Renu Joseph

Department of Language and Linguistics
Universiti Tunku Abdul Rahman, Malaysia
renuj@utar.edu.my

Jason Miin-Hwa Lim[*]

Centre for the Promotion of Knowledge and Language Learning
Universiti Malaysia Sabah, Malaysia
jasonlim@ums.edu.my

DIRECTIONS FOR THE FUTURE: A GENRE-BASED INVESTIGATION INTO RECOMMENDATIONS FOR FURTHER RESEARCH AND PRACTICAL APPLICATIONS IN FORESTRY

Abstract

Writers incorporate recommendations in the Discussion sections of research articles to indicate how their findings can lead to interesting avenues for further research and useful applications in real life, but it is not clear how such recommendations are positioned and realised using different language resources in their attempt to get their papers published. Based on a genre-based move analysis of 60 Forestry research articles, we have found that such recommendations appear in a vast majority of the Forestry Discussion sections while two-thirds of them close with a recommendation. Recommendations for practical applications occur far more frequently than those for further research, thus reflecting the applied nature of Forestry. In terms of language resources, recommendations for further research involve largely overt signals indicating possible knowledge outcomes, while those for practical applications require implicit linguistic signals demonstrating additional insights and values. It is suggested that learners be acquainted with the prevalent structures first before attention is directed to other covert strategies for highlighting the practical contributions of a study. Our findings can be used to illustrate how experienced writers aptly deploy rhetorical shifts to sensibly move to their targeted recommendations via relevant statements on the limitations and findings of their current research.

Key words

recommendations, Forestry, genre analysis, discussion section, further research, practical applications.

[*] Corresponding address: Jason Miin-Hwa Lim, Centre for the Promotion of Knowledge and Language Learning, Universiti Malaysia Sabah, Locked Bag 2073, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia.

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1. INTRODUCTION

The ability to produce research articles (RAs) in English is a critical skill emphasised in English for Academic Purposes (EAP) programmes intended for second language learners of English at graduate level (Lim, 2017). The importance of the RA as a medium for the dissemination of new knowledge has resulted in a series of genre-based studies of the RA. While some have addressed the whole RA (Kanoksilapatham, 2005, 2015; Nwogu, 1997; Stoller & Robinson, 2013; Tessuto, 2015), others have focused on specific sections such as the Introduction (Anthony, 1999; Ozturk, 2007; Samraj, 2002, 2005), Methods (Kanoksilapatham, 2011; Lim, 2011; Peacock, 2011), Results (Brett, 1994; Kanoksilapatham, 2005; Yang & Allison, 2003) and Discussion (Basturkmen, 2009, 2012; Hopkins & Dudley-Evans, 1988; Yang & Allison, 2003). Among the sections of the RA, the Discussion section has the critical function of indicating how the results of the current study stand in relation to past research in the area. In this section, writers step back from the study-specific information presented in the Results section and provide readers with a wider perspective, from which the findings of the study are interpreted in terms of their implications to the real world and their contribution to existing disciplinary knowledge (Weissberg & Buker, 1990). In writing the Discussion section, writers are expected to bring together various strands of the study being reported, such as the motivation and methods of the study, its key findings, the reasons for and implications of the findings, the strengths and limitations of the study, and directions for the future (Basturkmen, 2009). This explains why the drafting of the Discussion section is often challenging for many novice writers (Basturkmen & Bitchener, 2005; Dudley-Evans, 1994). In this regard, several researchers have attempted to demystify the structure and organisation of the section. Notably, Hopkins and Dudley-Evans (1988) proposed an eleven-move linear model for the rhetorical structure of the Discussion section, which was adopted with some modifications by Swales (1990) and Holmes (1997). The models proposed by other researchers (Kanoksilapatham, 2005; Nwogu, 1997; Yang & Allison, 2003) used alternative schemes of analysis, although all of these latter models included constituent steps that further itemised the information elements in each move. Despite the difference in terminology and organisation, the existing models for RA Discussion sections share certain common information elements (rhetorical moves), such as statements of findings, explanations for findings, generalisations, comparison of present research results with past research findings, recommendations for further research, and implications for practical applications.

Although the most commonly occurring information elements have been identified, a detailed analysis of how these elements are realised in Forestry has yet to be undertaken. To be precise, few studies have analysed how the communicative functions of such information elements are realised in terms of the lexico-grammatical choices in the Discussion section (Lim, 2008a, 2008b).

However, it is such explicit knowledge of the link between communicative functions and their linguistic realisations that enables novice writers to produce texts that meet the disciplinary standards in terms of linguistic choices and structure (Bawarshi & Reiff, 2010; Samraj, 2002). In our experience of teaching Forestry students to meet the disciplinary standards concerned, we noticed that students find it difficult to use appropriate language resources to convey recommendation-related information in their Discussion section. Motivated by the need to explicitly ascertain the language choices needed, this study therefore narrows its focus on the language resources used by writers to signal such future directions arising from the studies being reported. Several previous studies have listed these directions for the future as an integral part of Discussion sections (see Table 1).

DISCIPLINE	APPLIED LINGUISTICS	DENTISTRY	EDUCATION
Author(s)	Yang & Allison (2003)	Basturkmen (2012)	Loi, Evans, Lim, & Akkakoson (2016)
Functional labels of moves /steps	Deductions from the research - making suggestions - recommending further research - drawing pedagogic implications	- implications for further research - clinical practice or policy	- implications of the study - recommendations for further research

Table 1. Comparison of recommendations in the Discussion sections across disciplines

From Table 1 it is evident that researchers across disciplines considered it important to include directions for the future in RA Discussion sections in an effort to link the current study to future expansions in disciplinary knowledge. It should, however, be acknowledged here that some comparative difficulty has arisen as a result of the terminological differences relating to the semantic scopes of the moves on recommendations. In particular, Yang and Allison (2003: 376) subsumed 'recommendations for further research', 'pedagogical implications' and 'making suggestions' as steps under the same move called 'deductions from the research'. (These different forms of recommendations are therefore collectively referred to as 'deductions' in this paper.) This means that they viewed recommendations for further research and practical implications as separate steps (rather than separate moves). Likewise, Basturkmen (2012) combined both of these steps in a single move. However, given that the drafting of recommendations for further research and practical applications appear to be distinctly different rhetorical categories in Forestry, the two forms of deduction (relating to recommendations for further research and practical applications) are considered as separate moves in this study.

Although the review above has shown that the two types of recommendations clearly differ from each other, we do not know whether one type of recommendation is more prevalent than the other within the same discipline and across different disciplines. In this investigation, we will ascertain the degrees

of prevalence of these two different types of recommendations by finding out the proportion or percentage of Discussion sections containing each type of recommendation (e.g. 27/60 x 100% where '27' is the number of Discussion sections containing the first type of recommendation, and '60' refers to the total number of Discussion sections analysed in the study). This happens to be an area in which a comprehensive cross-disciplinary comparison appears difficult because the percentages of texts containing the recommendations were not always reported in past studies. Yang and Allison (2003), for instance, reported that recommendations for further research and those for practical applications (pedagogical implications in particular) appeared with average frequencies of 1.5 and 0.75 per Discussion section in Applied Linguistics, but they did not report on the percentage of texts containing each type of recommendation. In contrast, Basturkmen (2012) reported that implications for further research and practical applications (clinical practice/policy), considered collectively as a whole, appeared in 70% of the Discussion sections in Dentistry, but no result was reported for the percentage of texts containing each type of recommendation mentioned above. In another study of research articles in Management, Lim (2008a) reported that recommendations for further research appeared in 95% of the Discussion sections in the discipline, but did not include any information on the recommendations for practical applications or the "implications of the study for professional practice or applied settings" (Basturkmen & Bitchener, 2005) which, in the case of applied disciplines, are understandably important. A more recent study conducted by Loi, Evans, Lim, and Akkakoson (2016), however, was more specific in reporting that implications for the study (focusing on practical contributions and applications) and recommendations for further research appear in 65% and 70% of the educational Discussion sections (in English) respectively. Such different results explain (i) why our findings (to be reported later) can be compared with only the available figures reported in these previous studies, and (ii) why it would be meaningful to look into the degrees of prevalence of each type of recommendation in this study in order to examine how directions for the future are highlighted differently in an applied science discipline such as Forestry. However, it should be acknowledged here that reporting the percentages of texts containing each type of recommendation (in comparison to those in previous studies) is important only to a certain extent because (i) the samples used in most previous genre analyses were relatively small, and (ii) it is pedagogically more significant to look into how the communicative functions in each recommendation are realised via the salient language resources and how the related moves are linked with each other. This study therefore aimed to (i) ascertain the extent to which researchers deploy recommendations for future research and practical applications in the Discussion sections of Forestry RAs, (ii) explore the rhetorical choices and linguistic mechanisms used by researchers for making such recommendations, and (iii) identify the ways in which the recommendations are linked to other moves through rhetorical shifts in the Discussion section. In this paper the term 'rhetorical shifts'

refers to shifts from one particular move or step to another move or step, which may be "inter-move, inter-step and intra-step shifts" (Lim, 2014: 73), and it differs in part from the term "rhetorical function shifts" which refers to (i) general shifts in functions "beyond the paragraph level", and (ii) specific shifts in functions which "operate within" a paragraph (Selinker, Todd-Trimble, & Trimble, 1978: 314).

2. DATA COLLECTION AND ANALYSIS

To meet the aforementioned objectives, we analysed 60 Discussion sections of Forestry RAs selected from four high impact Forestry journals published in 2011 and 2012, namely *Forest Science*, *Forest Ecology and Management*, *Canadian Journal of Forest Research*, and *Agricultural and Forest Meteorology*. The journals were selected based on (i) the prestige levels of the publications as indicated by their impact factors, and (ii) topic coverage or representativity of the field as reflected in their wide coverage of topics within the field of Forestry (Kanoksilapatham, 2005; Lim, 2012; Stoller & Robinson, 2013; Yang & Allison, 2004). Accordingly, a purposive sample of 15 RAs was selected from each journal, so as to provide the researchers with rich and diverse insights into how researchers organise and execute their research writing (Dörnyei, 2007). The sample was purposive in that three criteria were used in collecting the sample for this study. First, we ensured that all the articles were published in reputed and established Quartile 1 Forestry journals indexed in Web of Science. It was important to choose the articles not only because of their extensive coverage, but also with reference to their impact values in the field (Lim, 2012). In this regard, according to the 2011 Journal Citation Reports (Thomson Reuters, 2011), the four journals selected were all Quartile 1 journals with impact values of 1.047, 2.487, 1.685, and 3.389 respectively. Second, in view of the focus of this study, we ensured that all the articles incorporated a distinct Discussion section so that valid conclusions could be made about recommendations incorporated in comparable texts. Third, each article had to be chosen from the most recently published issues at the time when the study commenced. This means that journals published in 2011 and 2012 were selected in order to ensure that the articles represented those which were the most recent with regard to writing practices in the discipline. Given that this investigation focused on identifying the ways in which writers make recommendations for further research and practical applications, the information elements used in determining the directions of the studies were considered collectively as "deductions from the research" (Yang & Allison, 2003: 376).

We based our analysis on the ESP approach to genre analysis (Swales, 1990, 2004) and started with the identification of rhetorical stages (i.e. moves and/or steps) in the Discussion sections. Given that in the Forestry Discussion sections only some moves had more than one step, a code was assigned (i) to a step if the move had two or more steps, and (ii) to a move if the move could not be further

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subdivided into steps. This was done based on their related salient communicative functions as well as linguistic clues such as specific lexical items, discourse markers, tense and modality changes, and verb forms (Connor & Mauranen, 1999; Nwogu, 1997). In this investigation, "the reliability of the coding process refers to the degree of inter-coder consistency in categorising a text segment when two coders were engaged in coding the same information elements" (Lim, 2019: 38). The type of inter-coder agreement was "percent agreement" which showed "the number of agreements per total number of coding decisions" (Biber, Connor, & Upton, 2007: 35). The 'number of agreements' in this study was defined as the number of coding decisions (made by both coders) which were the same in the dataset comprising 60 Discussion sections as indicated below:

$$\frac{3{,}078 \text{ coding agreements}}{1{,}581 \text{ coding decisions by Coder 1} + 1{,}567 \text{ coding decisions by Coder 2}} \times 100\% = 97.78\% = 0.9778$$

On the basis of the percent agreement illustrated above, the inter-coder agreement achieved after the second round of coding was 97.78%, clearly meeting the requirement that inter-coder reliability needs to be at least 90.0% (Miles & Huberman, 1994) before it could be considered as satisfactory. In parts where inter-coder discrepancies emerged in the process of ascertaining step boundaries, a discussion was conducted to identify the possible nuances that led to the differences between the choices made by both coders so that both coders could objectively differentiate moves that were deductions from those which were not.

The next step was to identify the moves indicating future directions in each RA. This means that we identified the frequencies of occurrence of the two moves, and ascertained whether each move should be categorised as obligatory or optional (Kanoksilapatham, 2005; Lim, Loi, Hashim, & Liu, 2015; Soler-Monreal, Carbonell-Olivares, & Gil-Salom, 2011). (In this paper, 'frequency' is defined as "the number of times a move occurs in a Discussion section", while an 'average frequency' is defined as "the total number of times a move occurs in all the Discussion sections divided by the total number of Discussion sections.) Each move was categorised as "obligatory" if it appeared in all (100%) of the Forestry RAs, "quasi-obligatory" if it appeared in 51% to 99% of the texts, and "optional" if it occurred only in 50% or less of the texts (Soler-Monreal et al., 2011: 8; Wong & Lim, 2014: 151; Yang & Allison, 2003: 372-374). Apart from the analysis of the frequency of occurrence of moves, we carried out a move sequence analysis to identify where writers generally position the moves related to recommendations (Lin & Evans, 2012; Swales, 1990). Additionally, the move analysis also focused on prominent rhetorical shifts or "recurrent connections between information elements" (Lim, 2014: 72) linking the recommendatory moves to other moves.

The identification of moves related to the recommendation of future directions was followed by a qualitative analysis to distinguish salient linguistic mechanisms associated with each move, which would be pedagogically valuable.

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Text segments related to each move were examined to identify frequent and recurring instances of lexico-grammatical features which could be directly linked to the communicative function of the text (Lim, Loi, & Hashim, 2014; Mur Dueñas, 2009). In this context, sentence structures, clause elements, phrasal categories, parts of speech and tense usage were considered with the purpose of identifying prominent language resources (Lim, 2014). The supporting lexico-grammatical resources were identified based on language descriptions presented by several scholars (Biber, Johansson, Leech, Conrad, & Finegan, 1999; Downing & Locke, 2006; Greenbaum & Quirk, 1990; Quirk, Greenbaum, Leech, & Svartvik, 1985) so that the recurrent salient resources used to perform each communicative function could be clearly presented.

3. RESULTS AND DISCUSSION

Before reporting the detailed results on the two types of deductions, it is essential to provide a brief account on the overall generic structure of the Discussion sections in the Forestry articles of the sample. The generic structure has emerged from the analysis of this study (and has not been extracted from any particular previous study). The Discussion sections of the articles examined in this study consisted of nine moves. In Move 1, 'providing background information', writers furnish contextual and theoretical background information on the study apart from reminding readers of the purpose of the study. This is followed by Move 2, 'highlighting main finding(s)', in which writers refer to tables and figures reported in the preceding Results section, and 'explaining finding(s)' in Move 3 that provides reasons for particular finding(s). Based on such findings, writers proceed to Move 4, 'making a generalisation', where writers show what their research findings suggest with regard to the entire population concerned. Another major move is Move 5, 'comparing present and past research findings', in which writers state whether the present research results support or differ from those reported in previous studies. Subsequently, writers continue to Move 6, 'evaluating a finding', which focuses on highlighting the specific value of their research findings with reference to the original purpose or hypotheses of the study. Based on the findings and the related evaluation, writers may proceed to Move 7, 'evaluating the study', in which limitations of the entire study are acknowledged apart from the significance of their research which may be stated with reference to its pioneer status and/or contributions to the field of Forestry. The Discussion section may generally end with (i) Move 8, 'recommending further research', which signals the knowledge gaps that still remain to be addressed in further studies, or (ii) Move 9, 'recommending practical applications', which highlights the immediate uses of the major findings of the entire study.

Given that this paper focuses on recommendations for further investigations and practical applications, it is necessary to report the findings in accordance with

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the research questions given. 'Recommending further research' is a move in which researchers signal the knowledge gaps which they have noticed in the course of the study so that these emerging gaps could be addressed in future studies. The other move, 'recommending practical applications', highlights the immediate applications of the findings and also includes the implications that the writers' findings have for practitioners and stakeholders such as forest managers, policy makers and forestry practitioners. Although both moves are quasi-obligatory, their frequencies vary considerably. While 'recommending further research' is employed in 66.7% (40/60) of the Discussion sections, 'recommending practical applications' is employed in 81.7% (49/60) of the texts. The average of frequency of 'recommending practical applications' (1.9 occurrences per section) is markedly higher than that of 'recommending further research (1.3 occurrences per section). This difference suggests that in an applied discipline such as Forestry, writers prefer to emphasise the possible practical applications of their research more often than the possible areas for further research (see Table 2). Overall, deductions (comprising both types of recommendations) are incorporated in the vast majority (91.7%) of the Discussion sections, thus signifying that Forestry researchers generally view deductions as vital in the final section of a research paper to be published.

MOVE OR CATEGORY	FREQUENCY	AVERAGE FREQUENCY	NUMBER OF DISCUSSION SECTIONS CONTAINING THE MOVE OR CATEGORY	PERCENTAGE OF DISCUSSION SECTIONS CONTAINING THE MOVE OR CATEGORY (%)	NUMBER OF DISCUSSION SECTIONS USING IT AS A CLOSING MOVE OR CATEGORY	PERCENTAGE OF DISCUSSION SECTIONS USING IT AS A CLOSING MOVE OR CATEGORY (%)
Recommending further research	88	1.3	40	66.7	14	23.3
Recommending practical applications	115	1.9	49	81.7	31	51.7
Total deductions	203	3.4	55	91.7	45	75.0

Table 2. The use of deductions in Forestry Discussion sections

Table 2 shows that over half (31/60) of the Discussion sections close with a recommendation for practical application or highlight an implication that the main findings have for forest management professionals and researchers. This helps to end the article with a proposal for action on the part of the reader. In addition, almost a quarter (23.3%) of the Discussion sections close with 'recommending further research', thus providing a definite take-away for the readers, particularly other researchers who would like to continue the current stream of research. The following sections analyse each move in detail.

3.1. Linguistic mechanisms in recommending further research

In making recommendations for further studies, researchers draw on the experience that they have gained in the course of the study being reported, on the basis of the insights relating to the limitations of their own research or notable knowledge gaps which they have discovered after completing the study. In its most direct expression, the need for additional work is signalled through lexemes denoting future studies, which are employed in combination with verb and adjective phrases denoting necessity, as shown in Table 3.

LINGUISTIC MECHANISM	INSTANCES OF RECOMMENDING FURTHER RESEARCH
Using verb phrases indicating necessity after subjects denoting additional work	While numerous studies have been conducted in this area (Erez and Lavee, 1971; Erez and Couvillon, 1987; Naor et al., 2003; Arzani and Mousavi, 2008), <u>further work is required</u>. (RA5: 1083)
	<u>Additional studies</u> with a priori hypotheses regarding plant species richness <u>are needed</u> to address such biodiversity questions. (RA30: 922)
	<u>Closer inspection</u> of this frequency mode <u>is needed</u> with respect to coherency with other tree-ring chronologies, associations with NAO proxies, and temporal changes in power. (RA1: 161)
Employing adjectives denoting necessity after subjects denoting additional work	<u>Further monitoring will be necessary to determine how</u> herbaceous ground covers affect long-term recruitment of native species that contribute to natural succession…(RA38: 132)
	<u>These types of experiments are necessary to ensure models are validated</u> under orchard conditions. (RA5: 1083)
	<u>Continued study</u> of AMO–wildfire associations throughout future changes in AMO, PDO, and AO phases <u>will be necessary to fully understand</u> the limitations of our results. (RA17: 2199)

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Table 3. Recommending further research by highlighting necessity

Table 3 highlights the wide array of noun phrases denoting future studies or additional work (e.g. 'further work', 'closer inspection', etc.) used in combination with either passive verb phrases indicating necessity (e.g. 'is required', 'are needed', etc.) or verb-adjective phrases denoting requirements (e.g. 'will be necessary', 'are necessary', etc.). Writers justify such statements of necessity by clearly indicating the purpose of future studies in the form of purpose adjuncts containing verbs signalling investigation (e.g. 'to address', 'to determine', etc.). Necessity statements are made in the simple present to highlight the state of affairs at the time of writing.

While it is true that verbs indicating necessity clearly point out a knowledge gap to the reader, Forestry researchers occasionally imbue their directions with a greater sense of urgency. Specific research areas that need immediate attention are highlighted using stronger verbs indicating justification rather than just necessity, as shown in the following examples.

(1) <u>Wildfire response effectiveness</u> using area and time-based performance measures <u>deserves further study</u> at more precise scales. (RA60: 395)
(2) <u>The study of *Copaifera* productivity</u> as an economically viable NTFP therefore <u>warrants further consideration</u> within the context of an integrative spatial analysis. (RA31: 263)
(3) Since thinning age and site may be significant determinants of coppice competitiveness, <u>further experiments</u> where each of these variables is manipulated in turn <u>are warranted</u>.(RA29: 847)
(4) <u>The degree to which the arbitrary boundaries of latitudinal belts</u> or any other observational unit reflects the underlying mechanisms involved <u>merits</u> <u>further investigation</u>. (RA17: 2199)

In the examples above, instead of plainly stating that research is needed or that it may be beneficial, writers make a stronger statement that justifies further research in specific areas. For this purpose, writers employ semantically emphatic verbs (compared to 'need' or 'require') in combination with objects denoting further research (e.g. '<u>warrants</u> further consideration', '<u>merits</u> further investigation', etc.) to highlight an area which merits attention in further research endeavours.

In addition to making necessity statements, Forestry researchers attempt to boost the appeal of their research recommendations by accentuating potential benefits, especially in terms of enhanced understanding, to the disciplinary community (see Table 4).

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LINGUISTIC MECHANISM	INSTANCES OF RECOMMENDING FURTHER RESEARCH
Using 'predicator-object' structures indicating possible knowledge outcomes	<u>Future investigations</u> that address the patterns and mechanistic controls of carbohydrate accretion and depletion <u>can provide</u> <u>valuable insight</u> into carbon cycling dynamics... (RA43: 147)
	<u>Experiments to quantify possible relationships</u> between tree growth, various agricultural yields, and climate <u>could provide</u> <u>much-needed answers</u> for both the scientific and agricultural communities however have not yet been done. (RA1: 161)
Employing facilitation-focused verbs with purpose adjuncts indicating additional insights	<u>Further research</u>, including interviews with leaders from the Innu nation, DNR, and other organizations, <u>could help</u> <u>to understand the specific Labrador context</u>... (RA19: 2256)
	Perhaps, <u>future researchers</u> could use both the objective measure of use (traffic counts) along with surveys of recreationists who use the monitored sites. The use of these data <u>could help</u> researchers <u>to triangulate results and provide more information</u> about the activities that guests pursue at the sites. (RA46: 289)

Table 4. Recommending further research by foregrounding potential benefits with reference to knowledge outcomes and additional insights

Table 4 shows that the benefits of a completed study are presented as predicator-object structures indicating possible knowledge outcomes (e.g. can provide <u>valuable insight</u> into', 'could <u>provide much-needed answers</u> for', etc.). Benefits are also presented using verbs denoting facilitation (e.g. 'could help') in combination with purpose adjuncts denoting better comprehension of specific phenomena (e.g.

'to understand the specific Labrador context', 'to triangulate results and provide more information about activities', etc.). In these cases, justifications for additional work are pitched at the disciplinary community's collective aspiration towards advancing knowledge.

3.2. Rhetorical shifts used for recommending further research

Our analysis has shown that recommendations for further research follow a statement of limitation of the study being reported. In such instances, writers acknowledge a limitation in their study, especially methodological constraints, as shown in Figure 1, and follow it up with a recommendation for additional studies where the problems are circumvented.
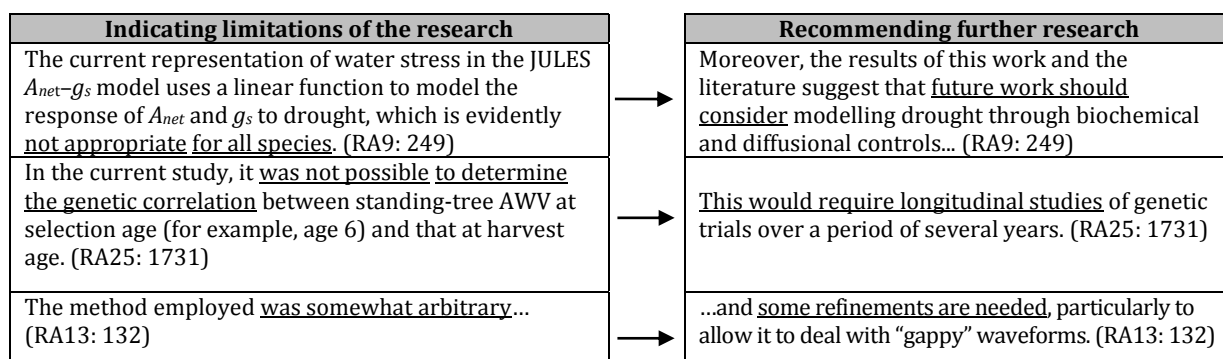
Indicating limitations of the research	Recommending further research
The current representation of water stress in the JULES A_{net}–g_s model uses a linear function to model the response of A_{net} and g_s to drought, which is evidently <u>not appropriate</u> for all species. (RA9: 249)	Moreover, the results of this work and the literature suggest that <u>future work should consider</u> modelling drought through biochemical and diffusional controls... (RA9: 249)
In the current study, it <u>was not possible</u> to determine the genetic correlation between standing-tree AWV at selection age (for example, age 6) and that at harvest age. (RA25: 1731)	<u>This would require longitudinal studies</u> of genetic trials over a period of several years. (RA25: 1731)
The method employed <u>was somewhat arbitrary</u>... (RA13: 132)	...and <u>some refinements are needed</u>, particularly to allow it to deal with "gappy" waveforms. (RA13: 132)

Figure 1. Rhetorical shifts from 'indicating the limitations of the research' to 'recommending further research'

Figure 1 shows that writers acknowledge the drawbacks of their methodology using negative evaluative adjective phrases (e.g. 'not appropriate', 'somewhat arbitrary', etc.) which indicate a form of failure or unsuitability. These limitations are acknowledged and possible future criticisms are forestalled by stating a solution to the problem, which is to continue the research in such a way as to address these stated limitations. Thus writers make a transition from the statement of limitation to recommendations for further research marked by references to additional work and verbs denoting necessity or inclusion (e.g. 'some refinements are needed', 'future work should consider', etc.). In terms of tense usage, this transition is largely marked by a shift from the simple past to the simple present or the modals denoting suggestion.

A closely related shift appears in the form of a transition from statements of omission to recommendations for further research. As exemplified below, writers indicate that they have not covered specific aspects or have only partially addressed a restricted research area because they are beyond the scope of their current work.

(5) It is important to acknowledge that the spatial patterns in seedling abundances we observed <u>tell only a partial story</u> of the forest regeneration process. A comprehensive understanding will await <u>more long-term studies</u> of temporal dynamics of disturbance... (RA34: 1252)

(6) This study <u>looked at only one severe SBW outbreak</u> for comparison, but ideally the harvest treatment <u>should be compared</u> with multiple outbreaks to determine where it fits in the natural range of variation. (RA16: 2189)

(7) A thorough investigation of the effect of tree height on lateral distribution is <u>beyond the scope of this study</u>. Experimental design in similar <u>future investigations</u> should therefore pay close attention to relative tree heights. (RA23: 1575)

(8) We <u>did not investigate</u> the influence of scale here, and <u>more sophisticated methods</u> of integrating variation in the X, Y domain with topographic variation in air temperatures <u>are clearly needed</u>. (RA4: 1072)

Here, writers use predicator-object structures to acknowledge that the current study has only addressed a specific research area partially (e.g. 'tell <u>only a partial story</u>', 'has <u>only examined the third step</u>', etc.) or that it was not addressed at all (e.g. 'did not investigate', 'was beyond the scope of this study', etc.). The identified research gap is subsequently highlighted as an area where further study (indicated by 'more long-term studies', 'more sophisticated methods', etc.) needs to be conducted, thus demonstrating how shortcomings can be reasonably overcome and closely linked with an avenue for further research.

In Forestry, transitions into recommendations for further research are not restricted to those concerning limitations of the study as writers often present a finding and follow it up with a related description that can possibly arouse readers' interest, even though it may be outside the scope of their own inquiry. In such cases, the new area of interest is earmarked for future studies (see Figure 2).

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Presenting a finding	Recommending further research
We <u>found evidence</u>, for example, of <u>positive spatial synchrony</u> of multiple, building populations during development of the Markagunt Plateau outbreak. (RA51: 12)	<u>Future studies</u> that combine the data precision of dendrochronological approaches with a full characterization of entire landscapes <u>could further understanding</u> of how spruce beetle outbreaks develop. (RA51: 12)
There was a <u>higher-order interaction</u> between the level of MPB-caused mortality and both site and spatial arrangement... (RA57: 185)	<u>Further work</u> <u>is needed</u> to improve our understanding of how spatial heterogeneity influences fire behavior at stand and landscape scales... (RA57: 185)
Root prevalence in pure Pg plots dropped off <u>more quickly</u> with distance from tree stems. (RA23: 1575)	<u>Future research</u> <u>may address</u> the effect of stem density on lateral distribution of Pg fine roots. (RA23: 1575)
Partial response functions developed from this model show disease severity to be <u>most sensitive</u> to elevation followed by mean winter air temperature, mean relative humidity during July, and then stand age. (RA26: 673)	Given the moderate sensitivity of disease severity to air temperature, <u>further research</u> <u>should investigate</u> how climate change influences the spatial distribution of severity... (RA26: 673)

Figure 2. Rhetorical shifts from 'presenting a finding' to 'recommending further research'

As shown in Table 2, writers present possible offshoots from their current findings in the form of noun phrases indicating relationships (e.g. 'higher order <u>interaction</u>',

'positive spatial <u>synchrony</u>', etc.) and comparative/superlative modifiers (e.g. '<u>more</u> quickly', '<u>most</u> sensitive', etc.) before using noun phrases which suggest what would possibly occur if a more comprehensive or different set of variables was introduced (e.g. 'the effect of stem density on lateral distribution of Pg fine roots', 'how climate variable influences the spatial distribution of severity', etc.). Using such rhetorical shifts, writers not only demonstrate that the study being reported has achieved its objectives, but also generate additional questions that may conceivably emerge from the study, thus drawing readers' attention to the remaining issues for future considerations.

3.3. Linguistic mechanisms in recommending practical applications

While 'recommending further research' signals the commitment of the researchers to stretching the boundaries of existing knowledge, 'recommending practical applications' reflects the practical value of the data, method or findings for practitioners and researchers. In this move, writers appeal to the applied nature of the discipline and provide responses to the questions about (i) how these findings can possibly become useful for the practitioner, and (ii) what benefits a practitioner can possibly derive from these findings. This explains why the most common realisation of this move involves the use of phrases indicating functionality and practicality, as exemplified in Table 5.

LINGUISTIC MECHANISM	INSTANCES OF RECOMMENDING PRACTICAL APPLICATIONS
Using verb phrases indicating application	<u>This methodology</u> of comparing growth of infected host trees with that of non-infected non-host trees growing at the same site <u>could be used</u> <u>to estimate</u> the effects of other dwarf mistletoe on tree growth in other regions of the western United States and Mexico. (RA59: 375)
	<u>The regression trees</u> created here <u>could also be applied</u> to forecasted future climate regimes <u>to predict</u> the impact of future climates on MPBs in whitebark pine habitat. (RA47: 333)
	Combined, <u>the two metrics studied here</u> (sub-canopy direct beam irradance and SVF$_\theta$) <u>may be used</u> <u>to explain</u> much of the observed plot-scale variability... (RA12: 55)
Using adjective phrases indicating utility	<u>The 30m topographic index</u> is similar to that of Lundquist et al. (2008) and <u>could be</u> <u>useful</u> outside the daily modeling framework, example as a gradient modeling layer... (RA4: 1070)
	<u>The reference spatial conditions reported here</u> are <u>immediately and directly applicable</u> to the design and monitoring of fuel reduction and forest restoration treatments in similar forests. (RA22: 1515)
	<u>The results of the study</u> are <u>useful</u> for at least two reasons to managers during all stages of road management ... (RA46: 289)
Using noun phrases indicating useful aids	<u>This study has shown</u> that <u>experimental manipulation</u> of plant canopies <u>can be</u> <u>a useful tool</u> <u>for elucidating</u> the controls on plant water-relations... (RA2: 363)
	<u>Use of a selection index</u> to improve both growth rate and sawtimber quality is <u>a potentially valuable tool</u> for consideration in loblolly pine breeding programs. (RA56: 176)

Table 5. Language resources relating to the functionality and practicality of a study

Table 5 shows that writers employ noun phrases that distinctly specify methodological options of their research (e.g. 'the two metrics studied here', 'the regression trees created here', etc.) and emphasise their functions via suggestion indicators involving the use of verb phrases denoting functionality and applicability (e.g. '<u>may be</u> used', '<u>could also be</u> applied', etc.). These statements of applicability are supported by purpose adjuncts (e.g. 'to estimate the effects', 'to predict the impact of future climates', etc.) which clearly define the specific functions that the highlighted aspect covers for practitioners. Forestry researchers also employ adjective phrases indicating utility (e.g. 'useful', 'immediately and directly applicable', etc.) to signal the areas in which their results may perform desired positive functions. Interestingly, the scope of recommendations for practical applications in Forestry actually includes areas beyond research results, given that writers use noun phrases highlighting the prized quality of their instruments (e.g. 'useful tool', 'a potentially valuable tool', etc.) and the noteworthy functions of their research methods (e.g. 'experimental manipulation of plant canopies', 'use of a selection index', etc.).

Our analysis has therefore shown that writers' recommendations for practical applications revolve not only around the results that they have obtained, but may hinge largely on the value of the research methods perceived to have contributed to their eventual findings.

A practical application often takes the form of a possibility of increased understanding or additional knowledge for researchers, or alternatively, a specific solution to a problem in forest management, as shown in Table 6.

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LINGUISTIC MECHANISM	INSTANCES OF RECOMMENDING PRACTICAL APPLICATIONS
Using a 'predicator + object + prepositional phrase' structure denoting an increased awareness in practice	<u>Results of simulation studies</u> such as ours can provide information that may be useful to <u>forest and fire managers</u>. For example, results from this study and others <u>may provide managers with further understanding</u> of the potential errors in predictions made by operational fire behavior models. (RA57: 187)
	<u>Evaluation of the zenith angle</u> that when used to compute SVF$_\theta$ <u>explains the most variability in ablation rates</u> across all snow depth sensor locations <u>may provide insight</u> into the source of the governing energy fluxes. (RA12: 55)
Employing a 'predicator + object' structure denoting an additional value for stakeholders	<u>This study</u> should both <u>encourage Aboriginal peoples</u> to engage in forest planning processes and <u>help forest planners</u> <u>to appreciate the potential benefits</u> of such involvement, provided that they are open in their conceptions of what it means to manage forest ecosystems. (RA19: 2256)
	<u>Identifying areas more susceptible to high impact (i.e., ground-based) harvest techniques</u> <u>allows land managers</u> <u>to develop alternative strategies</u> to meet management objectives and can help prioritize allocation of monitoring resources. (RA28: 829)

Table 6. Predicator-object structures employed in highlighting practical benefits derived from the study

In such recommendations, writers recurrently use noun phrases denoting Forestry practitioners (e.g. 'forest and fire managers', 'forest planners', etc.) to highlight the active roles that can possibly be played by the stakeholders involved. It is in this

move that researchers employ noun phrases denoting research efforts (e.g. 'evaluation of the zenith angle', 'identifying areas more susceptible to high impact harvest techniques', etc.) and predicator-object structures followed by either (i) prepositional phrases (e.g. 'may provide managers <u>with further understanding of the potential errors</u>', 'explains the most variability <u>in ablation rates</u>', etc.), or (ii) infinitive phrases (e.g. 'encourage Aboriginal peoples <u>to engage in forest planning processes</u>', 'allows land managers <u>to develop alternative strategies</u>', etc.) in order to highlight an increased awareness in practice or an additional value that signals their concerns about stakeholders' interest in real life.

Instead of recommending concrete practical applications in the short term, Forestry researchers have the propensity to foreground the usefulness of their research by stating that their findings have long-term implications or consequences for Forestry research and practice. These implications take the form of (i) identifying areas where the finding may be applicable, (ii) making recommendations for action, and (iii) identifying challenges encountered by forest managers or practitioners. Such specific practical applicability of a finding is indicated directly using the subject-predicator-object-adverbial (SPOA) structure as shown in Table 7.

SUBJECT (noun phrase referring to findings with an optional adverbial in some cases)	**PREDICATOR** (stative linking verb)	**OBJECT** (noun phrase denoting effects or consequences)	**ADVERBIAL** (referring to specific areas affected by the implications of the findings)
<u>This relationship</u> between maximum LAGC and species	has	<u>important implications</u>	<u>for emerging objectives</u> such as identifying optimal species mixtures for forest management strategies aimed to provide carbon and biodiversity benefits. (RA48: 374)
<u>Habitat differences</u>	have	<u>implications</u>	<u>for resource management</u> on a temporal as well as a spatial scale. (RA31: 262)
However, <u>the relationships and metrics</u> explored in this study	have	<u>more global implications</u>	<u>for the improvement of land surface and hydrologic models</u> in snow-covered forests. (RA12: 55)

Table 7. Using the SPOA structure in drawing implications of a finding

As shown in Table 7, references to results (e.g. 'this relationship', 'habitat differences', etc.) are linked with 'predicator + object' combinations (e.g. 'has important implications', 'have more global implications', etc.) which contain the ramification-related noun 'implication'. Such PO structures are ensued by purpose adverbials indicating the actual consequences of a result (e.g. 'for the improvement of land surface and hydrologic models...', 'for resource management', etc.), thus overtly signalling how a remarkable finding precipitates a notable application in the disciplinary community.

Another interesting strategy used in this move involves researchers' attempt to exhort practitioners to adopt specific measures using phrases relating to

necessity in three ways. First, as shown in Table 8, necessity-related complex verb phrases (e.g. 'statistical models of source distances may need to be parameterized', 'excess trees…would need to be planted', etc.) are employed to signal the requirement for specific actions to be taken. Second, writers use noun phrases specifying practical applications (e.g. 'to periodically recalibrate forest models', 'replanting with varieties that require less chill', etc.) in combination with modal auxiliaries signalling tentativeness and adjective phrases indicating necessity (e.g. 'may be necessary') in a bid to show a possible practical application resulting from their findings.

LINGUISTIC MECHANISM	INSTANCES OF RECOMMENDING PRACTICAL APPLICATIONS
Using complex verb phrases indicating necessity	The differences in average input distances for the same processes in the two studies indicate that <u>statistical models of source distances</u> <u>may need</u> <u>to be parameterized</u> on the landscapes to which they are intended to apply… (RA18: 2240)
	If species with poorer survival, and with poor abilities to disperse from adjacent forested areas due to seed size or other characteristics, are desired to be a particular proportion of the species in the restored forest stand, then <u>excess trees of these species</u> <u>would need to be planted</u> in anticipation of higher mortality. (RA38: 133)
Using modal auxiliaries signalling tentativeness and adjective phrases indicating necessity	Until the mechanisms and interactions are better understood, it <u>may be necessary</u> to <u>periodically recalibrate forest models</u> with permanent plot data <u>to reflect these emerging influences</u> on species composition, structure, and yield. (RA37: 104)
	Other high chill locations, namely Orange, Lenswood, Tatura and Bacchus Marsh, may also experience significant chill declines, consequently <u>replanting with varieties that require less chill</u> <u>may be necessary</u>. (RA5: 1083)
Employing illustrative verbs and noun phrases denoting necessity (on a definite note)	<u>These findings</u> <u>highlight</u> <u>the need</u> <u>to pre-treat invaded Quercus sites</u> prior to harvesting operations for managers that want to maintain Quercus. (RA42: 131)
	<u>This important difference</u> <u>shows</u> <u>the absolute necessity</u> <u>to integrate a soil resistance in the calculation of V_d</u>, especially when surface relative humidity is very important. (RA3: 679)

Table 8. Language resources used in highlighting the need for specific actions using necessity-related phrases

Third, on a more definite note, Forestry researchers signal the need for specific real-life actions using noun phrases denoting necessity. In such cases, the sentence-subject referring to a finding (e.g. 'these findings', 'this important difference', etc.) is linked by an illustrative verb (e.g. 'shows', 'highlight', etc.) to a sentence-object indicating a need (e.g. 'the need to pre-treat invaded *Quercus* sites', 'the absolute necessity to integrate a soil resistance in the calculation of V_d', etc.) so as to demonstrate a sense of urgency in the actions proposed for real-life implementation in forest management.

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3.4. Rhetorical shifts used for recommending practical applications

Recommendations for practical implications often appear towards the tail end of Discussion sections and are preceded by the presentation of findings. It is at this juncture that key discoveries of the study are presented once again, so that researchers can underscore the value of the finding by immediately following it up with a recommendation for practical application, as exemplified in Figure 3.

Presentation of a finding	Recommending practical applications
Three metrics derived from Procrustes analysis, which allow comparison of perimeter orientation, size and shape, were demonstrated as <u>descriptors of model performance</u>. (RA10: 116)	These <u>have the potential to aid researchers to evaluate models</u> on the basis of "goodness of fit", apportion error to specific sources and provide for the use of systematic approaches to model improvement. (RA10: 116)
Occasional irregular, multi-cohort harvests <u>generated little to no decrease</u> in harvest yields relative to selection treatments with the same maximum diameter (Table 2). (RA37: 105)	However, the increased horizontal heterogeneity with variable opening sizes <u>may be helpful in providing habitat conditions</u> for a range of fauna and flora uncommon in stands managed by conventional uneven-aged methods… (RA37: 105)
This was somewhat surprising given that the prescription called for non-random selection of leave trees based on tree size and species. (RA22: 1515)	<u>This result</u> <u>illustrates the importance of considering</u> <u>spatial and nonspatial aspects</u> of forest structure simultaneously during the development and implementation of restoration treatments. (RA22: 1515)
Gap creation generally <u>had no effect</u> on mortality of surrounding trees with the exception that mortality of understory trees declined with distance from gap. (RA40: 118)	<u>Our findings</u> <u>have implications</u> <u>for the role of tree age and physiology</u>, competitive status, and natural vs. created gaps in forest succession. (RA40: 118)
In particular, the trends with the 99th percentile of LAGC indicate that for many tree species assemblages, <u>increasing tree species diversity might increase maximum LAGC storage</u>. (RA48: 374)	<u>This relationship between maximum LAGC and species</u> <u>has important implications</u> <u>for emerging objectives</u> such as identifying optimal species mixtures for forest management strategies aimed to provide carbon and biodiversity benefits. (RA48: 374).

Figure 3. Rhetorical shifts between 'presenting a finding' and 'recommending practical applications'

The examples above show the inter-move rhetorical shifts between the presentation of findings to their possible applications. Writers' findings are followed by practical applications in the form of expressions signalling probability (e.g. '<u>have the potential</u> to aid researchers to evaluate models', '<u>may be</u> <u>helpful</u> in providing habitat conditions', etc.). To demonstrate a close connection between findings and such recommendations, writers use noun phrases denoting findings (e.g. 'our findings', 'this relationship between maximum LAGC and species', etc.) and predicator-adverbial structures that express the related ramifications for forest management practices or approaches (e.g. 'illustrates the importance of considering spatial and nonspatial aspects', 'have implications for the role of tree

age and physiology', etc.). These rhetorical shifts are used not only to remind readers of the key findings which constitute the major contributions of the study, but also to underscore the real-life contributions of their research to forest restoration, conservation and management.

4. CONCLUSION AND PEDAGOGICAL IMPLICATIONS

We have analysed the 60 Discussion sections of Forestry research RAs in order to identify how writers in this applied science indicate directions for the future via their recommendations for further research and practical applications. Although both deduction-related moves have been found to be quasi-obligatory, recommendations for practical applications appear far more frequently as they are found in a vast majority of the Discussion sections compared to recommendations for further research, which appear in only two-thirds of the sections concerned. Overall, deduction(s), comprising at least a type of recommendation, appear in nearly 92 percent of the Forestry Discussion sections, thus reflecting the applied nature of Forestry as an academic discipline, where foresters in the field generally act as the ultimate judges of the utility of the new knowledge generated through research. Such deductions are particularly obvious towards the end of a research discussion in Forestry given that two-thirds of the Discussion sections close their RAs with deductions.

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At this juncture, some comparisons of our results with previous research findings need to be made to enlighten us about Forestry in relation to other academic disciplines. While the average frequency of 'recommending further research' (1.3 per section) in Forestry Discussion sections appears to be close to the figure (1.5 per section) in Applied Linguistics (Yang & Allison, 2003), the average frequency of 'recommending practical applications' in Forestry discussions (1.9 per section) is markedly higher than the figure (0.75 per section) in Applied Linguistics (Yang & Allison, 2003), thus suggesting that recommendations for practical applications constitute a relatively recurrent information element in Forestry.

While the average frequency reflects how often an information element recurs, the degrees of prevalence across disciplines could be studied meaningfully with reference to percentages of texts containing each information element. In this case, we can refer to some previously published data for Education and Management for a sensible comparison with Forestry. If we compare the average degrees of prevalence of these two types of deduction, it can be observed that recommendations for further research appear in nearly all (95%) of the Discussion sections in Management (Lim, 2008a), but only two-thirds of the Discussion sections in both Forestry and Education. To be precise, recommendations for further research are incorporated in about 66.7% of the Discussion sections in Forestry and 65.0% of those in Education (Loi et al., 2016). Such a figure in

Forestry is also higher than those in the Discussion sections in Law (35%) and Biochemistry (54.3%) (see Kanoksilapatham, 2005; Tessuto, 2015). The quasi-obligatory nature of recommendations for further research in Forestry suggests that researchers put collaboration and disciplinary advancement before the narrow concerns of competition, as suggested by Berkenkotter and Huckin (1995). Another possible explanation is that writers who acknowledge the limitations of their study, as Lim (2008a) suggested, would not wish to leave the reader focusing on the limitations but would rather make a transition to recommendations for further research, so that the article sensibly ends on a more positive note. Despite the importance of 'recommending further research' mentioned above, its degree of prevalence is still comparatively lower than that for 'recommending practical applications' in a cross-disciplinary comparison. To be precise, recommendations for practical applications are found in 70.0% of the Discussion sections in Education (Loi et al., 2016), but in a vast majority (81.7%) of those in Forestry. Such a cross-disciplinary difference is even more distinct when deductions, as a whole, are considered across disciplines. While it has been reported that only 70.0% of the Discussion sections in Dentistry include deductions (Basturkmen, 2012), we have found that deductions are incorporated in a vast majority (91.7%) of those in Forestry, thus accentuating the prominence of deductions in Forestry researchers' works in the closing sections of their published research reports.

While the findings on the percentages of Discussion sections containing the recommendations have enhanced our understanding of both the rhetorical practices of Forestry researchers, it is necessary to look into how our results on language resources have relevant pedagogical implications, especially in the preparation of instructional materials. There is no denying that guiding learners to acquire the distinct language resources in recommending further research might be less challenging compared to that involved in recommending practical applications. This is because recommendations for further research, unlike recommendations for practical applications, involve primarily overt signals such as (i) verb/adjective phrases indicating necessity after noun phrases that explicitly denote additional work (as demonstrated in Table 3), and (ii) emphatic verbs and predicator-object structures which conspicuously indicate possible knowledge outcomes (as exemplified in Table 4). Nevertheless, it may be more challenging for novice writers to recognise the implicit linguistic signals employed in recommending practical applications. It is therefore recommended that novice writers be given an exercise that requires them to use (i) verb/adjective/noun phrases with purpose adjuncts to implicitly recommend practical applications (as exemplified in Table 5), and (ii) predicator-object structures to signal additional insights and values (as shown in Table 6). It needs to be acknowledged that the SPOA structure (see Table 7) appears to be a relatively straightforward signal (compared to other language resources for recommending practical applications); nevertheless, given that a substantial amount of information is generally conveyed in the sentence-adverbial position (in the SPOA structure), it would be reasonable

to suggest that novice writers in Forestry research be encouraged to provide detailed information on their own suggested practical strategies (for forest maintenance and management based on their studies) in the subject-adverbial positions (as exemplified in Table 7). After learners have been acquainted with such common structures, attention can be directed to the more covert strategies for highlighting the practical contributions of a study (see Table 8). These recommendations for practical applications (unlike the previously mentioned recommendations for further research which is overtly signalled by noun phrases denoting future studies) actually employ verb/adjective/noun phrases indicating necessity, which only tacitly highlight the practical contributions of the study. Such instances of multiword expressions (as demonstrated in Table 8) can be used in an exercise to expose learners to a range of possible choices to be adopted in their own research contexts, thus familiarising learners with both the communicative functions and language resources needed for recommending practical applications.

Apart from the importance of highlighting language resources, our findings have shown that two types of rhetorical shifts are particularly salient and can be given emphasis in instructional materials intended to help novice writers augment the values of their recommendations.

While the first type of rhetorical shifts involves an inter-move transition from an acknowledgement of research limitation to only a recommendation for further research (not a recommendation for practical application), the second type of rhetorical shift involves a transition from the researchers' own finding to a recommendation for further research or practical application. Based on the analysis, it is therefore reasonable to suggest that novice writers be familiarised with the practice of positioning a recommendation for further research immediately after a limitation of their research, particularly their methodological constraints (see Figure 1), before making a recommendation for further research. Novice writers can be encouraged to use such a transition to demonstrate their cognisance of their own research limitations while showing an insight into how a methodological shortcoming can be circumvented in the future. In addition, learners can be introduced to some rhetorical transitions that closely link their own specific findings with recommendations for further research or practical applications, thus drawing readers' attention to how their results broaden the scope and value signalled initially by their study. More interestingly, novice writers can be encouraged to associate a key discovery of their own research with a suggestion for practical application (as shown in Figure 3) in order to demonstrate the extent to which their own finding has a direct or vital bearing on an application in forest conservation and management. In brief, while our findings on the frequencies of deductions, the percentages of texts containing them, and the associated language resources have revealed the degrees of recurrence, prevalence and linguistic realisations of recommendations in Forestry research, our results on rhetorical shifts can be used to highlight how each deduction is aptly positioned to

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demonstrate the researchers' cognisance of their own limitations and to underscore the centrality of their major findings.

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RENU JOSEPH is an Assistant Professor of English at Universiti Tunku Abdul Rahman. Her areas of interest include English for specific purposes and genre analysis. She has a doctoral degree in English Language Studies from Universiti Malaysia Sabah.

JASON MIIN-HWA LIM is an Associate Professor of English at Universiti Malaysia Sabah. He has published extensively in research domains relating to English for specific purposes and language education. His works have been published in a range of established journals, including *Journal of English for Academic Purposes* (Elsevier), *System* (Elsevier), *Discourse Studies* (Sage), *Ibérica* (AELFE), and *English for Specific Purposes* (Elsevier). He was a Fulbright Research Scholar at the University of Michigan, and a Research Fellow at the SEAMEO-RELC in Singapore. He is an Editorial Board Member of *Journal of English for Academic Purposes*.

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