

## Using Genre- and Corpus-based Findings to Inform the Writing of the Discussion Section of a Research Article

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### Introduction

Postgraduate science and engineering (S&E) students in non-English speaking countries are strongly expected to publish in peer-reviewed SCI (Science Citation Index) international journals to fulfil graduation requirements and gain employment (Cargill, 2004). The publication pressure has posed difficulties for novice writers who may not be very clear about generic structures and lexico-grammatical choices in research articles following IMRD (Introduction-Methods-Results-Discussion) routine (Bitchener & Basturkmen, 2006). Therefore, it becomes pressing to implement training with a strong focus on writing for international scientific publication targeted at novice student researchers of S&E. However, scarce accounts have been found which specifically address ‘discussion of results’ sections in research article writing instruction. The importance of this section has long been recognised, as it is not restricted to simple description of research results, but functions to convince readers of the value of research by interpreting findings, connecting findings with prior research, and proposing new contributions or claims.

While a few corpus-informed pedagogical applications on thesis writing or research article writing have been reported to date, there are limited instructional materials that directly develop teaching discussion sections, and thus support S&T graduate students in the article preparation process. The current study is part of a larger research project which focuses on analysing the rhetorical organization and language choices of research article discussion sections. This small-scale study reports on how the results of genre and corpus studies inform the instructional design of a writing workshop in the Chinese context. In this study, chemical engineering was chosen for exemplary pedagogical practices. The interdisciplinary nature of the discipline would be of potential benefit to a number of engineering scientists and practitioners from related engineering fields where a discussion of findings constitutes an essential section in a research article.

The research questions posited for this pedagogical practice are: 1) How was the workshop of teaching discussion sections implemented? 2) How did the student participants perceive the usefulness of the workshop? To answer the first question, the researcher presented a series of instructional activities in consultation with corpus-informed findings, along with the audio-recordings of the workshop and observational notes taken on the spot to record the process, e.g., the participants’ performances or quick remarks during activities. In response to the second question, the post-workshop feedback forms were designed to evaluate whether the workshops actually addressed students’ needs in writing up discussion sections.

## Methods

### Instructional Design for the Writing Workshop

The workshop materials and tasks presented in paper format were motivated by the genre- and corpus-based findings on discussion of results section described in a prior research project (Jin, 2018a, 2018b), which are beyond the detailed descriptions in this study. The workshop lasted about two hours. The first part focused on the exploration of underlying linguistic characteristics in the self-compiled corpus consisting of 213 ‘discussion sections’/‘discussion of results’ sections in chemical engineering research articles (the Corpus of Discussion Sections in Chemical Engineering, CDSCE). The multidimensional analysis (Biber, 1988) was adopted and the resulting salient linguistic characteristics typical to this part-genre were identified, such as the dense use of noun/noun phrases, and stance expressions towards findings in the form of hedges, boosters, evaluative adjectives, and first-person pronouns. The second part was inspired by genre analysis (Swales, 1990) revealing the rhetorical functions realizing in six moves. Various authentic examples of move structures and lexico-grammatical choices that characterize discussion sections were extracted from the CDSCE corpus.

The corpus-informed teaching application utilised the printout materials informed by corpus analysis, given the consideration of limited time of the workshop and participants’ difficulties in conducting corpus investigation. Despite that participants were unable to directly work on the corpus tool to autonomously search the language or tagged rhetorical patterns, exposure to the printed materials and controlled practices derived from the analyses “not only provide research support for the selection of specific linguistic items [...] but also ensure that authentic language use data are included” (Chang & Kuo, 2011, p. 227).

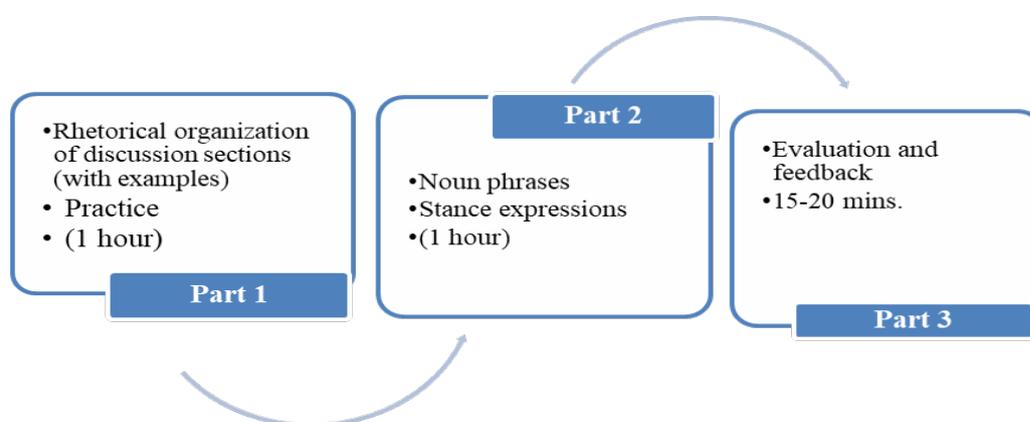


Figure 1. Workshop instruction unit

### Preparation of the Workshop

A workshop entitled *Learning to discuss research findings in a professional way* was held in September 2018 at the School of Chemical Engineering in a well-known university in mainland China. The school was listed among the top 10 best chemical engineering schools from 2000 to 2017. The research students are under pressure to publish in top-ranking international journals as a graduation requirement and to gain employment. However, relevant writing training was not incorporated into the postgraduate curriculum, due to a lack of teaching and research staff specialized in this area and the unavailability of the comprehensive plan for curriculum design and instruction.

The researcher obtained ethical consent first from the school head to commence the writing workshop

for postgraduate students, making clear the purpose and procedures. A recruitment notice was posted in the school bulletin for three days as required. Around 30 students registered for this workshop thereby indicating their willingness to participate.

### **Student Participants in the Workshop**

The workshop recruited 30 postgraduate students (22 male and 8 female students) at the master's and doctoral level in chemical engineering. Before enrolling in postgraduate studies, they obtained their CET-4 (College English Test, Level 4) certificate demonstrating general English language proficiency. According to the school's graduation requirement, a master's student is expected to publish in a SCI-index or SCI-expanded (SCIE) index international journal or in an indexed Chinese journal. A doctoral student is required to publish in at least two SCI-index international journals. Among them, the doctoral students already had two English articles published in SCI-index international journals. The Year 2 Master's students published one English RA paper on average and Year 1 Master's students did not published their work.

### **Examples of Teaching Materials and Instructional Activities**

The design of the activities foregrounded the training of discipline-specific rhetorical and linguistic awareness, which are the areas novice writers often have problems with when writing research articles. All the examples demonstrated and practised in the workshop were extracted from the self-compiled corpus (CDSCE) designed for the whole project (Jin, 2018b). Chinese was used in the instructions throughout to facilitate communication with the participants.

## **Findings and Discussion**

### **Understanding of the Rhetorical Organization of Discussion Sections**

In this part of the workshop, participants were provided with the basic concept of genre analysis to figure out how this section is rhetorically structured. Common rhetorical moves derived from genre analysis were introduced first, followed by the concise explanations of each move through examples:

- Introduction of background information of the study↵
- Statements of the most important findings↵
- Comments on results (explanations of results, comparison with previous studies, evaluation of results)↵
- Generalizations from findings (speculations, claims, proposals)↵
- The strengths and limitations of the study↵
- Recommendations for further research or practical applications↵

Informed by the genre analysis (Jin, 2018a), the first four moves occurred in over 60% of the samples which were deemed as conventional moves in discussion sections. As the enhancement to the introduction,

samples for move analysis were given for practice in Extract 1. The activity is framed as a demonstration of the process of move analysis, enabling participants to see how these moves appeared in the sequence that experienced writers employed to realize particular communicative functions.

|  | Move structure <sup>o</sup>   |
|--|---|
| <p><b>Extract 1:</b> Na, K (main group IA) and Mg, Ca (main group IIA) were chosen as the main alkali metals to investigate the poisoning effect over nano V2O5-WO3/TiO2 catalysts. The degree of the poisoning effect for all the alkali metal doped catalysts can be ordered as follows: K&gt; Na&gt; Ca &gt; Mg), <u>and the results showed that the poisoning effect of alkali metal increased proportionately with the alkalescence. Surface acidity and reducibility could be the main influence factors. Previous work of BET and XRD results (not shown) showed no obvious structure change happened. Many researchers [28] had reported that strength and number of Bronsted acid sites could be decreased with the loading of alkali metals over V2O5/TiO2 oxide based catalyst, and our work has also proved this conclusion (reference to previous studies). Reducibility of surface species was one part of the catalytic cycle proposed by Topsoe [14,15].</u></p> | <p>Contextualizing the study--introduction of research procedure<sup>o</sup></p> <p>Statement of results<sup>o</sup></p> <p>Comment on Results (comparison of current findings with prior research)<sup>o</sup></p> |
| <p><b>Extract 2</b></p> <p>The process we propose has several advantages over conventional biodiesel production processes: (1) short reaction time and high unit productivity, (2) no excess alcohol requirements, (3) lower capital costs due to the small size of RDC and no need for additional separation units, and (4) no neutralization and separation of the catalyst, as solid acids are used instead of homogeneous catalysts. <u>Further investigations</u> on the process efficiency and in-depth economic analysis of the RD system are required in order to fully establish its impact on the biodiesel production.</p>  | <p>The strengths of the study <sup>o</sup></p> <p>Recommendations for future</p>  |



*corresponds to...↵*

*In comparison/contrast to....., the results...↵*

**Evaluation of findings↵**

*The approach/result is/reveals + adj. (e.g. new, novel, significant, accurate). ↵*

**Expressions of strengths and limitations↵**

- *Despite this, the present case study has justified the success\_of the....↵*
- *... (The process we propose) has several advantages over....↵*
- *The results of this study cannot not be taken as evidence for...↵*
- *Unfortunately, we are unable to determine from this data...↵*
- *The lack of... means that we cannot be certain that... ↵*
- *It should be noted that this study has been primarily concerned with...↵*
- *The findings of this study are restricted to...↵*
- *This study has addressed only the question of...↵*
- *We would like to point out that we have not... ↵*

Figure 3. Workshop exercise of summarizing sentence templates.

### Noun Phrases: Focus on the Informational Production

The issue addressed here was the awareness-raising activity of dense nouns/noun phrases for novice research students. As informed by MD analysis, noun/noun phrases were identified as a distinct linguistic characteristics in discussion sections of science writing (Jin, 2018b), and the function of this is to enable writers to package information in a dense and economical way without finite verbs (Biber, 1988), e.g., *peak mean plasma concentration*. I used AntConc to extract the noun sequences in my specialised corpus in advance, and the exemplars were then used in the workshop. The explicit discussion of noun sequence construction (e.g., three-noun sequences, four-noun sequences) may increase their awareness of the recurring noun sequences in science writing. Participants were also encouraged to understand the noun sequences in their disciplinary reading not limited to the examples extracted from the specialised corpus.

**Reading text extracts of noun sequences<sup>4</sup>**

Using *microsecond laser fresh photolysis*, Navio have investigated the dynamics of charge trapping and recombination. (ACB3)<sup>4</sup>

The area under the curve of this signal would be a measure of *surface oxygen vacancies amount*. (ACB6)<sup>4</sup>

...and up-regulated the *gene expression of bone sialoprotein attachment protein*. Another study tried to improve *bone tissue reconstitution* with CH+calcium phosphate composites on the *rabbit and sheep models* [36]. (KCE14-CLA)<sup>4</sup>

The enzyme was purified with 4612.4Umg *protein specific activity*, [...].

Additionally, Lu et al. purified refolded rhPON3 from E.coli using *DEAE-Sepharose fast flow anion exchange chromatography*....

(Tukish2-CLA)<sup>4</sup>

Figure 4. Workshop exercise of addressing nouns/noun sequences.

### Strengthening Linguistic Awareness of Stance Presentations

In this consciousness-raising activity, the participants were expected to notice the stance features salient in discussion sections informed by the MD analysis, which is defined as the way to project authors' attitudes and opinions into academic texts (Hyland, 2005). To be specific, the use of hedging and boosting devices suggest the degree of (un)certainty and commitment such as *can, could, may, might, would, approximately, kind of, maybe, clearly and obviously*, and first-person pronouns (*I, we, our*) make authors' role prominent in research activities. The explicit discussion on them has been a notable omission in academic writing instruction. Introducing novice writers to these stance features help them to argue "clearly for a position, projecting appropriate conviction and displaying a command of material" (Hyland, 2005, p. 376).

**Stance expressions in RA discussion sections**

The sentences below contain stance features from published examples. After reading, discuss the following questions in relation to your thoughts and impressions of seeing these linguistic devices in the published work in your group.

**Text extracts**

Furthermore, we **could** find that the formation of  $N_2O$  at high temperature got smaller with the doping of alkali metals, and this result **would** also be an important proof of the decrease in the reducibility of surface vanadium species. [...], the catalytic cycle **could** consist of four steps: [...]. **Obviously**, H-abstraction of  $NH_4$  to  $NH_3$  (**may** be viewed as partial oxidation of ammonium) is a key step in the SCR cycle. [...], and the formation of  $NH_4$  in first step **could** be inhibited. (CEJ1-CHA)

**This is interesting because** the KCl in the flue gas is expected to lead to deposition of KCl. [...] The higher deposition rate of KCl is **unexpected because** there was slightly less gaseous KCl in the flue gas. (CES9-CHA)

**We speculate that** this occurs because the reducing agent removes oxygen atoms located near the dopant and this will make the dopant less positive. **We speculate that** this would not happen if CuO formed metal clusters. (JC5-CHA)

Similarly, **our** work also **found** that 100%  $N_2$ , 100%  $NH_3$  [...] .Recent work in **our** laboratory [47] **indicates that** PES membranes treated with a  $H_2O$  vapor plasma for 2 min at 25 W have a protein adsorption. (JM5-CHA)

**Questions for discussions**

What is an author's purpose in using the hedges and boosters in discussing findings?

What do you think of using first-person pronouns to state the research findings? Do you think it is necessary to make yourself prominent?

Figure 5. Workshop exercise of discussing stance expressions.

Participants were grouped in pairs to discuss the rhetorical effects brought by these stance expressions in relation to their reading experience. The groups discussed the questions on the task sheet. The participants generally agreed on the incorporation of such devices to determine the degree of certainty and commitment to scientific propositions. Taking hedging devices as an example (e.g., *possibly*, *probably*, *maybe*, *might be*), they remarked that the mitigated findings/claims were more acceptable to readers and gain wider acceptance of findings. As S4 put it,

On many occasions, we are not absolutely right in interpretation of findings. We may lose sight of factors that affect the experiments. If we can say *the findings could be attributed to or possibly because...* rather than *the findings are related to...*, then it is a way to tone down the force of an utterance, so that the findings can be more acceptable to readers.

However, it is interesting to note that a small number of the participants held different opinions of these stance expressions in their reading and writing. What they frequently mentioned was that such linguistic devices should not appear to weaken the objective nature of scientific research articles. For instance, they remarked that expression such as *we speculate that...* is a very confident-sounding and an explicit way to signal authorial presence. What they often resorted to were the results-oriented expressions *the results show/it shows....* In addition, one fifth of the participants articulated that they simply discussed the results without referring to these adjective terms to make personal evaluation of findings. They remarked that senior researchers were more confident to articulate their position and attitudes based on their command of disciplinary knowledge. Their status as novice writers in the research community made them reluctant to show their involvement in their findings in such a direct way. This consciousness-raising activity on stance expressions helps novice writers to think beyond the conventions in writing manuals and prompts them to understand the stance options available to them for their work.

## Feedback from the Participants

At the end of the workshop, the participants were required to fill in an e-evaluation form consisting of eight items (see Appendix). They were expected to respond to items covering the following aspects: overall satisfaction with the writing workshop; the difficulty and clarity of teaching materials and hands-on instructional activities; understanding of the rhetorical organization and linguistic choices of discussion sections; and the possibility of using them in writing. Apart from that, one open-ended question was asked (i.e., *Do you have any comments on this writing workshop?*) to elicit participants' perceptions that may not be reflected by the quantitative results of the five-point Likert-scale survey items. The overall evaluation enabled the researcher to gain a clear idea of the effectiveness of the material design based on corpus consultation and informed the adjustment and development of the instruction.

The participants' answers to the individual items in the questionnaire survey were calculated. The response options ranged from 'strongly disagree' to 'strongly agree'. Due to space constraints, the total number of responses to 'agree' and 'strongly agree' were reported in this study, reflecting positive responses about the workshop materials and activities. The responses on overall satisfaction and fulfilment of expectations indicated the effectiveness of the workshop (mean scores=4.01), as nearly 70% of the participants reported their overall satisfaction, 30% of them reported their neutral attitudes towards the workshop.

In response to the question on the suitability and clarity of the instructional activities, twenty out of thirty participants found that the materials used in the workshop were suitable for their ability and were presented in an intelligible manner. It is not surprising to see the results like this as the sampled texts for demonstration and class exercises selected from discipline-specific journals may largely facilitate their understanding of the text-based activities.

More than half (50%) of the participants reported that the workshop gave them a clear understanding of the rhetorical moves and linguistic choices in the discussion of research findings. For the students with limited experience in writing research papers, this outcome appeared to illustrate concrete benefits which enabled them to grasp the generic features through analyzing the discipline-specific texts. More than a third of the participants expressed that they would like to discuss their research findings for international submission by making use of what they had learned in the workshop, suggesting that the workshop may well contribute to their international scientific communication, "linguistically illuminating and pedagogically useful" (Chang & Kuo, 2011, p. 231).

The open-ended question in the evaluation form elicited some elaborated comments about the workshop beyond the simple descriptive statistics in the Likert-scale items. Participants' responses to the open-ended questions were analyzed and recurring themes were identified, as shown in the following categories.

### Processing the exercises

Around 50% of the participants mentioned that the workshop exercises were not difficult (e.g., 'my relative extensive exposure to reading helps me do the exercises'). However, other participants, in particular, the Year 1 Master's students, expressed their difficulties in processing activities because of the lack of technical vocabulary that hindered their understanding such as class exercise 2.4.3. In addition, they repeatedly mentioned their accustomed skim-and-scan reading style, i.e., grasping the main findings and focusing merely on scientific process/results instead of noticing the structure of rhetorical patterns.

In addition, approximately 20% of the participants commented on the discipline-specific examples for practices. One student said that 'felt highly motivated to read and analyze the texts in my discipline', 'analysis of the discussion sections in our discipline is a wise choice. The writing knowledge can thus be directly transferred into my organization of a discussion section.' Their responses thus further indicated that the familiarity with the discipline-specific texts appears to enhance their motivation to engage in training and also largely facilitate novice researchers in understanding subject-matter information.

## Rhetorical/sentence-level improvement

Nearly 80% of the participants made positive comments on the two-level design of ‘discussion of results’ sections. Around 70% of them did not notice the rhetorical and linguistic features until they were exposed to the practices. Taking stance features as examples, their understanding was restricted to their prior knowledge, ‘I thought I was not allowed to reveal my attitudes towards findings in research articles in my prior reading or writing experience. This part is only equal to present dry and solid facts until I saw the authentic exemplars in disciplinary writing.’, ‘The reviewers once commented that they expected to see my thoughts towards findings. I did not know what they meant. The workshop highlighted these features, and it seemed that the strategic employment of hedging/boosting devices would be fine even though they are such *small words*.’ The frequent occurrence of this theme suggests that a detailed language/genre focused activity is likely to increase participants’ consciousness of these resources available to them.

## Further improvement

Half of the participants provided some suggestions for improvement. The most salient comment was about the prolonged time for more exercises and in/after-class interaction. Second, participants were asked whether their teacher can allocate time to ‘correct the errors and inappropriate expressions’ in their drafts for submission or give them some ‘writing tips’ or ‘take-home messages’ for their writing. Third, some participants mentioned that the practices were nothing more than some obvious language points that they can also summarize in their years of exposure to texts. They recommended the inclusion of writing a response letter to reviewers or editors or some online manuscript editing strategies. Other recommendations were proposed such as more interaction with peer students or the instructor, and the consideration of participants’ research experience in recruitment stage.

## Conclusion

In this report, the formation of a small-scale writing workshop for graduate-level students in the Chinese context in the discipline of chemical engineering was described. The overarching goal of the instructional activities is to demystify the discussion sections in RA writing. The identified rhetorical moves and language choices at the lexico-grammatical and sentence level derived from the genre and corpus analysis of self-compiled academic corpora serve as the orientation for novice writers, which they could build on fundamental writing knowledge to deal with more complex structural patterns. The evaluation done at the end suggests that the participants were able to gain explicit rhetorical-based and language-related skills, and their perception of the workshop approach as being immediately relevant and useful suggests that it is likely to be made use of to assist publication practices. The concrete samples obtained from authentic discipline-specific texts for practice seem to reduce their unfamiliarity with the content and thus stimulate their motivation in learning.

Given the limited set of practices and analyses, it would be presumptuous to conclude that their increased confidence is the result of instruction and the exercises. However, it might shed light on future corpus-informed pedagogical practices. Academic writing practitioners in non-English speaking contexts may find this workshop approach useful if they intend to follow a similar approach to design learning materials and tasks, by drawing on the expertise of genre and corpus linguistics knowledge, though with the possibility that the effectiveness in other discipline-specific contexts may not be fully appreciated. EAP practitioners can also utilize the results to provide valuable feedback to polish novice writers’ drafts. To improve the workshop design, they may consider the prolonged time for instruction and allocate enough time to communicate with participants about their drafts. Further research may include a post-workshop assessment task where participants are expected to (re)write a discussion section, showing

the extent to which they can incorporate what they have learned, and thus verify the learning effects by comparing their pre- and post-writing samples.

### The Author

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## Appendix

### Workshop Evaluation Form

**Instructions:** Please indicate your degree of agreement (ranging from 1 to 5) with the statements listed below.

1. What is your general comment of this workshop?

你对本次小型写作工作坊整体满意度?

Unsatisfactory-----satisfactory

不满意-----很满意

1            2            3            4            5

2. What do you think of the workshop in terms of following aspects?

如下所示，你对此次学习各方面的满意程度?

● On teaching materials and exercises

教学材料及课堂练习

a) Suitability 难度

easy-----difficult

容易-----很难

1    2    3    4    5

b) Clarity

unclear-----clear

不清晰-----清晰

1    2    3    4    5

● On the content 课程内容

Has the researcher taught what you expected to learn? 授课内容是你们预期想学的吗?

Unsatisfactory-----satisfactory

不满意-----很满意

1            2            3            4            5

● On the researcher's presentation and delivery 教师展示与讲授技巧

Unsatisfactory-----satisfactory

不满意-----很满意

1            2            3            4            5

3. The impact of the workshop on your writing of **discussing results of research**

对如何写论文中‘讨论结果’部分的影响?

a) Rhetorical organization 关于了解此部分的结构

Least helpful-----very helpful

没有帮助-----很有帮助

1            2            3            4            5

b) Linguistic characteristics/patterns

关于了解此部分的语言特征

Least helpful-----very helpful

没有帮助-----很有帮助

1            2            3            4            5

c) To use the knowledge and writing skills gained from this session 将今天学到的东西运用到以后的写作当中

Strongly agree-----strongly disagree

非常赞成-----非常不赞成

1            2            3            4            5

**开放式问题 Open-ended question**

Please provide comments (e.g., your reflections or suggestion for improvement) you want to make about the workshop instruction

请如实反馈对参与此次写作工作坊的个人感受以及优化的意见，建议。