courses in the student's home faculty or discipline. It may also be that students that do not believe that they are personally capable of changing in response to feedback; that is, because they hold a belief that ability or intelligence is innate and fixed, feedback is not used (Mangels, Butterfield, Lamb, Good, & Dweck, 2006). This may contribute to the positive correlation between ASE and SRL.

The lack of direct path from SRL to GPA also highlights the possibility that it is the active attention and use of externally received feedback to identify mistakes and guide learning that is important for raising GPA, rather than the more internally self-driven feedback (self-regulation) that monitors how well *studying* is going. Perhaps this is also because individuals are worse at attending to or judging their own learning gaps and that attending to and using the feedback from the tutors or markers is more relevant to subsequent performance. Two items in the Use of Feedback factor reflect this 'I make active use of feedback from my tutors and/or markers' and 'I pay attention to feedback from my tutors and/or markers'.

However, this interpretation of using tutor and marker feedback to improve future performance, at first seems at odds with the finding that trusting teacher or tutor feedback and receiving clear tutor or marker feedback is associated with weaker overall academic performance. Perhaps this is because those that trust such feedback and think it is clear, interrogate the feedback less than those who think the feedback is not right or is unclear. Consequently, trusting feedback results in less attention to it and a more surface-like processing of its content; accordingly, the student's subsequent performance is not improved by feedback because deeper cognitive engagement does not arise. This interpretation to some extent parallels Kapur's (2008) research on productive failure which found that exposing students to ill-structured problems followed by well-structured problems ultimately led to better learning outcomes compared to those were only exposed to well structure problems. Kapur (2016) argued that productive failure (i.e., not being able to easily generate a correct solution) can prepare students for more learning gains in subsequent instruction.

We also found that peer feedback was negatively associated with GPA but it did contribute positively to SRL. It may be that academically weaker students were not able to tell that the peers on whom they relied were not a good source of feedback. If peer feedback is not high quality, then it will not effectively guide next learning steps; a concern expressed frequently by school-age students in peer assessment (Peterson & Irving, 2008). Additionally, since peers are not official markers of course-work, relying on them rather than official tutor or lecturer marking could be maladaptive to performance, especially more likely the more novice peers are. However, the positive association of the 'peers help' SCoF factor to SRL suggests that feedback from classmates may be a useful check on how their studying is going. But in the end, the successful student is one who does not rely on peers for help, but instead relies on him or herself to use feedback.

This study poses some challenges for assessment for learning initiatives in higher education that seek to involve students in more interactive, collaborative group work (Strijbos, 2016). Such reforms are especially common-place in disciplines that seek to mimic post-graduation employment practices (e.g., medicine, commerce, and science), in which many students in this study have their majors. Students may believe that such group work is prone to many negative interpersonal processes (e.g., social loafing and/or free-riding) which interfere with the validity of peer-based feedback (Strijbos, 2016). Thus, advocates of assessment reform certainly have to deal with students' prevailing belief systems which seem to associate higher grades with those who do not depend on their peers or tutors.

In the current study, the shared covariance of SRL and AES allows a more accurate identification that it is not the process of regulating one's study, but rather one's active use of the feedback and one's confidence that one can do the academic work assigned that contributes directly to achievement. That is, only the Use Feedback SCoF factor related to ASE, hence it would seem that self-perceptions of academic ability (ASE) are largely independent of how feedback is perceived and used. Nonetheless, this path from seeking and using feedback to self-efficacy seems consistent with self-regulation.

While it was expected that the SCoF factor of ignoring feedback (perhaps because the content was negative or threatening to one's self-esteem) would be a maladaptive response to achievement, this was not the case. This factor had a zero relationship to SRL, ASE, and GPA, suggesting, that while the temptation to ignore feedback exists, it clearly has no systematic impact. Apparently, both high and low achievers seldom fall prey to ignoring feedback and do so in relatively equal proportions. It may be that each ignores different kinds or aspects of feedback and future studies that attempt to disentangle what kinds of feedback are ignored and under what conditions and by which kinds of students would be helpful.

4.3 Implications for Practice

Clearly, the strong correlation between Use Feedback with Tutor/Marker Comments (r= .78) (Table 3) indicates a positive connection between being given feedback by instructors, lecturers, or tutors and using it. Seeking this feedback is part of being a self-regulating learner. However, the negative relationship of Tutor/Marker Comments to achievement is challenging to the simplistic notion that if students perceive they receive good feedback, they will benefit from it. It seems likely that the most effective learners in this sample interrogate and internalise the feedback from external sources and process it so as to inform and guide their own formative action. Nonetheless, this is a vexing question for higher education; how do students get feedback that helps them improve, if conceptions of clear and honest teacher- and peer-based feedback have a maladaptive impact on performance?

A suggested practice worth considering involves tutors and markers not giving feedback directly to students, but rather instead requiring that students generate their own analysis and recommendations as to how their work could be improved early enough in the coursework process that such deeper and engaged self-reflection generates improvement (Hanstedt, 2015). Another suggestion is to avoid giving grades or marks to early pieces of work, instead only providing descriptive formative feedback commentary; although, if the institution requires grades, then providing compliments and praise has been shown to mitigate negative effects associated with low grades (Lipnevich & Smith 2009a, b). A further possibility is the use of structured peer assessment activities (e.g., PeerWise; https://peerwise.cs.auckland.ac.nz/) that require students to answer and evaluate peer-written multiple choice questions. This process requires deeper engagement with peer critique and may generate a positive contribution to performance, transforming the current negative

relationship of peer feedback to performance. Additionally, students could be encouraged to engage deeply with feedback, for example by being required to comment on how they have used previous marker feedback to make changes to their subsequent work. Nonetheless, the key requirement is that feedback be descriptive, not only of the current state of performance, but also prescriptive of appropriate courses of action for improvement (Shute, 2008).

However, with relatively short semesters (approximately 12 to 15 weeks of instruction), the need to provide frequent and early grade indicators, and the importance of grades to student graduation and life chances, there remain challenges for how high quality feedback can be generated and used in higher education. Feedback needs to support effort and appropriate study strategies for the next assessment, which is complicated since research has shown that there is high variability and diversity in higher education assessment practices (Boud, Lawson, & Thompson, 2015). Given the dissimilarity among higher education assessments it is difficult to see how feedback from one assessment might help a student know what to do for the next assessment. Even if the feedback is perceived as clear, valid, and motivating, it may not be relevant for the next assessment task or may not warrant deep interrogation. Hence, this study suggests higher education providers tell the truth to their learners, but also align their assessments and feedback practices, so that feedback from one assessment can help students improve for the next assessment.

4.4 Future Research

A number of factors limit the generalisability of this study. As has been stated many times, this study is a cross-sectional design and lacks a robust design capable of disentangling the causal paths of such inter-correlated and reciprocal constructs. Future work with experimental treatments (e.g., Smith & Lipnevich 2009a,b; Panadero et al., 2012, 2013) would be beneficial. The study uses a relatively small sample size drawn from one course meaning that future studies should use larger samples from more diverse courses and faculties so that the current results can be properly tested. The current study has used various trimming processes to generate a statistically acceptable solution and, through selection of only one of the many MSLQ scales, has used just a few of the many correlates of achievement (Richardson et al., 2012). Thus, the study takes advantage of chance artifacts in the data which need independent corroboration in a replication and extension study.

Indeed, some interpretations are entirely speculative, albeit plausible, and direct testing of the cultural explanations for some results is needed. Potentially, the use of different reference points for three of the constructs could impact upon the validity of results, perhaps in the same way that response scales with different lengths can distort responses (Adelson & McCoach, 2010). For example, ASE was referenced against the students' major (e.g., I am certain I can master the skills taught in my major), and SRL was based on the students experience of the course to date (e.g., "when I study for this class….."), and student GPA was based on course grades averages at the beginning of the term, which for some students meant they were based on only 1 term of study. Thus, future studies would do well to align the reference points so as to make interpretations more coherent. Future research could also exercise control over student beliefs by priming their thinking towards or away from self-regulation or by randomly assigning students to conditions in which different styles of assessment and feedback are implemented. Gaining insight into student motivations for specific assessments, courses, and degrees might also shed light on these exploratory results. As with much of educational psychology, the results here depend almost entirely on self-reported data. Future studies that could use observable behaviours as proxies for motivational and self-belief constructs would be highly desirable, though difficult.

4.5 Conclusion

Although it is not possible to prove the causal paths specified among the various constructs, they are suggestive of causal mechanisms that are coherent with self-regulation theory. Students who actively use feedback to guide their learning practices increase in self-regulated learning and academic performance. Ensuring that students receive feedback beyond grades and scores early enough to effectively guide subsequent learning is necessary, as is students implementing such an approach to their learning.

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