Designing personalised, automated feedback to develop students' research writing skills

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Constructive and formative feedback on writing is crucial to help Higher Degree Research (HDR) students develop effective writing skills and succeed, both in their degree and beyond. However, at the start students have a poor grasp of good academic writing, and HDR supervisors do not always have the time or the writing expertise to provide quality, constructive, formative feedback to students. One approach to address this problem is provided by Writing Analytics (WA), using text analytics to provide timely, formative feedback to students on their writing, in the process introducing a clear set of terms to describe important features of academic writing. This paper describes how Swales' (1990) *Create A Research Space (CARS)* model was used to extend a writing analytics tool such that it could be applied to HDR students' writing, and how good feedback practices were employed to design constructive automated feedback. This work summarises a process that can be used to develop theory driven writing analytics tools that should facilitate thesis writing.

Keywords: research writing, thesis writing, writing analytics, learning analytics, genre, feedback

Introduction

A significant component of Higher Degree Research (HDR) students' training in writing is provided via supervisory feedback. Receiving this ongoing formative feedback is critical to helping HDR students develop and improve their research writing skills. While some supervisors provide timely, clear, constructive feedback, others provide feedback that is vague, confusing, too critical, or too late. Numerous studies have described problems regarding supervision feedback on writing detailing issues of timeliness, quality and usefulness. For example, Paré's (2010) study found that "supervisor feedback is often ambiguous, enigmatic, and coded – that is saturated with meaning, but difficult to understand". Paré goes on to say that "even supervisors who publish frequently may not be capable of conducting the sort of close textual analysis that leads to insightful feedback" (p.107). Other studies have found that while students were grateful for feedback on their writing, they were seldom positive when reporting about the quality of that feedback (Aitchison, Catterall, Ross, & Burgin, 2012). Indeed, Aitchison et al. (2012) found that many students felt frustrated when supervisors employed "less-useful feedback practices" (p.442). Some of these included feedback only on grammar and sentence structure rather than how to write for their discourse community; re-writing students sentences with no explanations; and inappropriate comments. Timeliness was also a concern, with a lack of feedback from supervisors, feedback that was too late, or feedback only received when approaching thesis submission. *Writing Analytics* is a potential solution that uses text analytics techniques to help provide timely, actionable and formative feedback on student writing. It is an active area of research in the Learning Analytics community, however, to date only two tools have been used in this HDR context (as reviewed below). This paper describes how an existing writing analytic tool was modified to generate personalised, effective feedback that can be used to develop HDR students' writing skills, focusing specifically on writing introductions and abstracts. The modifications to the existing tool were theory driven, deriving from genre and process based approaches to writing, along with sound feedback processes inspired by Hattie and Timperley's (2007) feedback model, and Nicol's (2010) 10 recommendations of good feedback. The design of these modifications is presented, with piloting indicating early positive feedback. While we have piloted the tool, this paper focuses on the design of the tool, not on the testing or evaluation of it.

Doctoral writing is challenging for students and supervisors

Effective written communication skills are essential for HDR students, not only to complete their dissertation itself, but also for their professional life post degree. They are necessary for publishing research, applying for research grants, and responding to criteria etc. in job applications. Indeed, effective writing is one of the core skills identified by employers as necessary for HDR graduates (McGagh et al., 2016). However, many HDR

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students find research writing difficult (Aitchison et al., 2012; Catterall, Ross, Aitchison, & Burgin, 2011; Ross, Burgin, Aitchison, & Catterall, 2011). For example, Aitchison et al., (2012) report that identifying and learning complicated linguistic practices is a challenge for many HDR students. Similarly, Maher, Feldon, Timmerman, and Chao's (2014) investigation of doctoral writing from the perspective of supervisors found a common complaint that students lacked familiarity with disciplinary writing patterns and were unaware of their audience. While some universities provide a wide range of writing support for doctoral students (including writing workshops, writing circles, or one on one consultations with academic language and learning educators), others do not. The apprenticeship model is still the main avenue for teaching HDR students to write, but this is highly dependent upon the quality of supervision that a HDR student receives. Paré (2011) asserts that doctoral supervisors are also writing teachers as supervisors introduce students to their discourse community's practices and guide students through the writing process with their feedback, instruction and suggestions. However, while some supervisors provide clear, understandable and actionable feedback, Parés' (2010, 2011) analysis of supervision meetings reveals feedback on HDR student writing is often ambiguous, confusing, unhelpful, coded and difficult to decipher. Even the most accomplished academics sometimes fail to provide insightful, relevant feedback on their students' writing. Some supervisors are confident helping students in the writing process, but many are not (Aitchison et al., 2012), and few have the writing expertise or pedagogical training to assist their students in the writing process (Catterall et al., 2011). So how can supervisors become more confident talking about and facilitating better quality writing? Paré (2011) suggests that easiest way supervisors can improve their knowledge about writing the dissertation is to learn more about academic writing by reading books on the subject that are theory and research based, exploring journals that focus on writing composition and scholarship, and looking at literature on rhetoric. However, most academic writing literature is focused on undergraduate academic writing and writing in general, with very few contributions focussing specifically on HDR writing.

The learning and teaching of writing: approaches and theories

Quality writing involves rhetoric; understanding the audience and applying rhetorical cues to help facilitate understanding. Rhetorical insight into the disciplinary discourse community is necessary for creating and disseminating knowledge (Tardy, 2005). However, HDR students find it difficult to develop an understanding of this rhetorical aspect to research writing, especially when writing the introduction section of their thesis (Paltridge & Starfield, 2007). The rhetorical complexity of the dissertation is a challenge for HDR students (Thompson, 2016), as this is one of the first times that they are expected to write for their discipline's discourse convention (Torrance, Thomas, & Robinson, 1992). Despite this expectation, most HDR students do not have the expertise in applying discipline specific discourse conventions in their writing, and few HDR students have the experience of writing for an academic audience (Torrance et al., 1992).

One theory that explores the different conventions used across academic disciplines is genre theory. Hyland (2007) argues that a genre based approach is a theoretically robust method to teaching writing because university classrooms have become more socially, culturally and linguistically diverse. This diversity of students means that educators and teachers cannot presume that students' previous learning experiences will afford them with the writing and genre knowledge needed for their studies (Hyland, 2007). Genre based approaches have received substantial attention in the teaching and learning of language, especially in L2 (second language learners) classrooms, because of their emphasis upon the purposeful and socially situated nature of language (Hyland, 2007). A genre based approach to teaching writing looks at how language is structured in texts to achieve a communicative purpose in particular contexts (Swales, 1990), and involves "being explicit about the way language works to make meaning" (Cope & Kalantzis, 1993, p.1). Hyland (2007) argues that genre-based pedagogies are beneficial for learners because a genre approach to teaching writing is explicit, systematic, supportive, empowering, critical and consciousness-raising. Being explicit helps students see how grammar and vocabulary choices create meaning in a text. This explicit emphasis upon the way that writing works to communicate meaning allows students to bring together the language, content, context, and purpose of a text, in a critical and deliberate way. By empowering students with the strategies and skills that are implicit with this approach they can tackle complex writing tasks and become more effective writers.

This research specifically draws on English for Specific Purposes (ESP). ESP places great importance on communication within discourse communities (Swales, 1990) where its membership to a community is based on communicative purpose, which is important for HDR students to master. In ESP the communicative purpose is considered the rationale of the genre which shapes the structure of the discourse and influences content and style. Its focus on genres, allow teachers to ground their lessons in texts that students will need to write beyond the classroom. ESP teachers identify the specific practices of discourse communities and how texts are used both within the community and beyond it in wider social contexts. Identifying these specific practices and how community members use language in their texts provides ESP teachers with an understanding of the rhetorical

features required in texts, which provides them an insight to the rhetorical characteristics that their students' texts must satisfy for entry to particular discourse communities.

An example of this is Swales' (1990) Create a Research Space (CARS) model which describes the rhetorical and linguistic patterns that authors make in their research article introductions. Swales (1990) analysed a number of articles from a variety of disciplines and found that effective research article introductions followed three rhetorical moves:

- Move 1: Establishing a research territory
- Move 2: Establishing a niche
- Move 3: Occupying the niche

These rhetorical moves are made up of sentences that explicitly state the communicative goal. For example, in **Move 1 Establishing a research territory** the author conveys to the audience that the research is important, central and relevant, with sentences like *It is now widely recognised that feedback is critical in the writing process*. **Move 2 Establishing a niche** is where the research problem is stated or gaps in previous research are introduced, for example, *Despite the potential of writing analytics tools, little research exists on how automated feedback impacts students' writing.* **Move 3 Occupying the niche** states the goals of the authors research and/or paper, the solution, or results; *We present a pilot study that explores the impact of a writing analytics tool on students' writing process*.

The introduction to a research article and thesis is critical in order for authors to establish their contribution, and compete for reader attention (Paltridge & Starfield, 2007; Swales & Feak, 2012). There is intense competition to be published in highly regarded academic journals, therefore the introduction is strategically important. It is here that writers demonstrate that they have met the expectations of their audience (discourse community) and assert that their research is worthy of publication. This means producing engaging and effective writing by using rhetorical strategies to show that their research is relevant and significant (Move 1), the research problem is worth solving (Move 2) and establish their overall argument (Move 3). In thesis writing the introduction sets the scene of the dissertation that follows. Students need to explain the importance of their research and build on previous literature (Move 1), establish the research gap (Move 2) and present their original contribution to knowledge (Move 3).

The CARS model has been used to teach research writing in postgraduate contexts. Specifically, it has been used to help students identify the rhetorical features of research article introductions specific to their discourse community (Cai, 2016). It is a heuristic as its ease of use and broken down moves of the introduction and explanation allows students to identify the language features needed to achieve each particular move and communicative goal to participate in their discourse community, and also provides students a place to start, as they try to create a research space of their own. The CARS model has been presented in numerous books, some aimed at supervisors to help teach writing to their students (Kamler & Thomson, 2014; Paltridge & Starfield, 2007), another to help academics publish (Thomson & Kamler, 2013), and others to assist HDR students with their research article writing (Swales & Feak, 2012). It is for this reason that a genre-based approach and the CARS model in particular was incorporated in designing the writing analytic tool to develop and raise rhetorical awareness which is needed in HDR research writing.

While the genre approach looks at the textual features used to compose a text, it does not consider how students go about writing their texts. To help develop the writing skills of HDR students and teach research writing it is also important to understand the *processes* involved when they write. However, writing is itself a very complicated process (Hayes & Flower, 1977), and more than a set of skills (Curry & Hewings, 2005; Kamler & Thomson, 2014; Wellington, 2010), which makes it both difficult to teach, and hard for HDR students to learn. Understanding the writing process gives educators an insight on when and how to intervene to provide formative feedback on students' writing to improve their writing process and in turn improve their research writing skills. The process which people go through when they write a text is known as the cognitive process theory of writing (Flower & Hayes, 1981; Hayes & Flower, 1980), and has been a common model to understand the writing process. The writing process approach focuses on the important processes that writers do when producing a text: generating ideas, putting them together, and achieving a writing goal.

A key principle of the writing process approach is the iterative nature of writing and the importance of seeking and receiving feedback from others while a text is being produced (Curry & Hewings, 2005). Receiving feedback from others helps students to improve their writing and produce better texts. The process approach

provides students an understanding of how they write which makes them reflect on their own writing process. Additionally, feedback in the writing process approach makes students aware of audience and better at critiquing their peers writing as well as their own, while also reinforcing the drafting process, as explained in the next section.

The importance of feedback

Feedback is important to help HDR students achieve their learning goal of producing a quality thesis. However, as has been discussed above by Paré (2010, 2011) and Aitchison et al. (2012), supervisors, the main source of feedback, do not always provide clear, understandable and actionable feedback. Rather than just being corrective, feedback should be actionable, providing information specific to the task and the student's performance, so filling the gap between their performance and the task objective (Hattie & Timperley, 2007). Therefore, there is a relationship between students' writing goals and feedback. This relationship is complex, because the feedback might not address the student's current performance and writing goal (Hattie & Timperley, 2007), similar to what was found in Paré's (2010, 2011) studies on supervision feedback (discussed above).

Several studies exist that provide indications of what best practice entails when it comes to giving feedback. One such study is Hattie and Timperley's (2007) review where they claim that there are four feedback levels that directly affect feedback effectiveness: task, process, self-regulation, and self. Their feedback model proposes that feedback should answer these three questions: How am I going?, Where am I going?, Where to next?. In the case of writing, this model suggests not only providing corrective feedback on the text, but also feedback that suggests how students can improve their text, which closes the gap between where they are and their writing goal. Another study by Nicol (2010) outlines 10 recommendations for best practice, claiming that feedback should be: understandable, selective, specific, timely, contextualised, non-judgmental, balanced, forward looking, transferable and personal. While these good feedback practices are aimed at teachers and educators, they can just as easily be applied to automated feedback tools, specifically writing analytics tools. This body of work gives an important point from which to start in developing tools to help HDR students learn how to write.

Writing Analytics as a possible solution

One approach to provide students with timely, actionable feedback is the use of Learning Analytics (LA), specifically, Writing Analytics (WA), which derives from LA by placing an emphasis on supporting student writing practices (Buckingham Shum et al., 2016). There are many WA tools currently being used to help students develop their writing. Examples of this can be seen in Automated Writing Evaluation systems (AWE) (Burstein, Chodorow, & Leacock, 2004; Roscoe, Allen, Weston, Crossley, & McNamara, 2014; Villalón, Kearney, Calvo, & Reimann, 2008) that provide students with automated formative feedback. Using computational techniques such as natural language processing, AWEs analyse student writing and generate instant feedback on students' texts. Here we will focus upon WA that is developed specifically for improving research writing skills.

Research Writing Analytic tools

Several research writing analytic tools exist to help HDR students learn to write. An example of this is *Mover* (Anthony, 1999), a text analysis software that was used to test how generalisable the CARS model was in software engineering journal articles. Mover annotates research article introductions against the CARS model and has been implemented in a classroom setting to determine if it helps develop HDR students' research writing skills (Anthony & Lashkia, 2003). Their results are promising; the students were able to both identify the discourse features of published research article abstracts, and annotate more quickly, when using Mover vs. when doing it by hand. Indeed, without Mover all students but one were unable to identify the CARS moves in the abstracts. Students were also able to analyse structural and discourse features of their own abstracts quicker with the help of Mover. However, the experiment was only conducted with six students and not within an HDR research writing program. Furthermore, while Mover analyses students' drafts and identifies the moves that students have used in their writing, it does not provide feedback of any sort on the moves that are missing or how they might be added to the draft.

Research Writing Tutor (RWT) (Cotos, 2016) is similar to Mover as it also detects Swales (1990) rhetorical moves in students' research writing. One significant difference between RWT and Mover, is that RWT provides actionable feedback to its users by showing students how similar their use of rhetorical moves is to that of published works in their discipline. RWT also contains learning and demonstration modules which help students to understand the genre of research writing through exposure to a corpus of research articles, and demonstrates

how the moves learned in the learning module appear in research articles. Studies that have been conducted with RWT demonstrated that the automatic feedback influenced students' revision process, helping them to develop new strategies, while focusing more upon the rhetorical composition of their drafts (Cotos, 2012). Other studies reported that students found the feedback helpful because it directly related back to the writing task and that RWT's feedback helped students think about and analyse their writing (Cotos & Huffman, 2013; Ramaswamy, 2012). However, the RWT tool is not open source and cannot be accessed by external students. This means that while these studies show promise for using AWEs to provide timely, useful, clear, formative, actionable feedback to help students develop and improve their research writing skills, this particular tool is unavailable for wider use beyond the university at which it was developed. In summary, AWE tools like RWT can help develop doctoral students' research writing but they are yet to be implemented in a scalable form that can be broadly used by any in the academic community.

So far, this paper has argued that HDR writing is difficult for students to learn and for supervisors to teach, with supervisory feedback on writing often unclear and difficult for students to understand. Receiving understandable, constructive, feedback is critical for students to improve their research writing skills and achieve their writing goals. Both the genre and writing process approaches show promise for helping HDR students to learn how to write, and WA tools are a possible way in which to deliver feedback that is theoretically grounded in these approaches. However, few tools exist that deliver this feedback, and the one tool that has shown promising results in this area is closed source and not available to HDR students beyond the institution at which it was developed. These gaps motivate the design, implementation and evaluation program underpinning an open source writing analytics tool, available whenever students need it to help them with their research writing.

Developing personalised feedback for HDR writing

At UTS a WA tool called Academic Writing Analytics (AWA) was developed to help students improve their academic writing skills (Knight, Buckingham Shum, Ryan, Sándor, & Wang, 2018; Shibani, Knight, Buckingham Shum, & Ryan, 2017). While traditional AWEs identify grammatical errors, discourse structure and topic-relevant word usage, AWA uses a rhetorical parser that identifies sentences that signal rhetorical moves by identifying discourse patterns. Students see identified sentences (moves) highlighted, which prompts them to reflect on what they have written. While preliminary work with the system has been conducted in undergraduate contexts (Gibson et al., 2017; Knight et al., 2018; Shibani et al., 2017), to date it has not been applied to the HDR writing context.

This section outlines how the tool, now called *AcaWriter*, has been extended to create a system that provides formative, actionable feedback on HDR student writing, that addresses the feedback needs described above, through application of the Swales (1990) CARS model.

AcaWriter's Rhetorical Parsing

AcaWriter's rhetorical parser is based on the concept-matching framework (Sándor, Kaplan, & Rondeau, 2006) where expressions that both convey contextual concepts and are grammatically dependent are classified and tagged as rhetorical moves. For example, in Swales' (1990) CARS model, the concept of 'Establishing a research territory' (Move 1) where an author refers to previous literature on a topic, can be expressed like this: ***Recent studies*** *indicate that the Earth's climate is changing rapidly*. AcaWriter identifies the contextual concept in the words ***Recent studies*** as 'Background Knowledge', that is syntactically connected to other content, and thus tags the sentence as the rhetorical move Background (see table 1). AcaWriter's parser will tag sentences with the overall concept of that sentence, even if they are syntactically and semantically different. For example, consider the following two sentences: (1) *Despite its popularity,* ***limited research*** *has been undertaken into esports possibly due to the* ***lack*** *of recognition by sporting associations* and (2) *Several studies have examined issues related to voluntary genetic testing, but these studies contain* ***insufficient data*** *on the emotional and social impact of genetic testing*. We see not just a difference in their syntax (or how the concepts are expressed), but a difference in their underlying semantics (i.e. meaning). However, each makes a similar 'Contrast' rhetorical move between two concepts. This is identified by AcaWriter and tagged. Finally, even though the parser relies on grammatical dependencies, a sentence can be grammatically similar, but still tagged as performing different rhetorical moves based on the words used. For example: (1) *This approach fails to address the issue of bullying* is syntactically similar to (2) *This framework provides a new approach to tackle bullying.* Each sentence has a similar structure, but sentence 1 will be tagged as 'Contrast', while sentence 2 will be tagged as 'Novelty'. This example shows that AcaWriter is able to detect the communicative goal of sentences,

as Sentence 1 is signalling to the reader a gap in research, whereas, in sentence 2 the purpose is to show the results of research, that is a novel approach has been created.

Table 1: AcaWriter's analytical rhetorical parsing

Concept	Rhetorical move	Communicative function
Deictic	Summary	Authors' goals, contribution or conclusion
Position	Attitude	A perspective or stance
Surprise	Surprise	An unexpected outcome
Importance	Emphasis	Emphasis on significant, important ideas
Grow	Trend	A trend, growth, pattern or tendency
Contrast	Contrast / Question	Contrast, disagreement, tension, inconsistency and raising a question or missing knowledge
Background knowledge	Background	Consensus or background knowledge
New	Novelty	Novelty, improvement

AcaWriter can be extended to provide other parsers for other pedagogical contexts. As was mentioned above, it had previously been used in two learning contexts, an undergraduate law subject and a pharmacy and engineering unit. Two parsers were created as an extension to AcaWriter's original parser: reflective writing parser and the law essay parser (Gibson et al., 2017; Knight et al., 2018; Shibani et al., 2017) to fit these two educational contexts. AcaWriter's code has been recently released as open source so that other universities can also tailor AcaWriter to their unique learning contexts. This release is a part of the Higher Education Text Analytics project (HETA - see http://heta.io/resources/wawa-improving-research-abstracts-intros/ for more details) funded by Australian Technology Network (ATN). Automated feedback to students on their writing, analysis of student feedback comments, and analysis of curriculum materials are the three focus areas for the HETA project.

The CARS parser was created as an extension of AcaWriter as a part of this project. The moves in AcaWriter's original analytical parser, which identifies these rhetorical moves throughout a text (see table 2), were mapped to match the CARS moves identified by Swales and Feak (2012) (see table 3).

Table 2: AcaWriter's Rhetorical moves tags

Rhetorical move	Tag	Example
Question	Q	Current data is insufficient to conclude that…..
Background	B	Recent studies indicate that…..
Contrast	C	In contrast with previous hypotheses…
Emphasis	E	Studies on x have provided important advances..
Novelty	N	This model provides a new approach to…
Surprise	S	This discovery of x suggests intriguing…..
Trend	T	New models of x are emerging….
Summary	S	In this paper we show how….

Table 3: CARS Moves mapped to AcaWriter's moves (adapted from Swales & Feak 2012)

CARS Rhetorical Moves	AcaWriter Tags
Move 1 – Establishing a research territory: a. by showing that the general research area is important, central, interesting, problematic, or relevant in some way (optional) b. by introducing and reviewing items of previous research in the area (obligatory)	 E - Emphasis B - Background
Move 2 - Establishing a niche: a. by indicating a gap in the previous research, raising a question about it, or extending previous knowledge in some way (obligatory)	 C – Contrast & Q – Question
Move 3 - Occupying the niche: a. by outlining purposes or stating the nature of the present research(obligatory) b. by listing research questions and hypotheses (optional) c. by announcing principle findings (optional) d. by stating the value of the present research (optional) e. by indicating the structure of the research paper / thesis (optional)	 S – Summary N – Novelty S – Summary

Not all of AcaWriter's moves were relevant, so they were removed. Out of the 8 original AcaWriter tags, 6 were kept. AcaWriter's tags were mapped to the CARS moves by looking at the communicative functions of the AcaWriter moves and comparing them to the three CARS rhetorical moves. The validity of the mapping was established by first performing a discourse analysis of a number of research articles, and then testing the emerging CARS parser to see that it found the same moves. After this, the same parser was used to analyse the Elsevier STEM corpus (Elsevier, 2015), with sentences checked to see which were tagged and whether they matched the CARS moves.

Developing actionable feedback

For AcaWriter to be useful for HDR research writing, clear, specific actionable feedback should be generated so that students understand what they need to do in order to revise and improve their text. The CARS parser aims to provide formative feedback specifically on the rhetorical moves made in Introductions and Abstracts. By identifying and highlighting the CARS moves students are able to see where there writing is at the time of submission to AcaWriter, which links back to Hattie and Timperley's (2007) first question of their feedback model, *How am I going?*.

AcaWriter's original parser highlights all the rhetorical moves that appears in the text (see figure 1) to prompt the student to reflect on their writing. This can be confusing for students as they may not know how to interpret the highlighting and what to do next. This is where the genre-based approach was incorporated. In the CARS parser each AcaWriter tag was assigned a colour that corresponded to the CARS rhetorical move that they were mapped against. This was done so that students would be able to see that the sentences highlighted matched back to the CARS model. Figure 2 shows the AcaWriter CARS parser, where the sentences identified are highlighted corresponding to the colour as assigned to CARS rhetorical moves. Highlighting the moves in students' text encourages students to analyse and think critically about their writing, all while performing a genre analysis implicitly.

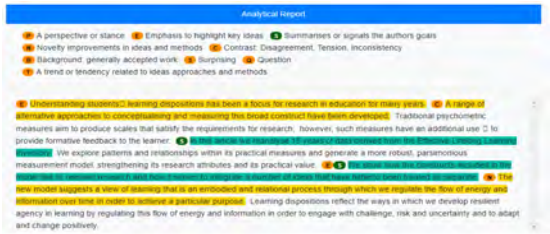

Figure 1: AcaWriter's original analytical parser

Figure 2: AcaWriter CARS parser

As Swales & Feak (2012) suggest that Moves 1 to 3 should follow consecutively, a rules system was developed to provide feedback when moves are in the wrong order (displayed in Figure 3), and if moves are missing (Figure 4). When students submit their writing to AcaWriter for feedback, the feedback provided is clear, understandable, actionable, transferable, specific, and timely, all characteristics of good feedback as discussed above (Nicol 2010; Hattie and Timperley 2007). AcaWriter's feedback also aligns with Hattie and Timperley's (2007) remaining two features of their feedback model, *Where am I going?* and *Where to next?*, as students are prompted to go back and revise their text specifically related to each move, with suggestions on how to improve their sentences. This feedback closes the loop between where students are and their writing goal, in this case to write an introduction or abstract. Students are able to go through the recursive nature of writing guided by feedback to help them achieve their writing goal. As AcaWriter is a web-based system, HDR students will be able to submit writing for feedback whenever they need it and receive feedback in real time. As HDR students

are busy and supervisors time poor to provide immediate feedback on students' drafts, it is anticipated that AcaWriter will be able to assist HDR students to hone their introduction and abstract writing skills, encouraging the ongoing revision of drafts.

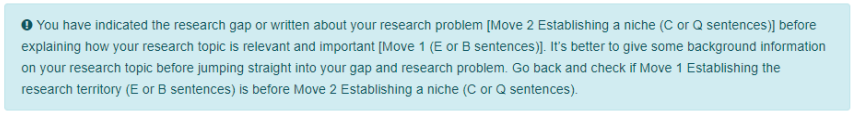

Figure 3: AcaWriter feedback moves in wrong order

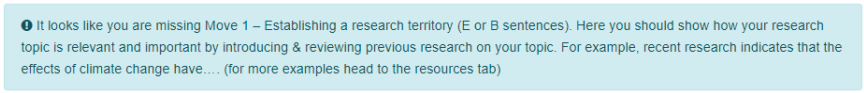

Figure 4: AcaWriter feedback missing move

Next steps

The work presented here is the first iteration of developing the AcaWriter CARS parser. It has so far been piloted with 12 HDR students at different stages of their candidature. However, the tool was not used standalone in the trail, it was embedded in an Abstract and Introduction workshop where students first learned the CARS Moves before using AcaWriter. All students stated that AcaWriter helped them think about the structure of their introductions and focus on the rhetorical moves in their writing. While some reported that AcaWriter helped them learn the CARS rhetorical moves, others needed more time to become familiar with tool and the CARS model. But, all students found the immediate feedback messages and highlighting useful making statements such as:

> Participant 7: I really liked the immediate feedback with the highlighted paragraphs. And the labelling where it said, oh, that's this move and oh you're lacking this move...
>
> Participant 1: ...I think it was very useful to use a piece of writing of my own and then when the software gives the feedback, maybe you think you're having the moves, you have the right structure but then it, it happened in my case the software told me ok, you're missing move 1, but I thought that it was there...I think in that sense, it challenges you in the way that you're thinking.

Although these initial responses are encouraging more work remains to be done to determine the effectiveness of the approach. In particular, an evaluation of how the AcaWriter CARS parser impacts upon students' writing must be completed to see if it improves students' writing process and the quality of their texts. Future trials will include using AcaWriter in discipline specific contexts. We also aim to embed AcaWriter in an online course where students learn how to write various sections of their thesis and research articles where additional parsers can provide feedback on those specific sections.

Conclusion

This paper has discussed the issues associated with teaching HDR students to write, as well as the essential nature of this task to their success (both as students and in their future careers). A theory-based approach to delivering WA tools designed to assist with this process has been discussed, specifically the technique for mapping the CARS model to rhetorical parsers. Early trials have been promising, and future work will continue to develop this important new tool. Providing tools that can help *all* HDR students learn to write will help to close the gap between those students who receive top supervision, and those who are not so fortunate. As the sophistication of the CARS parser improves we hope that it will help more students to navigate the learning of a key HDR graduate attribute in a timely and less stressful manner.

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