

Research writing in the Sciences: Liminal territory and high emotion

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Abstract

Academic and scientific literacy experts agree that becoming literate in an academic discipline involves coordinating language learning, and thinking in increasingly sophisticated ways to enable participation in discipline practices of knowledge construction. Despite this knowledge, understanding of writing pedagogies in tertiary science are in their infancy, and in the absence of universal methodologies of support there are potential consequences for research students as they progress from novice to expert in their discipline. We investigated the writing experiences of Science research students in an Australian university, with a focus on the writing needs of these students. Using a mixed method approach, quantitative and qualitative data were collected from 65 individuals (29 supervisors and 36 students) in an online questionnaire and in seven follow-up focus groups and interviews with 28 supervisors and nine students. The key themes which emerged from the data were the key role of supervisors, the relative importance and degree of difficulty of doctoral writing tasks and the anxiety, stress, struggle and high emotion, associated with “learning to write”, experienced by both students and supervisors. Despite considerable diversity, many supervisors were focussed on the product and outcome of writing, while many students struggled with the process of writing. Such struggles centred around the scatter gun of idiosyncratic, and sometimes good ideas which supervisors and students used to transition through liminal space to emerge with new writing skills and discipline understandings. There was a clear sense that the final product was the responsibility of the supervisor. Even to the extent of writing the thesis for the student. This indicates the time and publication pressures that students and supervisors are under with the rise of the enterprise university.

Keywords

Science, writing, PhD candidature, student/supervisor dyad, writing circles, threshold, liminality

Introduction

The rise of the “enterprise university” (see for example Marginson & Considine, 2000) is forcing a reconsideration of the development of literacy skills in research students in the Sciences as pressure increases to achieve timely completions of theses and the necessary publications, certified and validated by peer-review, to progress careers (Lee & Kamler, 2008; McGrail, Rickard & Jones, 2006). Students, however, do not necessarily *automatically* know “how to write” (Aitchison & Lee, 2006; Bjork, Brauer, Rienecker & Jorgensen, 2003; Murray, 2001) and their academic supervisors do not necessarily know “how to teach writing skills”. Perhaps this is because they do not perceive this as their role and/or the slow acculturation into the disciplines that they experienced restricts their ability to articulate the tacit (Carter, 2007; Ross et al., 2010). Although there have been some advances in science research training in recent years, mainly towards teams and peer learning (Havnes, 2008; Jackson, 2009), most of the training of writing skills still occurs through the traditional paradigm of the student/supervisor dyad (Frischer & Larsson, 2000; Parker, 2009; Pearson & Brew, 2002).

Part of the challenge for novices developing literacy skills is coming to terms with the variety of language forms and communication genres (McCune & Hounsell, 2005) with limited opportunities, in the undergraduate curriculum, to do so. This is possibly intensified in science disciplines because abstract and symbolic language, rather than the written text, can be used to express ideas (Ross, Taylor, Hughes, Kofod, Whitaker & Lutze-Mann, 2010; Snow, 2010). Although it is well acknowledged in the literature that scientific language can be a significant barrier to learning (Brown & Ryoo, 2008; Lemke, 2004; Ross & Tronson, 2007; Ross et al., 2010; Wellington & Osborne, 2001) it is not unusual to hear undergraduates declare that they have entered science and mathematics study at tertiary level to avoid writing

It is clear that increasing control over the use of scientific language, particularly in writing, is a transformative process for a student. Rather like the passage from “novice to expert” (Ross et al., 2010, p. 6) accompanied by an extension of language (Meyer & Land, 2005), both in verbal and written form reflecting a transformational cognitive and ontological shift (Meyer, personal communication). This claim is supported by a number of studies on student language and literacy learning for academic purposes. Leading researchers of both cognitivist (Bereiter & Scardamalia, 1987) and sociocultural persuasions (Bruce, 2008; Carter, 2007; Cummins, 2001; Haggis, 2006; Ivanič, 2004; Lea & Street, 1998; Wingate, 2007) broadly agree that becoming literate in an academic discipline involves coordinating language learning and thinking in increasingly sophisticated ways to enable participation in discipline practices of knowledge.

Such transformations and transitions do not, however, occur automatically, linearly nor are they unidirectional. Novices can get “stuck” (Meyer and Land, 2005) in a state of liminality. Transformations can be protracted, over considerable periods of time, and involve oscillation between states, often with temporary regressions to an earlier status (Meyer and Land, 2005 p.376) and can be characterised by high anxiety, high activity, procrastination and confusion (Ross et al., 2010). These are the periods when the desired transformed status is not yet in reach and mimicry rather than membership of the discipline may occur.

In this study, we aimed to determine what type of writing tasks research students and their supervisors find difficult and what approaches to supervision are used within the Sciences, which pride themselves on their unemotional objectivity and where “publication culture is the norm” (Cuthbert & Spark, 2008, p. 78). We did this analysis to determine if students are stuck in liminal places and if so just what are the strategies used to move them along the journey of peripheral to legitimate discipline membership characterised by a writing transformation.

Methods

The study was undertaken, by colleagues from a literacy support unit and science researchers in a large Australian metropolitan university, between December 2007 and July 2008. A mixed method experimental design was used to investigate the practices of doctoral supervisors in supporting the writing of their science postgraduate candidates. The survey targeted students who were enrolled in postgraduate research degrees (Masters, Doctor of Philosophy) and experienced supervisors who were currently supervising graduate students from a range of disciplines including; science, health, engineering, nursing, biomedical science, computing, and mathematics. An online 16-question survey was emailed to 177 research students and 187 supervisors. This represented all students currently enrolled in research higher degrees within the faculty and their supervisors.

Students and supervisors were asked: to rank the relative level of importance and the degree of difficulty they experienced with the main writing tasks in a doctoral candidature on a 1-5 (low to high) Likert scale; and to answer a series of open-ended questions about the sources of help for writing, access and uptake of supervisory and non-supervisory writing assistance, and perceptions of supervisor/student responsibility for writing development. The quantitative open-ended responses were categorized and enumerated.

Follow-up focus groups and/or interviews were undertaken to provide more detailed accounts of how participants experienced writing as part of doctoral candidature - either as students or as supervisors. The objective of these questions was to give graduate student participants an opportunity to discuss how they thought learning to write occurred during a doctoral candidature. Students were also requested to speak about themselves as writers and their writing experiences as graduate students, and they were asked to define their supervisor's role in developing their writing skills, together with other help that they accessed during the process of learning to write. Supervisors were encouraged to reflect on the pedagogical practices that they employed to assist students in learning to write. They were also asked which pedagogies they considered would be helpful for students beyond the immediate student/supervisor dyad. The qualitative data from the online surveys, and the focus and interview transcripts were theme coded using NVivo and compared with the quantitative results.

Respondent demographics

Of the 65 self-selected respondents (29 supervisors and 36 students; response rate of 17.85%) to the online survey, 41.0% were male and 59.0% were female. Ninety percent of supervisors who responded to the survey were acting as principal supervisor; 41% (12) were male, 59% (17) female, and 28% (8) were over 51 years of age. The students who contributed to the study were typical of the profile of students within the faculty who were beyond the first year of their candidature. For example, most student respondents (86.0%, n=31) to the online survey stated that they were enrolled in the PhD program and 75% (n = 23) had successfully developed their program of study which included a literature review, outline of their project, and oral defence of their research proposal; all compulsory for continuation of their candidature beyond the first year of their enrolment. Of the student respondents, 36.0% were under 30 years of age, 25% were between 31 and 40 years of age, and 39.0% were over 41 years of age, while 69.0% were female and 28.0% were male. The largest group of students (39%) came from a health science school and the second largest group (33%) came from a Science school (Tables 1-3). In the qualitative survey twenty eight supervisors participated in seven focus groups and two individual interviews in the following proportions: science (54%), nursing (18%), engineering (14%) health/science (7%), Maths and Computing (7%). Overall there was greater participation, in this research, by academics from science schools (quantitative and qualitative survey combined).

Table 1. *Ages of participating students and principal supervisors in the quantitative online survey.*

Age	Students (N = 36) n (%)	Supervisors (N = 29) n (%)
<30	13 (36.1%)	0
31-40	9 (25.0%)	5 (17.5%)
41-50	11 (30.6%)	15 (52.0%)
>51	3 (8.3%)	8 (28.0%)
Not known	-	1 (3.0%)

Table 2. Number of students and supervisors from each School participating in the quantitative online survey.

School	Students (N = 36) n (100%)	Supervisors (N = 29) n (100%)
Engineering	1 (2.8)	3 (10.3)
Mathematics	3 (8.3)	1 (3.4)
Health/Science	14 (38.9)	5 (17.0)
Nursing	3 (8.3)	9 (31.0)
Science	12 (33.3)	8 (28.0)
Medicine	-	2 (7.0)
Not known	3 (8.3)	1 (3.4)
Total	36	29

Table 3: Other data from the student respondents

	Studying PhD	Confirmation of Candidature completed ¹	
Yes	31(86.0%)	Yes	27(75.0%)
No	2(6.0%)	No	6(17.0%)
Not known	3(8.0%)	Not known	3(8.0%)

¹Confirmation of Candidature required for progression beyond first year of study

Results and Discussion

Importance and difficulty of learning to write

Students and staff ranked thesis and manuscript publication/preparation highest in importance and difficulty (student ranking of “high” for importance for thesis, 92.6%; journal article development, 92.3%; supervisor ranking of “high” - for thesis, 100%; journal article development, 83.3%). Supervisors tended to rank the level of difficulty of thesis publication at an equivalent or higher level of difficulty and/or importance than students. Of the writing tasks, thesis writing and development of journal articles were considered the most difficult and important. In contrast, the task of writing a conference paper was considered less arduous and more closely approximating the difficulty of writing an ethics application or abstract than the effort required for the development of a journal article.

Preparation of annual progress reports and laboratory reports was considered least difficult by both students and supervisors. Students considered laboratory reports substantially more important than supervisors perceived them to be while supervisors considered annual progress reports and ethics applications substantially more important than the students did. The greatest discrepancy in perceived levels of importance for writing tasks was the difference in importance between ethics applications and laboratory reports. Students thought writing laboratory reports more important than supervisors considered them to be, while the perception of supervisors was that ethics applications were a more important writing task than students viewed them to be (Figure 1).

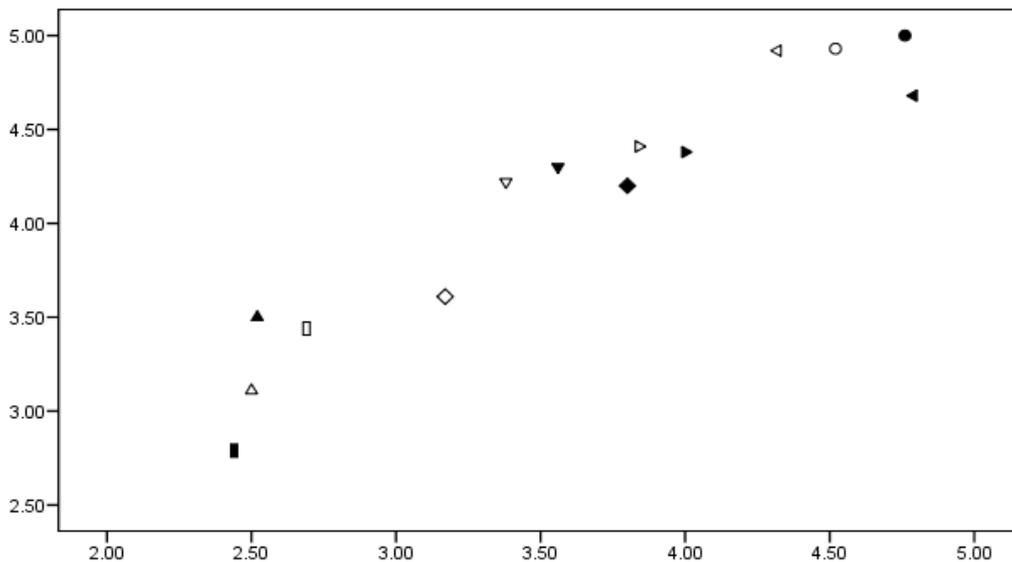


Figure 1. Comparison of student and supervisor's average ratings of importance compared to difficulty of writing. Filled in symbols are the ranking of supervisors and open symbols are ranking of students on a 1-5 Likert scale where they were asked the importance and level of difficulty of doctoral writing tasks from extremely difficult/important (5) to not at all difficult/important (1). ● Thesis, ◆ Ethics application, ▲ annual progress report, ▼ abstract, ■ laboratory report, ▶ conference paper and ◀ journal article.

When explicitly asked to compare the relative importance of writing the thesis to writing for publication, the majority of students said they were of equal importance. The three reasons commonly cited for this answer were; “for the dissemination of research”, “for the benefit of [their] future career” and “as a strategy for learning to write the thesis.” Only 2.3% of student respondents argued for the reverse: that “the writing of the thesis informed the writing of publications.” Amongst the supervisors there was effectively universal agreement that writing for publication and thesis writing were equally important. Their comments indicated a relatively seamless view of the equivalence of these two writing tasks.

Support and role of supervisors in learning to write

The theme of “learning to write” was evidenced in two ways: the level of support and the strategies for doctoral students learning research writing. When supervisors and students were asked about the level of support provided for doctoral writing, 15 students and 7 supervisors responded that the supervisor had the main role in doctoral writing. Students (7 responses) and supervisors (6 responses) were also in agreement that their support was either “insufficient” or “none”. More students (15) than supervisors (9) valued the support for doctoral writing provided by “workshops,” “writing retreats” and “thesis writing circles” (i.e., opportunities for communal support in writing organised by the university). Supervisors placed almost equal store on the communal writing opportunities and their own input (9 compared to 7 responses). “Peer support” was seldom mentioned (1 response). “Model texts/publications” were considered of even less value (<1 response) than peer support in the process of training for doctoral writing (Table 4).

Table 4. Support for doctoral writing nominated in responses developed from open-ended question in online survey. Whole values indicate number of responses with percentages in brackets.

Student (%)	Help for doctoral writing	Supervisor (%)
15(37.0)	Supervisor	7(26.0)
10(25.0)	Workshops	5(18.0)
7 (17.5)	Insufficient	6(22.2)
1(2.5)	Peer support	1(4.0)
0	Model texts	1(4.0)
1(2.5)	Publications	0
4(10.0)	Thesis writing circles	3(11.0)
1(2.5)	Writing retreats	1(4.0)
1 (2.5)	None	3(11.0)
40)		27

Overall, students considered the supervisor's role in developing writing was through non-specific writing, help and guidance (11 responses). More students (20 responses) than supervisors (9 responses) considered the supervisor's role "critical for developing writing, help/guidance and providing feedback". Students valued the support from supervisors in the categories of "encourage student/encourage writing" (6) and "develop style" (6). Despite more students identifying provision of "writing help/guidance" (11 responses) as the role of supervisors more than any other activity discussed, only one supervisor (1) identified this activity as a role for supervisors. No supervisors saw that their role was to develop the student's writing style. However, a similar number of students (5) and supervisors (4) considered that the role of a supervisor was to provide feedback to students. There was apparently a very low expectation from students and supervisors in "monitoring standards" or "mentorship" (see Table 5).

Table 5: The role of supervisors in developing writing developed from open-ended question in online survey. Whole values indicate number of responses with percentages in brackets.

Student (%)	Supervisor role in developing writing	Supervisor (%)
4 (9.5)	Critical for developing writing	4 (22.2)
11 (26.2)	Provide (non-specific) writing help/guidance	1 (5.5)
5 (12)	Give feedback	4 (22.2)
6 (14.3)	Encourage student/encourage writing	2 (11.1)
6 (14.3)	Develop style	0
2 (4.7)	Help with structure, layout, presentation	1 (5.6)
3 (7.1)	Correct English/grammar/edit	1 (5.6)
1 (2.4)	Refer on for writing help	1 (5.6)
1 (2.4)	Mentor/be a role model	1 (5.6)
1 (2.4)	Monitor standard	1 (5.6)
1 (2.4)	Limited role	0
1 (2.4)	Not edit	2(11.1)
42		18

When asked “What do you think is the most helpful way to develop research writing skills,” students and supervisors agreed that formal institutional support (e.g., writing workshops, classes, courses, writing retreats; 6 responses), “on-going writing support such as writing groups” (5 responses), “being critiqued and receiving feedback” (5 responses) and “reviewing, critiquing models including peer review receiving feedback”, “practice” and “supervisor” (4 responses) were more valued compared to other options presented (Table 6). Other nominated strategies that received no more than 1 response from students were “writing for publication” and “give writing to someone else and focus on the research” (Table 6).

Table 6. *Student and supervisor nominated strategies for developing research writing developed from open-ended question in online survey. Whole values indicate number of responses with percentages in brackets.*

Students (%)	Ways to develop research writing skills	Supervisors (%)
6 (20.0)	Formal writing workshops, classes, courses, writing retreats	3 (17.6)
5 (16.7)	On-going writing support such as writing groups	1 (5.9)
4 (13.3)	Reviewing, critiquing models including peer review	5 (29.4)
4 (13.3)	Practice writing “just do it, often”	4 (23.5)
5 (16.7)	Being critiqued, receiving feedback	1 (5.9)
1 (3.3)	Writing for publication	2 (11.7)
4 (13.3)	Supervisor	0
1 (3.3)	Should be able to give writing to someone else to do and just focus on the research	0
0	Pre-entry language testing screen out inadequate writers	1(5.9)
30		17

Liminal space and transitions

It was acknowledged, in focus groups, that a series of transitions were experienced by students between undergraduate course work and honours, between honours and PhD, between PhD and publication and between qualitative and quantitative research writing. For example, supervisors often referred to the gap between the kinds of writing expected in coursework graduate programs compared to research degrees and students too referred to the gaps between undergraduate and postgraduate studies and changes of approach from quantitative to qualitative research writing. This was echoed in the comments of one student who said “my written work came back poorly throughout my undergraduate degree, but I didn’t have to do much writing and I was not prepared for PhD writing”, another who said “honours was a completely different ball game” and finally “biggest challenge has been changing from scientific report writing approach of past to qualitative narrative approach... a shift in mindset”. One supervisor summed up the difference between the levels of writing as the difference between the ability to write descriptively and the ability to effectively interpret and critically analyse, “[research candidates] could be good at describing what they observe in their studies but when it comes down to the critical analysis of those data and interpreting those data, they basically lack that skill.”

Throughout the student and supervisor interviews there were strong comments relating to being stuck. One student stated, “I just get stuck in a little hole. Only going to thesis writing circle gets me out of the hole... if I go back to supervisors I just get pushed back in the hole”. Several supervisors indicated that they refused to help students who were stuck with basic English skills. They suggested it was not their “job” to develop these language skills in students and that students should have the skills at the point of entry. One supervisor summed this up by saying “I do not really do the grammatical corrections and all that, although I do point out mistakes from time to

time”. However, despite the identified “challenges” with writing, “pre-entry language testing” to “screen out inadequate writers” was only mentioned by one supervisor and the suggestion that being “able to give writing to someone else to do and just focus on the research” was only mentioned by one student (Table 6).

The perceived lack of ability, unwillingness or unrealistic expectation to teach writing and/or English was a theme taken up in several focus groups. One supervisor, not a native speaker of English, spoke of the difficulty of “trying to learn it [academic writing skills] as well.” The perceived problems associated with sufficiently supporting student writing were not restricted to supervisors with English as a second language. Some native English speakers claimed they had “learnt to write through ‘osmosis’ and, therefore, lacked the metalanguage through which to teach others.” Some supervisors also considered that they were not “good” writers and this impeded their ability to teach or advise others. For example, one supervisor said that “I didn’t actually learn English, I can write through mimicry,”... but if you “can’t learn by mimicry, that’s the barrier” while another said that “Mostly students, like staff, struggle. Not many staff are actually great at writing stuff.” However, a smaller number of supervisors felt confident in both their own writing skills and their ability to teach with one supervisor reporting that “I’ve always felt competent [in my ability to write and support student writing]. Confident and “competent” and yet his student stated, “supervisors didn’t really know how to help.”

Everyone in the focus groups agreed that competency in writing certified that a transition had taken place to transform a research student to doctoral standard. One supervisor said: “well if you are training people to be academics then you have to teach them to write” although there were some differences in the positioning of writing. Another stated, “the program is viewed as a licence to kill... Okay they have reached the standard, and for us in the area of science. The licence to kill really has a focus on the scientific method rather than writing” and “if you’re training people to be academics then you need to train them in how to write, in a way appropriate to the discipline” while other supervisors described the aversion to writing of students. For example, in discussion with a student who had done an “immaculate job”, but created a “very very poorly presented thesis” the first response of the student was: “I went into mathematics because I don’t like writing”. There was, however, considerable disparity in the views about the role of the supervisor in (1) the process, and (2) product of writing. While the majority of supervisors saw it as their responsibility to develop student writing skills, some supervisors articulated strong boundaries about what they should, could or would do “What you are presenting should be your work and not your supervisors work”.

Anxiety, stress, struggle and high emotion

Almost overwhelmingly the students interviewed spoke of the “joy and pleasure” or of the “pain and frustration” associated with writing. Several students described negative experiences in learning to write while at the same time identifying writing as central to a successful career but a challenge, typically “challenging initially, but satisfying overtime”. There were, however, an abundance of extreme responses from both students and supervisors. These extremes included one supervisor’s comment that they “usually enjoy the thesis writing,” while a student declared that “I hate every bit of it”. Similarly, one supervisor suggested that “writing is a major hurdle for four out of five students supervised,” while, other students thought that from frustration comes “joy” and the satisfaction that they are “now a confident and proficient writer in my field”.

This degree of anxiety and high emotion was more strongly presented in interviews and focus groups (where there was an equal ratio of females (5) to males (4)). The data revealed a dominant view that learning to write was a difficult component of the doctoral candidature, one that had to be suffered by both the student and the supervisor. According to this view, struggle was a normal aspect of the doctoral candidature, one that students should anticipate but expect ultimately to be of benefit “the only people who don’t [struggle] are experienced people who come to it much later in life”. One supervisor’s comments implied that the process involved “if it wasn’t a struggle, it wouldn’t be worth doing.” One even summed up this approach with the adage “affection is the

enemy of progress” and through this experience of struggle “you become a better person”. Corrected in this instance by the student/interviewer who replied “No you learn to write”. Other supervisors had a more nurturing approach offering that:

“...it is a developmental process, we probably do assist students but if it’s a partnership like it’s meant to be but I don’t actually mind that personally I work through students work with them and quite often all they need is just to re orientate the way in which they say something”
“... get the student to think about what they’re trying to say. Go away and really think about the interpretation of what you’ve written”.

One supervisor commented on the contrast between the nurturing and traditional approach to assisting students writing a doctorate:

“It’s just a different approach I think to say ‘look you’ve got to structure this better’....it’s relatively straightforward to write in a scientific way as long as you can bash it into the students but to write really conceptually is quite different”

While another stated that supervisory teams which included nurture and tradition did not work well:

“I found it difficult to supervise with other people that have the traditional model of the students come in once a month, and then they sit there and they hold court..... versus what I’ve seen in other relationships, it becomes a counselling session, you know, like my life’s tough”.

This acknowledged struggle by supervisor and student alike “students struggle like staff struggle” was not always described as a negative experience, but we observed that there appeared to be a co-dependent relationship between sustained negative experiences and the feeling of isolation and transition. Students who really struggled, for example stated, “horrendous, horrible, struggle”, “felt like giving up in the first years because no direction” and “I still want to convert, I don’t know if they’ll let me. I’ve suffered a lot – a lot of stress”. In the supervisor focus groups, much of the discussion was around the “relationship” with the student during the writing phase of the candidature, and associated with how the student would receive negative feedback about the quality of their writing. One supervisor suggested that if students “can’t take critique, [they] shouldn’t be doing a PhD, because it’s all about being critiqued the whole time. You just basically get nothing but critique for years.” Others supported their students to understand how to absorb the feedback, “I tell my students that ‘you must not be offended or shocked or horrified by the amount of red ink that comes back. It is absolutely and utterly nothing personal’ and if you say that exclusively to students, they’ll take in on board.” Another agreed and elaborated further, “just get on with it. [The feedback] isn’t anything personal; all you are trying to do is to bring it up to the mark, because it’s going to go out there to external referees.”

Pedagogies used to cross the writing threshold

In the focus groups, when supervisors were pressed to explain how they developed their students’ writing and assisted them to overcome barriers they might have to crossing the threshold, many supervisors appeared to have difficulty articulating precisely their role as supervisors beyond giving feedback and encouraging students. Silence was one of the most common responses. Overall, there appeared to be scatter gun of idiosyncratic, sometimes good ideas, with ambivalence about what kind of assistance was considered appropriate and to what extent supervisors should help students with their writing which was not communicated even amongst colleagues in the same school. When supervisors were pressed, the most commonly suggested strategies to assist students in writing were feedback, modelling and writing for publication with thesis writing circles barely rating a mention.

There was also a degree of disagreement among supervisors about the level of responsibility that supervisors had for the quality of the writing in the final thesis. For example, one supervisor considered that there was a particular responsibility to support students who had “weak English grammar.” This supervisor declared that they had gone so far as “writing the thesis for the student.” This person's discourse was, however, couched in terms of what they saw as a responsibility towards the student. There was some agreement with the view that if the content and/or laboratory work were “good,” then students could be helped to write the thesis. Other supervisors indicated that they would be prepared to modify or re-write a student's final text out of a concern for their own reputation or the public perception of the quality of the graduating student.

However, the most common position was for supervisors to recognise students had the ultimate responsibility for the development of writing competence “at the end of the day, it is the student's responsibility to write [the thesis].” Despite this stance, there was a clear sense within the focus groups that the final product was the responsibility of the supervisor. Associated with this position was the reference to “our core business and for me personally is to provide help”. This frustration with the “lack of time” was reflected in the comments of many supervisors, and this was considered to impede the imperative of giving “good” feedback on writing and/or supporting the development of writing. For example, one supervisor said, “trying to disentangle what they've written to see what they're trying to say is very, very time consuming. How much input I've put in, very much depends upon timelines and deadlines and stuff like that” and another, “how much help I give them gets impacted by timelines a lot as well as, you know, how frustrated I am “.

Feedback

Overall, feedback and “trial and error” were cited as the dominant way both students and supervisors tried to create a transformation in writing skills, although few students described this in positive terms. As with other aspects of supervision, some students were positive and others provided negative feedback. One student complimented their supervisors and listed what they considered to be “good” feedback practices: timely feedback, developmental and formative rather than summative, and couched in positive, instructive language. However, more frequently, there were complaints about the supervisors' level of support, particularly early in the process. For example, one student said, “feedback was always negative and discouraging” or not timely “The feedback was good quality, but took a very long time to come and by the time it had I had forgotten about it”. Others objected to the approach to feedback and in doing so, indicated the time they were spending on the writing process. For example, one student said “I learned by trial and error so I lost lots of time. It gives you a lot of frustration I lost 6 years” and the confusion which can erupt as drafts move backwards and forwards”.

“The only help was through trial and error with supervisors. Drafts went back and forth to supervisors whose *modus operandi* was ‘learn by doing’. The trouble is the more it gets rewritten the more foreign to you it becomes – not yours. When writing in collaboration with supervisors, they tend to monopolise. In the early stages it might be questions like ‘What does this mean?’ but later on they re-write”.

Followed by subsequent anxiety and emotion when mismatched expectations occur:

“I handed in what I thought was my final draft of the PhD thesis but my supervisor said it would fail writing. He said go away and re-write it – and get some external help. It took six months to fix up the grammar. At one meeting, I burst into tears and cried for two hours while [my supervisor] went through and said ‘That's not a sentence’ ‘That's not a sentence’.....”

Modelling

Although the use of models for the development of doctoral writing skills was generally not commented upon in the online survey, in the more open-ended exploration of the focus groups/interviews, both students and staff spoke about using models as a means for learning to write. It became quickly apparent, however, that individuals had very different views about what modelling involved. Students and supervisors saw benefit in looking at “good” research writing in theses and journal articles. One student said, “I will improve by trial and error and looking at models of journals”. A supervisor, who spoke of a lack of competence and confidence as a writing teacher, expected that students would learn by copying what they saw. Some supervisors considered that their actions to assist students with writing went well beyond modelling. At least one supervisor saw “modelling” was also re-writing the work for the student, and the same supervisor saw what he did was also more than modelling. “You’re not modelling, you know, you don’t give them an example of what to do, you fix up every sentence, every paragraph. You don’t model the process”. Others agreed stating “No, it’s not modelling; it’s just fixing it up. It is you know – it’s what we do”. Students and supervisors recognised the value of practising writing as a strategy for improving writing competence. One supervisor said:

“I guess the students that we have [are] forced. They’re facilitated and encouraged from Day 1 to write, I show them the first time we never expect them to write perfectly, they just write their ideas down, revise, and revise again and again”. The experience of writing, editing, getting feedback and rewriting is the best way to develop these skills.”

For example, a supervisor from a traditionally hard Science discipline (Chemistry) stated, “We can’t go on writing this thing.” Such perspectives from supervisors were, however, in the minority.

Publication

Out of all of the pedagogies used as strategies to cross thresholds, writing for publication has the characteristics of a transformational experience. When students spoke about writing for publication they spoke of the difficulties, rewards and satisfaction that they had finally reached a level of competence while both students and supervisors saw this activity as beneficial in learning writing skills and development of confidence in the student. For example, one offered that, “I submitted my first manuscript to a journal. It was a lot of work and frustrating sometimes. It took months to get it right. But so rewarding - I’m proud of it.” For students in some disciplines writing for publication was the “norm”, (e.g., computing, nursing) while for others it was an adjunct activity to writing their thesis. For example, one supervisor saw it as the way to train students to write:

“...Publication actually adds something else which is intangible that it adds strength to your theory because that’s already peer reviewed so that means when it goes to examiners, when you say this has been unpublished, as a peer reviewed article adds strength to your work to your thesis”

There was, however, an acknowledged mismatch between supervisor and student expectations of the amount of work associated with publication. One supervisor commented:

“Every paper I write, I screw it up the same way and I keep having to rewrite it a thousand times. Students don’t believe they need to rewrite things a thousand times. They think they can write it two times and that’s enough.”

A community to cross the writing threshold

In discussions about how they learned doctoral writing, students also spoke of “other-than-supervisor” pedagogies such as institutional writing support (i.e., workshops, thesis writing circles, writing retreats) also mentioned in the online survey (Table 6). Institutional writing support was more valued by students than supervisors. One student stated, “Big help from thesis writing circles. I went to a one-day workshop run by research office and found out about thesis writing circles. I joined one last year... gives really useful feedback” while another stated, “You need some formal training how to do research, read or write research... I heard about writing groups, but not on my campus” and finally when unable to find appropriate support one student stated, “We have started our own research group. We meet to listen to presentations, practice, writer’s block, discussions about readings and critique work”. Other examples of the positive feedback for institutionally organised activities either from students or supervisors requested more formal training. For example a student said “I am a member of a writing circle which I find has improved my confidence, knowledge and writing style. I value the nurturing environment and feedback on my work.” While a supervisor commented and “Often, [there is] the opportunity to work together with peers and [be] guided by someone more experienced during those sort of writing sessions. I certainly know one of my PhD students speaks quite highly of that approach.”

Conclusion

The results from this study suggest that many students and perhaps supervisors in the Sciences “get stuck” in the liminal places referred to by Meyer & Land (2005). These places are characterised by anxiety, stress, struggle and high emotion. Although many students move across the threshold transformed by their “rewarding” experiences to become a “confident and proficient writer for my field” others continue to oscillate in liminal space, “I’m stuck in a little hole” with the acknowledgment from supervisors and students that this “stuck place” may be part of the process, “If I say I’m stuck, they [supervisor] say it’s part of learning”. Those students that do move successfully across the writing threshold into the tribal disciplinary community produce rational theses, but the process and the student/supervisor dyad is often characterised by struggle, stress, anxiety, high emotion and results in trauma, “I’ve suffered a lot” and “I wanted to leave after my presentation as staff were only interested in the management” being common student responses.

Several students clearly identified that this struggle was often “correctional, negative and discouraging” while supervisors positioned this as assisting students to distance the feedback from the personal “absolutely and utterly be nothing personal” so that in future years students were better placed to “cope with the critique” of peer review. Such emotion is often seen as “noise in the system” (Lee & Williams, 1999) which institutional policies and practices could ameliorate. It has also been suggested that the irrational is a necessary condition; the production of rational disciplinary knowledge being a disavowal of the irrational (Lee & Williams, 1999, p.8) and in this case to perhaps ensure students are trained to “write like a hard scientist, be clinical, unemotional and objective” as a rite of passage and a process of acculturation into the disciplinary community of Science. The issue of the potential trauma and real anxiety in the student/supervisor dyad is that it may never be erased at the completion of the candidature; creating self doubts and anxiety in the personal and professional lives of students after graduation (Lee & Williams, 1999).

Our findings also highlighted that supervisors valued the product and outcome of writing rather than the process of writing. Students, in contrast, experienced the benefits of the process of writing as a way of connecting “doing” and “knowing”. For example, one student stated, “writing is my main research method – the way I find out what I know and learn more.” Only a few supervisors seemed to value this perspective. As one supervisor stated, “they themselves are still in the process of trying to identify issues, the aims and goals, objectives and so on.” It is likely that supervisors learn their values and supervisory role through their own experience of an “apprenticeship model” - learning to write by a slow process of acculturation and unable to see that writing is specific to the discipline (Carter, 2007). This may also explain why academics

simultaneously have little interest and great difficulty in being teachers of writing. There is a paradox between their desire to help students with sentence structure and error correction juxtaposed with trying to let students find their own way, against a backdrop of pressure to get PhDs completed and to publish articles in journals.

The results from this study suggest that supervisors of postgraduate students within Science disciplines need to be mindful of creating a culture in which doctoral students can learn to write naturally as discipline-specific researchers, without necessarily the high emotion and stress which may lead to trauma. The types of writing assistance that were effective, and students considered characteristic of “good supervision”, included timely and constructive feedback and direction sensitive to the needs of the learners, while simultaneously keeping the bigger conceptual issues in clear view. As one student stated “feedback was not helpful, mainly about grammar, not about how to write in an expanded form”. Writing support needs to be extended so that students are provided with writing retreats and writing circles so that they can create their own communities of learning.

To improve completions and efficiencies of good doctoral theses in the Sciences, there is also a real need to create a discourse about writing and the given tensions within the discipline. We are limited, at present, by a lack of the empirical research which would allow systematic critique of these issues and the development of a pedagogy(ies) of instruction to allow more students, to have that “ah hah” moment and move from the liminal space and across the threshold of “learning to write” in a shorter period. We are, however, now mindful of the “territory of high emotion” being navigated by both supervisors and students.

References

- Aitchison, C., & Lee, A. (2006). Research writing: Problems and pedagogies. *Teaching in Higher Education, 11*(3), 265-278.
- Bjork, L., Brauer, G., Rienecker, L., & Jorgensen, P. (2003). Teaching academic writing in European higher education: An Introduction. In G. Rijlaarsdam (Ed.), *Studies in writing*, Volume 12 (pp. 1-15). Amsterdam, The Netherlands: Kluwer.
- Bereiter, C., & Scardamalis, M. (1987). *The psychology of written composition*. Hillsdale, N.J., Erlbaum Associates.
- Brown, B. A., & Ryoo, K. (2008). Teaching science as a language: A content first approach to sciences teaching *Journal of Research in Science Teaching, 45*(5) 529-533.
- Bruce, I. J. (2008). Theorising tertiary writing instruction. In *Proceedings of the Tertiary Writing Network Colloquium, 2008*. Auckland University of Technology, Auckland, New Zealand: Tertiary Writing Network.
- Carter, M. (2007). Ways of knowing, doing, and writing in the disciplines. *Faculty Composition and Communication, 58*(3), 385-419.
- Cummins, J. (2001). *Negotiating identities: Education for empowerment in a diverse society* (2nd ed.). Los Angeles, CA: California Association for Bilingual Education.
- Cuthbert, D., & Spark, C. (2008). Getting a GRiP: Examining the outcomes of a pilot program to support graduate research students in writing for publication. *Studies in Higher Education, 33*(1), 77 - 88.
- Frischer, J., & Larsson, K. (2000). Laissez-faire in research education – an inquiry into a Swedish doctoral program. *Higher Education Policy, 13*(2), 131-155.
- Haggis, T. (2006). Pedagogies for diversity: Retaining critical challenge amidst fears of ‘dumbing down’. *Studies in Higher Education, 31*(5), 521-535.
- Havnes, A. (2008). Peer-mediated learning beyond the curriculum. *Studies in Higher Education, 33*(2), 193-204.
- Ivanič, R. (2004). Discourses of writing and learning to write. *Language and Education, 18*(3), 220-245.
- Jackson, D. (2009). Mentored residential writing retreats: a leadership strategy to develop skills and generate outcomes in writing for publication. *Nurse Education Today, 29*(1), 9-15.

- Lea, M., & Street, B. (1998). Student writing in higher education: An academic literacies approach. *Studies in Higher Education*, 23(2), 157 - 172.
- Lee, A., & Kamler, B. (2008). Bringing pedagogy to doctoral publishing. *Teaching in Higher Education*, 13(5), 511-523.
- Lee, A., & Williams, C. (1999) Forged in fire: Narratives of trauma and PhD supervision pedagogy. *Southern Review*, 32(1), 6-26.
- Lemke J. (2004). The literacies of science. In E. W. Saul (Ed.), *Crossing borders in literacy and science instruction: Perspectives on theory and practice* (pp. 33-47). Newark, DE: International Reading Association and National Science Teachers Association.
- Marginson, S., & Considine, M. (2000). *The enterprise university: Power, governance and reinvention in Australia*. Cambridge, MA: Cambridge University Press.
- McCune, V. & Hounsell, D. (2005). The development of students' ways of thinking and practising in three final-year biology courses. *Higher Education*, 49, 255-289.
- McGrail, M., Rickard, C., & Jones, R. (2006). Publish or perish: A systematic review of interventions to increase academic publication rates. *Higher Education Research and Development*, 25(1), 19 - 35.
- Meyer, J. H. F., & Land, R. (2005). Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. *Higher Education*, 49, 373-388.
- Murray, R. (2001). Integrating teaching and research through writing development for students and staff. *Active Learning in Higher Education*, 2(1), 31- 45.
- Parker, R. (2009). A learning community approach to doctoral education in the social science. *Teaching in Higher Education*, 14(1), 43-54.
- Pearson, M., & Brew, A. (2002). Research training and supervision development. *Studies in Higher Education*, 27(2), 135-150.
- Ross, P.M, Taylor, C.E., Hughes, C., Kofod, M., Whitaker, N., Lutze-Mann, L. (2010). Threshold concepts: Challenging the culture of teaching and learning biology. In J. H. F. Meyer, R. Land & C. Baillie (Eds.), *Threshold concepts: From theory to practice*. (pp. 47-52). Rotterdam, The Netherlands: Sense Publishers.
- Ross, P. M., & Tronson, D. A. (2007). Intervening to create conceptual change. *UniServe Science, Proceedings of the Assessment in Science Teaching and Learning Symposium* (pp 89-94). University of Sydney, September 28-29, 2007. Retrieved from: <http://science.uniserve.edu.au/pubs/procs/2007/19.pdf>
- Snow, C. E. (2010). Academic language and the challenge of reading for learning about sciences. *Science*, 328(2010), 450-452.
- Wellington, J., & Osborne, J. (2001). *Language and literacy in science education*. Buckingham PA: Open University Press.
- Wingate, U. (2007). A framework for transition: Supporting 'learning to learn' in higher education. *Higher Education Quarterly*, 61(3), 391-405.

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