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Reviewing Failure as Part of Reflection: A Potential Predictor of Health Sciences Students' Successes

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Reviewing Failure as Part of Reflection: A Potential Predictor of Health Sciences Students' Successes

Introduction

Teaching reflection to future health professionals has become increasingly common. When students reflect either “in” or “on” action (Schön, 1983; Mezirow, 1991), they learn from events by processing related emotions, by contextualizing how and why those events occurred, and by thinking critically about how to handle similar events in the future (Mann, Gordon, & MacLeod, 2009). Despite these perceived benefits for students and the increased use of reflective activities in curricula, the value of teaching reflection is far from certain in health professional education (Carr & Johnson, 2013; Embo, Driessen, Valcke, & van der Vleuten, 2015; Grant, Kinnersley, Metcalf, Pill, & Houston, 2006; Lew & Schmidt, 2011; McCrindle & Christensen, 1995; Ottenberg, Pasalic, Bui, & Pawlina, 2015; Sobral, 2001; Stephens et al., 2012). Our research aims to quantify the relationship between health sciences students’ willingness to review an artefact of failure (a key initial step for reflection) and their potential of becoming health professionals. That is, are the health sciences students who are likely to review artefacts from an unsuccessful experience the same students who are likely to become health professionals?

The Health Sciences First Year programme (HSFY) at the University of Otago is a foundation year for five health professional programmes: Medicine, Dentistry, Medical Laboratory Science, Pharmacy, and Physiotherapy. In the week before the HSFY student cohort commences its four requisite courses of the first semester, those students sit for a written English diagnostic test comprising of Reading Comprehension (RC), a Listening Comprehension (LC), and an Essay section. This diagnostic test primarily aims to identify at-risk students; it also provides an annual dataset of 1300 health sciences students’ basic literacy and study skills—skills that we have shown to correlate significantly with being selected into health professional programmes (Cop & Hatfield, 2016; Cop & Hatfield, 2017). While we have identified that linguistic skill at point of entrance to university seems to indicate subsequent academic performance in the health sciences at university, the relationship between students’ willingness to reflect (a skill that is not related to linguistic competency) and their academic success has not yet been sufficiently established. That is, even though this diagnostic test is intended to measure linguistic competency, the test may also be used to explore general study skills and habits of thought. Are students willing to review a failed test (a study skill), thereby taking a step towards reflection on failure (a habit of thought)? In this present study, therefore, the English diagnostic test acts as a proxy for one of the many skills and habits that students bring (or do not bring) to university: the willingness to reflect.

Reflection can occur at different phases of an experience. Boud, Keogh, and Walker (1985) recognized that “reflection is not a single faceted concept...but a generic term which acts as a shorthand description for a number of important ideas and activities” (p. 8). They locate three phases of reflection for any experience: reflection that prepares one for an experience; possible reflection during the experience; and reflection after the experience. In this third phase, individuals often return to artefacts created during the second phase, such as logs, diaries, or notes. In the instance of our students, the second phase (i.e. the testing period) leaves only one physical artefact: the test itself. Students are prohibited any other paper or electronic recording device. Each test paper not only contains the questions and a student’s subsequent responses, but students also frequently take notes in the margins, highlight portions of text or instructions that they deem important, formulate draft answers, and record their thought processes in the margins.

While the test is intended to assess literacy skills, the physical test paper becomes a key artefact of students' experience—a physical artefact that is not necessarily tied to the literacy skills it tests. Certainly, students are likely to review the test to see where they went wrong with their literacy skills, but here we are primarily interested in the act of reviewing. With reviewing physical artefacts being important to reflection, reviewing these test papers becomes a key step towards reflection for our students. Can such a step towards reflection tell us anything about which students will go on to succeed in the health sciences?

The relationship between reflective tasks and academic performance has not been clearly defined. Some studies have shown little relationship between reflection and academic success (Carr & Johnson, 2013; Grant et al., 2006; Ottenberg et al., 2015). For example, Lew and Schmidt (2011) studied the prolonged reflective journal writing of 690 applied sciences students, finding that while repeated self-reflective writing on their learning process and on their course content did have some benefits for students, it did not lead to significant improvements in their test scores. Other studies have shown more significant relationships between reflective tasks and academic results (Embo et al., 2015; McCrindle & Christensen, 1995; Sobral, 2001). For instance, looking at 994 pre-clinical medical students at the Uniformed Services University, Stephens et al. (2012) explored how self-reflection (as measured by the first-year "Human Context of Health Care" course—a course that emphasizes self-reflection) related to academic achievement (as measured by both pre-medical school MCAT scores and end-of-medical school GPA). They found that "Human Content of Health Care" grades correlated with overall GPA ($r=0.3$; $p < 0.001$). Such studies show how reflection impacts or fails to impact academic results, but they do not necessarily relate those impacts to students' professional futures.

Our research approaches the relationship amongst reflection, academic results, *and* becoming a health professional through the willingness to take this initial step towards reflection. That is, while many studies allow students to opt into research about reflective tasks, the reflective tasks themselves are not optional, being either part of assessments or built into the curricula (Chimera, 2007; DasGupta & Charon, 2004; Embo et al., 2015; Jasper, 1999; Lew & Schmidt, 2011; Sukhato et al., 2016; Wellard & Bethune, 1996; White, 2008). When students had a choice to engage in reflective activities, they often did not choose to do so. For example, Grant et al. (2006) invited 232 third-year medical students by email to attend a lecture that would explain how one might benefit from reflective learning and what students' participation in reflective learning activities would involve. Sixty-five students attended the initial lecture; 35 continued with the activities; of those 35, 15 dropped out subsequently. Plack et al. (2007) asked 81 third-year pediatric students (after the students had attended presentations on how journaling influences reflection) to participate voluntarily in maintaining reflective journals during their six-week clerkships at Georgetown University Hospital. They offered no specific incentives for participation. Twenty-one students (25.9%) opted in.

In their systematic review of research into reflection and reflective practice, Mann et al. (2009) argued that "most models of reflective practice depict reflection as activated by the awareness of a need or disruption in usual practice" (p. 3). Given their assertion, the uncertainty about the relationship between reflection and academic performance, and the apparent student reticence towards voluntarily engaging in reflective tasks, our research gauges how first-year health sciences students' willingness to review an artefact from failure at this early point in their

university career might be indicative of their later academic success and entrance into health professional programmes.

Methods

HSFY students who fail their first English diagnostic test (T1) are given a second opportunity to take the test (T2). Between these two tests, students are strongly encouraged to review their failed test. The rationale for this process is twofold. First, it decreases the number of students who fail the diagnostic for non-linguistic reasons, such as unfamiliarity with the demands of the academic discourse community or performance-reducing anxiety on what usually is their first test in a university setting. Second, it allows students time to reflect on their failure before they take T2 by reviewing their marked test, understanding whether they failed for linguistic or comprehension reasons, and seeking help with specific areas of deficiency. The students are informed by email of their T1 results three weeks after completing T1 (the time needed to mark the tests). The emails do not inform students why they failed. While students may intuit that they failed because they were anxious, did not answer every question, or did not use their time efficiently, they cannot know the specific reasons for losing marks without reviewing the test. They have 60 days from receiving the email to taking T2.

There is motivation (beyond improvement on the diagnostic) for HSFY students to review their test in this instance—motivation that could combat the previously cited reticence for reflective tasks. While all HSFY students take the same four courses in the first semester, they are required to take only three core courses in the second semester, with the fourth course being optional. This optional fourth course gives students a chance to boost their GPAs as only their seven best course results for the whole year are considered during the admission process for the five health professional programmes. Students who fail T2 *do not* have the option of taking an optional fourth course because they are required to take a remedial communication course, a course which is graded pass/fail. That is, it cannot contribute to students' GPAs. As students value the limited available spots in the health professional programmes, they also wish to avoid a course that cannot help their admission efforts. Students are generally intrinsically motivated to review T1.

Given the intrinsic motivation for succeeding on T2 for each student, were students taking the time to review the one concrete artefact of the testing process, a seemingly important step in retrospective reflection? To confirm if students from the 2016-2017 HSFY cohort reviewed their failed T1, administrators stamped and dated students' tests after the students had reviewed their failed tests. We then paired Students Reviewed (SR) and Students did Not Review (SNR) with their marks on T1 and T2, with their Mean Marks for their requisite Semester 1 courses (MMS1), and with Entrance into Health Professional Programmes (EHPP).

To ensure that all students took the same diagnostic tests and courses under the same circumstances, we included only students who took both T1 and T2 and who completed all four first-semester HSFY courses. Students who withdrew from courses or took some courses in previous years were also excluded. In total, 568 students met the criteria for inclusion in this study (300 in 2016 and 268 in 2017). In sum, the sample is composed of all students who took the diagnostic test, completed their HSFY, and proceeded through the programme in the single year. With these students' results, we tested the following four research questions:

What portion of students would choose *not* to review their failed T1 before sitting T2?
Would SR demonstrate greater improvement on T2 than SNR?
Would there be a significant difference for SR and SNR in mean marks across requisite first-semester HSFY courses?
Would SR have a higher entrance rate into health professional programmes?

To gauge students' improvement on T2, we first needed to determine students' baseline on T1 itself. To set this baseline, we looked at students' Reading Comprehension Mark (RM) and Listening Comprehension Mark (LM). Only these two sections were chosen (rather than the third section, the Essay section) because together they sufficiently cover written and aural communication skills and because they are also similar in structure, making comparison more appropriate: both are 10-minutes long, have 5 questions worth two marks each, and require written responses of roughly the same complexity. They do differ, however, in that the RC requires students to respond with grammatically complete sentences, but the LC allows students to respond in bullet or point form. Naturally, students must produce more language for the RC, which means there is more language to examine and there are more errors to commit. To help determine students' baseline for T1 and relative improvement on T2, we therefore also focused on the following five general error categories as found in the RC: blank answers (N.Blank), sentence fragment errors (N.Frag), grammatical errors (N.Gram), punctuation errors (N.Punct), and spelling errors (N.Spell).

We gained ethical consent for this research through the Department of English and Linguistics and the Ethics Committee at the University of Otago. Funding for this research came from a 2017 University of Otago Research Grant.

Results

1. Forty-two percent (N=237) of students chose *not* to review T1 after failing and being encouraged to review it.
2. As to which students showed greater improvement on T2, an ANOVA analysis demonstrated that SR were already scoring higher on T1 itself than were SNR (Table 1). This relationship was significant for both RM ($F(1,566)= 5.608, p=0.018$) and LM ($F(1,566)=4.117, p = 0.043$): SR scored 5-8% higher on T1 itself than did SNR. SR also committed fewer N.Blank, N.Frag, N.Punct, and N.Spell errors on T1—errors that might be attributed to study skills (such as using the allotted time effectively or following instructions by writing in grammatically complete sentences) or attention to detail (such as placing a full-stop at the end of a sentence or avoiding the misuse of a homonym). Yet, SR committed more N.Gram errors on average on T1—errors that are perhaps most indicative of linguistic deficiencies, such as subject-verb agreement or verb conjugation errors.

We then examined if reviewing the marked T1 correlated to improvement on T2 by calculating the difference between T2 and T1 and then by turning that into a proportion of students' T1 score. This relative improvement, therefore, accounted for SR having higher scores on T1 than did SNR and measured how much the student improved. While SR improved on T2 by all

measures (RM, LM, N.Blank, N.Frag, N.Gram, N.Punct, and N.Spell) more than SNR improved, these differences did not reach significance. The number of N.Blank approached significance using the non-parametric Wilcoxon test, required due to the non-normality of the data ($W=29340$, $p = 0.093$). In sum, there was no clear evidence of improvement on T2 by reviewing a failed test.

Table 1. Marks (RM and LM) and Number of Errors (N.*) on T1 for SR and SNR

	RM	LM	N.Blank	N.Frag	N.Gram	N.Punct	N.Spell
SNR	3.45 ^a	5.77 ^b	0.23	1.22	1.33	1.86	1.21
SR	3.75	6.03	0.18	1.05	1.61	1.73	1.12

^a. RM ($F(1,566)=5.608$, $p=0.018$); ^b. LM ($F(1,566)=4.117$, $p=0.043$).

3. SR earned an MMS1 of 66 (SD: 13.8), compared to 57 (SD: 14.4) for SNR, a difference of 9 marks. To test the significance, we built a set of regression models that predicted MMS1 with independent variables of RM, LM, and Reviewing (SR or SNR). It was not appropriate to include N.Blank, N.Frag, N.Gram, N.Punct, and N.Spell here as they comprised RM and LM scores. RM and SR were significant; LM neared significance (Table 2). This model, therefore, indicated that students who reviewed their test earned higher health sciences marks even after higher diagnostic scores are accounted for in the model.

Table 2. Linear Regression Model to Predict Mean Mark in Health Sciences Courses

Predictor	Estimate	<i>T</i>	<i>P</i>
Intercept	47.764	16.405	<0.001***
Reviewed = Yes	8.015	6.731	<0.001***
Reading Mark	1.591	3.955	<0.001***
Listening Mark	0.638	1.697	$p = 0.09$

The consistency of the importance in reviewing the test could also be seen by examining SR versus SNR by quartile for RM (built around standard deviations from the mean). In all RM quartiles, those who reviewed their marked T1 earned a higher MMS1 (Figure 1a). Finally, we flipped perspective and looked at MMS1 quartiles. How did SR and SNR relate to MMS1 quartiles? As seen in Figure 1b, the chance of achieving a higher quartile mark decreased steadily for SNR.

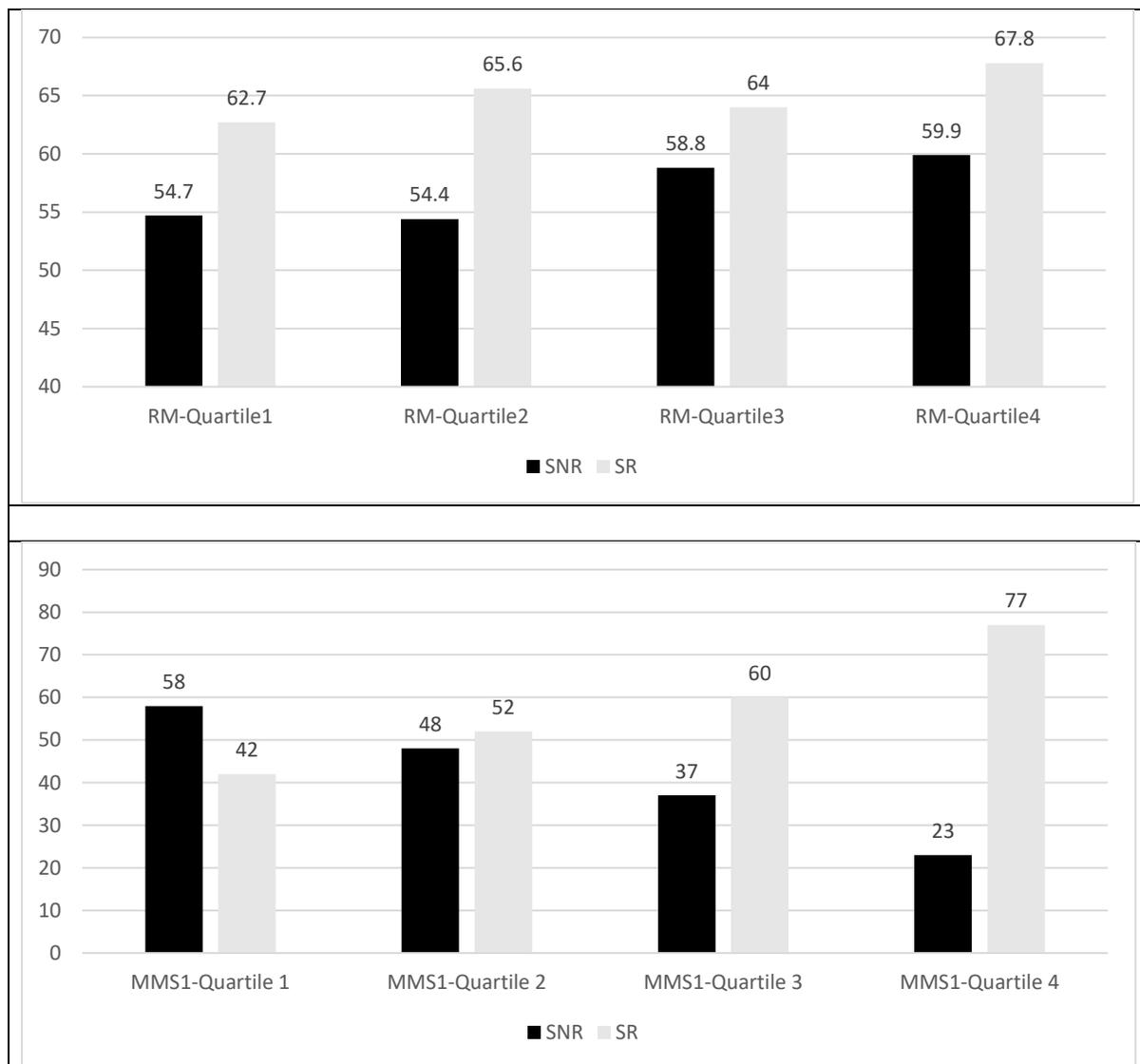


Figure 1a. Mean mark in Health Sciences classes against RM on the diagnostic test for SR and SNR. Figure 1b. Percentage of SR and SNR in each quartile for their mean mark in Health Sciences courses.

4. 74% (N=136) of those who failed T1 and still successfully gained entrance into a health professional programme were SR, while 26% (N = 48) of successful candidates were SNR. By comparison, of those who did not successfully gain entrance into a health professional programme, 55% were SR and 45% were SNR. We created a logistic regression with successful placement into a health professional programme as a binary dependent variable and RM, LM, and SR/SNR as independent variables. Only SR/SNR was significant (*Wald's Z* = 3.108, $p = 0.002$) in indicating who would be placed in a health professional programme. SR are the students who earn higher MMS1 and therefore who are more likely to gain placement in health professional programmes—even though MMS1 is not the only factor for placement. When MMS1 is added to the logistic regression model as an independent variable, only MMS1 is

significant (*Wald's* $Z = 8.307$, $p < 0.001$) and SR/SNR no longer is (*Wald's* $Z = 0.764$, $p = 0.445$). Therefore, SR/SNR indicates MMS1, which in turn indicates placement offers.

Discussion

Given that reflection on action (or retrospective reflection) can be facilitated by reviewing written artefacts created during an experience (Boud et al., 1985), and given that the diagnostic test paper is the only written artefact from our students' unsuccessful experience (i.e. the test records both their answers and their process notes), we examined the rate of voluntary participation in our relatively simple reflective activity (i.e. coming to review a failed test). That rate was considerably higher (58% SR) than the rate of voluntary participation in reflective activities in previous studies (Grant et al., 2006; Plack et al., 2007). This higher rate could be due to a variety of factors. For one, students should have been intrinsically motivated to perform this reflective task because passing T2 could aid their chances of gaining admission to a health professional programme: if they passed T2, they might be able to bolster their GPA through an elective course in the second semester. Our students were also free to review their test as frequently as they liked, for as long as they liked, and at their convenience during hours when administrative staff were on duty (11:00-16:00, Monday-Friday). Previous studies with lower voluntary participation rates in reflective activities required a more sustained or specific effort from their students (Grant et al., 2006; Plack et al., 2007). Further, some studies have shown students resisting or doing the minimum amount of reflection needed to comply with or to pass the particular reflective task (Hahemann, 1986; Pee, Woodman, Fry, & Davenport, 2000; Sukhato et al., 2016; Wellard & Bethune, 1996); other studies have shown that one of the frequent complaints about reflective activities is the amount of time that such tasks often take to perform (Chimera, 2007; Grant et al., 2006; Pee et al., 2000). That is, our higher rate of participation might reflect the simplicity of the task, the temporal freedom that students had, or the meaningfulness of the task to them.

Notwithstanding this simplicity, freedom, and meaningfulness, slightly less than three-fifths of students reviewed their test, suggesting that health sciences educators need to teach reflective processes to their students. This teaching may include focusing on learning as a continual process of development, a process that may require individual effort and motivation to facilitate that development. If students are not willing to take a relatively simple initial step towards reflection when they could receive direct benefits from that step, students may not be more motivated to do so when others (e.g. their patients) will instead be the beneficiaries. More research is needed to discover if altruism could be a stronger motivation for engagement in the reflective process than is self interest.

Choosing to reflect upon performance by reviewing their failed test did significantly indicate larger success in students' health sciences education. On average, students who chose to review their failed test achieved 9 more marks across their first-semester courses than did students who did not review their failed test. The effect of reviewing on MMS1 persisted at all levels of ability on the diagnostic test (Figure 1a). Additionally, while 58% of those in the lowest MMS1 quartile did not review their T1, only 23% in the highest quartile did not review their failed T1 (Figure 1b). It is unlikely that reviewing the test has a direct causal relationship with higher marks. Indeed, there was no clear evidence that those reviewing T1 improved more on T2 than those

who did not. However, the sort of student who does choose to take this step towards reflection in this one instance does better in their health sciences courses in general. The effect of reviewing the failed T1 and achieving higher MMS1 carried over to earning a placement offer in the professional programmes as well, with three-quarters of those who earned a placement offer in a health professional programme having chosen to review their test.

Our data suggest that health sciences students who are likely to review artefacts from an unsuccessful experience are also the same students who are likely to become health professionals—so long as academic success remains part of admission processes for the health professions. Our study corroborates previous studies (Embo et al., 2015; McCrindle & Christensen, 1995; Sobral, 2001) that found a connection between reflection and academic success as opposed to previous work that did not (Carr & Johnson, 2013; Grant et al., 2006; Ottenberg et al., 2015). The reasons for this difference in findings appear to depend upon both the students themselves (for instance, students at the start of their university career or those several years into a programme) and the precise sort of reflection. More research is needed to determine precisely which types of reflection or which stages in the reflective process determine success in the health sciences: is a small step such as coming to review an artefact from an unsuccessful experience as predictive of success as is reflecting profoundly in an extended written reflective exercise?

Following this research, we recommend that future studies should attempt to determine if health sciences students will engage in relatively simple reflective tasks more willingly if those tasks are perceived to benefit others' interests rather than the students' own interests.

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