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A Move Analysis of Chemistry Research Abstracts Published in the International Conference Proceedings

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Abstract

This study aims to analyze a move structure of research abstracts in Chemistry in order to identify sequences of moves and identify a key linguistic feature in terms of verb tenses used to compose each move. In the analysis, 30 Chemistry research abstracts were randomly collected from the proceedings of Pure and Applied Chemistry International Conference 2018 (PACCON). These collected abstracts were from 6 different subdisciplines in Chemistry, namely Analytical Chemistry, Environmental Chemistry and Renewable Energy, Inorganic Chemistry, Food and Agricultural Chemistry, Material Chemistry and Nanotechnology, and Organic and Medicinal Chemistry (5 abstracts from each subdiscipline). The researcher coded all the data and the results were double-checked by a chemist. The five-move model proposed by Hyland (2000) was used as a model in the analysis. The results of this study revealed the dominant move patterns used to write up the research abstracts in Chemistry as well as the similarities and differences of move patterns in the Chemistry research abstracts across subdisciplines. Furthermore, the preferred move tense for each section in the research abstracts was also found. Lastly, the pedagogical implications for teachers and students in the related fields were presented.

Keywords: Move analysis, discourse analysis, research abstracts, chemistry, English for specific purpose

1. Introduction

Studies of genre analysis have received a lot of attention from the linguistic research community, especially in the field of English for Specific Purposes or ESP (Amnuai & Wannaruk, 2013). There are many linguists defining the term 'genre,' but the most famous person is Swales (1990) who posits that 'genre' is a recognizable communicative event with a particular communicative purpose and commonly used or understood by members of specific discourse community in which that genre occurs. Therefore, genre analysis, in the field of applied linguistics, is an analysis of how a text is constructed and interpreted to achieve specific purposes (Bhatia, 1993).

Research articles (RAs) can be considered one of the most common genres in academic writing which yield plenty of pedagogical implications (Yearley, 1981). When considering a genre analysis on research articles, Swales (1981) can be regarded as a pioneer in the field. He analyzed an introduction part of the academic research papers written by researchers from different disciplines, namely biology, medical, and social sciences. He finally found that research introductions generally consisted of four segments, including 1) establishment of the research field, 2) reporting prior research, 3) preparing for present research, and 4) introducing present research. In addition, it was found that the three from these four segments always occurred on most of the research article introductions. Each segment of the text is referred to as 'move' and each move has its own communicative purpose but together contributes to the purpose of the whole text. Such analysis is called 'move analysis' which has become an important area of research in applied linguistics.

Apart from the introduction part, when researchers write a research article, they are required to write an abstract section which normally will be the first paragraph in most research articles. The abstract is a crucial part since it provides the readers with a summary or a brief description of all the content in the research article. Berkenkotter & Hucking (1995 as mentioned in Kosasih, 2018) proposed that there are four reasons which make the abstract a crucial section in the research article. First of all, the abstract provides the readers with easy access to the information or content of that article. Second, it helps the readers to



screen and decide whether that article is what they are looking for. Third, it gives readers a framework to read the article. Lastly, the abstract provides summaries of primary points of a research article. Nevertheless, the characteristics of each research disciplines are always different, the structure and style of writing of the research abstract in each field are, therefore, also distinct (Hwang et. al., 2017).

Considering the generic structures to write up a research abstract, there are two well-known structures proposed by Bhatia (1993) and Hyland (2000). According to Bhatia (1993), it is suggested that an abstract should provide four crucial details of the research article that it intends to describe. These four details include 1) the action a researcher has done, 2) the method the researcher has employed to complete that action, 3) the results of the study or action, and 4) the conclusion. Therefore, the research abstract, according to Bhatia's notion, would consist of four moves which are 1) Introducing the purpose, 2) Describing the methodology, 3) Summarizing the results, and 4) Presenting the conclusion. Similarly, Hyland (2000) also proposed a model for research article abstracts. However, his modal consists of five moves, namely Introduction, Purpose, Method, Product, and Conclusion, and each of these five moves has its own distinctive function.

Apart from Bhatia and Hyland's, a number of studies have been conducted on research article abstracts in English. One of these is Kosasih (2018) who examined 40 English abstracts of students' thesis in four disciplines, namely public administration, management, fisheries management, and mathematics education in order to identify the move structure and compare the consistency of these cross-disciplinary English abstracts with Bathia's (1993) four-move structure and Swales & Feak's (2004) five-move structure. It was found that AM-R (Aim-Method-Result) move structure was mostly employed in the abstracts while only 15% and 10% of the abstracts were in line with Swales & Feak's (2009) five-move structure and Bhatia's (1993) four-move structure, respectively.

Similarly, Hwang et. at. (2017) examined the rhetorical features of the abstracts of the research articles in nanoscience and nanotechnology written by Vietnamese and English authors. The framework used in the analysis was based upon Hyland's five-move model for the abstract section. Interestingly, Hwang et. at. (2017) found that the abstracts of nanoscience and nanotechnology did not follow Hyland's model since the most frequently used move structure was Purpose – Methodology – Results or P - M - R. Furthermore, the researchers also noticed that the move structure of Vietnamese abstracts was significantly different from English abstracts which could be due to the authors' cultural differences.

Oneplee (2008) investigated the structures of one hundred scientific articles from two scientific journals, Science and Nature using Santos's abstract move pattern theory (1996) as a framework. The results showed that the trends of abstract writing in both journals were identical in the sense that the writers tended to put the emphasis on the study results (25.8%), followed by background information (21.8%), and drawing conclusions (15.8%). Interestingly, the methodology was found only 11% of all the analyzed research abstracts.

Darabad (2016) also investigated the rhetorical structure of research article abstracts in three disciplines, i.e. Applied Linguistics, Applied Mathematics, and Applied Chemistry. A total of 63 abstracts from international journal were randomly selected and analyzed. The Five-Move Model by Hyland (2000) was employed as a basic model in the analysis. The results revealed that the research abstracts from three disciplines shared some similarities and differences in terms of the rhetorical structures.

In addition, Al-khasawneh (2017) analyzed 20 abstracts written by native and non-native speakers of English in the applied linguistics field in order to explore the differences in the rhetorical structure of research abstracts produced by two groups of writers. Hyland's (2000) model of rhetorical moves in research abstracts were used as a model in the analysis. He found that the abstracts from both native and non-native writers were similar in the sense that they contained three common moves, namely purpose, methodology, and result. However, it was found that the native writers were more likely to employ the introduction and the conclusion moves in their abstracts while the non-native writer tended to omit these two moves when compared to their native counterparts.

Zanina (2017) investigated 20 English and 20 Russian research article abstracts on management in order to determine the most obvious cross-linguistic differences in terms of move structure. She also



employed Hyland's (2000) five-move model as a framework for the analysis. The results of her study revealed that most English-language abstracts showed conformity to the conventional model, meanwhile, the Russian-language abstracts did not. Most Russian-language abstracts were composed of a three-move structure containing purpose, methodology, and product or result, while the introduction and the conclusion moves occurred occasionally.

Furthermore, Sidek et al. (2016) examined the abstracted collected from the conference proceedings to determine whether the rhetorical move presenting in these abstracts would follow the conventional model. All the collected abstracts were written by scholars in the field of language and education, and Hyland's (2000) five-move model was used as a framework in the analysis. The results of their study showed that most abstracts partially contained the rhetorical moves as suggested by the conventional model. In addition, it was found that the writers of these abstracts had omitted one or more rhetorical moves in their abstract. Among all abstract sections, the introduction move tended to be omitted the most. Sidek et al. (2016), therefore, concluded that the introduction section in the research abstract might not be mandatory and could be omitted since providing an introduction to the study was, sometimes, unnecessary.

From the aforementioned studies, the conclusion can be drawn in the sense that the research abstracts in each field tend to have a distinguished rhetorical structure which may not be similar to the structures or models proposed by many researchers and scholars.

2. Objectives

Generally, there have been a lot of studies conducted to analyze the rhetorical structures or move patterns of the research abstracts in various disciplines, namely linguistics, applied linguistics, engineering, management, public relation, etc. Nevertheless, to the best of the researcher's knowledge, there have been a few studies on move analysis aimed at analyzing the abstracts in Chemistry written by Thai-native speakers of English. Therefore, this study was conducted to investigate the rhetorical move structures of the research abstracts from six subdisciplines of Chemistry published in the international proceedings with objectives as demonstrated below;

1. To identify sequences of moves in the English-language research abstracts from six subdisciplines in Chemistry

2. To compare the move patterns of the English-language research abstracts across subdisciplines in Chemistry

3. To analyze the linguistic feature related to verb tenses used in the English-language research abstracts in Chemistry

It is expected that this study would shed some light on the move analysis of English research abstracts in Chemistry and benefit the students' academic writing, especially in writing an English research abstract in Chemistry.

3. Methodology

In order to fulfill the proposed objectives, 30 English-language abstracts from six subdisciplines in Chemistry (5 abstracts per each subdiscipline) were collected using a purposeful random sampling technique. These sub-disciplines of Chemistry include Analytical Chemistry (AN), Environmental Chemistry and Renewable Energy (EE), Inorganic Chemistry (IN), Food and Agricultural Chemistry (FA), Material Chemistry and Nanotechnology (MN), and Organic and Medicinal Chemistry (OR). All the collected abstracts were from the proceedings of Pure and Applied Chemistry International Conference 2018 (PACCON) which was held in Songkhla province, Thailand on 7-9 February 2018. In addition, all of the abstracts were written by the native speakers of Thai. The researcher decided to work on the abstracts from such proceedings since PACCON was well-known among chemists worldwide, so it was a great source of quality and impactful research.

In order to analyze the collected research abstracts, Hyland's (2000) five-move pattern was adopted as a framework. According to Hyland's (2000), the research abstracts generally consisted of 5



major rhetorical moves, namely Introduction, Purpose, Method, Product, and Conclusion with details as demonstrated below:

 Table 1 Hyland's (2000) Model of Research Abstracts

Moves	Functions
Introduction	Establishes the context of the paper and motivates the research
Purpose	Indicates purpose, outlines the aims behind the paper
Method	Provides information on design, procedures, data analysis, etc.
Product	Indicates results and argument
Conclusion	Points to applications or wider implications and Interpretation scope of the paper

Each move in the selected abstracts was identified and coded using abbreviations, i.e. 'I' for Introduction move, 'P' for Purpose move, 'M' for Method move, 'R' for Result move, and 'C' for Conclusion move. It should be noted that in this study Hyland's Product move would be coded as Result move instead so that the abbreviation used would be different from Purpose move (P). In addition, a chemist, who was familiar with Chemistry research paper, was asked and trained to recheck the coding of the rhetorical moves in order to increase the reliability of the results. The results of the study were also compared to Hyland's modal to see if there was a similarity or any difference. The figure below showed an example of how the data were coded out of the examined research abstract.

Abstract:

Sodium dithionite $(Na_2S_2O_4)$ is a conventional reducing agent for indigo dyeing with cotton in an alkaline solution in order to reduce an indigo pigment to a water soluble leuco form. In this study, three monosaccharides (glucose, fructose and galactose) were studied as eco-friendly reducing agents to compare with $Na_2S_2O_4$. Two alkaline media: NaOH and Ca(OH)₂ were applied in the reducing system. The optimum condition for reduction of natural indigo was found at 50°C and 30 min. The results showed that surface and cross section of the dyed cotton fabrics using $Na_2S_2O_4$ and monosaccharides as reducing agents in NaOH solution could give darker blue shade than in Ca(OH)₂ solution. In addition, color strengths (K/S) of fabrics in NaOH medium from glucose were higher than the ones from other reducing sugars and $Na_2S_2O_4$. On the other hand, $Na_2S_2O_4$ gave higher color strength fabrics than that from monosaccharides in Ca(OH)₂ solution. From the build-up study, shade depths of cotton fabrics increased as indigo concentrations in the dyebath were raised. Therefore, monosaccharides could effectively use as green reducing agents in NaOH solution for natural indigo dyeing on cotton fabrics.

Figure 1 A sample of analyzed abstract

From figure 1, the bolded part was coded as the Introduction move (I) since it provided the general background of the research. The italicized part was coded as the Purpose move (P) since this part indicated the main aim of the study. The underlined part was coded as the Methodology move (M) since it told the readers how the study was conducted. The part with dotted-underline was coded as the Result move (R) because it presented the results of the study, and the highlighted part was coded as the Conclusion move (C) because it showed the implication of the research. Therefore, the move sequence of the above abstract was I -P - M - R - C.

4. Results and Discussions

The figure with colors below presented the overall rhetorical structures of 30 Chemistry abstracts across six subdisciplines.



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Figure 2 Overall rhetorical structures of Chemistry thesis abstracts across six subdisciplines

The results of the analysis suggested that the rhetorical structures of the English-language chemistry abstracts from 6 sub-disciplines did not conform to the conventional five-move abstract writing model proposed by Hyland (2000) since not all, but only 7 abstracts (23.33%) across all disciplines consisted of all five major moves, namely Introduction, Purpose, Method, Result or Product, and Conclusion (I – P – M – R – C), meanwhile, the other 23 selected chemistry research abstracts (76.67%) had distinct rhetorical move patterns and were not in accordance with Hyland's (2000).

No	Rhetorical Moves	Numbers of Abstract (%)
1	I-P-M-R-C	7 (23.33%)
2	P - M - R - C	5 (16.67%)
3	I - P - M - R	4 (13.33%)
4	I - M - R - C	4 (13.33%)
5	P - M - R	3 (10.00%)
6	I - P - R	1 (3.33%)
7	I - M - R	1 (3.33%)
8	M - R - C	2 (6.67%)
9	M - R	3 (10.00%)

 Table 2 The most preferred rhetorical move patterns across six Chemistry subdisciplines

From table 2, however, it was quite obvious that the I - P - M - R - C move was the most preferred move with the proportion of 23.33%, followed by the P–M–R–C move at 16.67%, followed by the I–M–R–C move and the I–P–M–R move with the proportion of 13.33% each, followed by the P–M–R and the M–R move at 10%, and followed by the M–R–C move with the proportion of 6.67%. In addition, the I – P – R move and the I – M – R move turned out to be the least frequent move pattern used in the Chemistry research abstracts with the proportion of 3.33% each.

	Table 3 The most preferred m	ve patterns across six Chemi	stry subdisciplines
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Move Patterns	Numbers of Abstract (%)	
Two-move pattern	3 (10.0	0%)
Three-move pattern	7 (23.3	3%)
Four-move pattern	13 (43.3	3%)
Five-move pattern	7 (23.3	3%)



In addition, when considering the preferred move patterns, it could be seen that most researchers preferred a four-move pattern (P - M - R - C, I - P - M - R, and I - M - R - C) the most at 43.33%, followed by a three-move pattern (P - M - R, I - P - R, I - M - R, and M - R - C) and a five-move pattern (I - P - M - R - C) at 23.33% each. A two-move pattern (M - R) was employed the least at 10%.

Table 4 The omission of each research abstract section

Moves in Research Abstract	Number of Omission (%)
Introduction move (I)	13 (43.33%)
Purpose move (P)	10 (33.33%)
Methodology move (M)	1 (3.33%)
Result move (R)	0 (0%)
Conclusion move (C)	12 (40%)

Furthermore, when it was not the five-move pattern, it was found that the abstract sections which the researchers tended to omit were the introduction section (43.33%), followed closely by the conclusion section at 40% and the purpose section at 33.33%. Interestingly, there was one abstract that did not have a methodology section (3.33%). Nevertheless, the methodology and the result sections were crucial and available in most research abstracts, so they could be considered as the mandatory constituents in the research abstracts in Chemistry. This finding reflected the awareness of the writers that the results and the methodology were must-mentioned sections since the nature of doing research in Chemistry was to conduct experiments, so it was deemed necessary for each researcher to clearly state the methodology and results of their experiments in the abstract, while the less necessary sections such as introduction, purposes, and conclusions of the study could be, sometimes, omitted. The interesting point was why the purpose and conclusion sections were omitted since these sections seemed important for the research abstract. Due to the fact that this study did not include an in-depth interview with the authors of the selected research abstracts, so the reasons behind the omission of each research section was still inconclusive. However, the findings were in concordance with Darabad (2016) who also found that the introduction was the least dominant move in the English abstracts in three disciplines, i.e. Applied Linguistics, Applied Mathematics, and Applied Chemistry. Also, the results were in line with the study of Sidek et al. (2016), who also found that most abstracts in the language and education field did not contain the introduction section. According to Kanoksilpatham (2005), the move would be considered conventional if its proportion is not less than 60% of the corpus, and it would be optional if that move occurred less than 60% of the corpus. Therefore, it could be posited that the introduction section might not be obligatory in the Chemistry research abstracts, while other sections were necessary.

Considering the move patterns of the abstracts from the Analytical Chemistry (AN) field alone, most researchers were likely to omit the introduction part and started the abstract by stating the purpose(s) of their study since the preferred move patterns were P - M - R and P - M - R - C with the same proportion of 40%. There was only one abstract (20%) which employed the I - P - M - R move.

In the Environmental Energy and Renewable Energy (EE) field, the I - P - M - R - C move and the P - M - R - C move were the most frequently used moves at 40 % each, followed by another four-move structure I - P - M - R at 20%. This was in line with the move patterns in the abstracts from the Food and Agricultural Chemistry (FA) field since the most frequently used move pattern was the I - P - M - R - Cmove at 60%, meanwhile, the other abstracts employed the I - P - R move and the I - M - R - C move at 20% each. So, the for the FA, it could be posited that most researchers in such field tended to follow the conventional five-move pattern since the I - P - M - R - C move was the most dominant.

For the Inorganic Chemistry (IN) and the Material Chemistry and Nanotechnology (MN), it was found that the move patterns employed in the abstracts were quite unique and differed from other subdisciplines. Starting with the IN, the most frequently used move pattern was the M – R move with the proportion of 60%, followed by the I – P – M – R move (20%) and the M – R – C move (20%). The results may suggest the preferred writing style for those who worked on the Inorganic Chemistry in the sense that

they tended to be very concise by stating only the methodology and the results of their experiments in the research abstracts.

Considering the Organic and Medicinal Chemistry (OR), it was found that there was no specific move pattern preferred by the researcher. The most frequently used move pattern was I - P - M - R - C move (40%), followed by the other three different move patterns which were the I - P - M - R move, the M - R - C move, and P - M - R - C move with the proportion of 20% each.

Lastly, for the Material Chemistry and Nanotechnology (MN) field, the I - M - R - C move was the most dominant move used in the abstracts (60%), followed by the P - M - R move and the I - M - R move with the proportion of 20% each.

Table 5 Tense used in cach abstract section
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Abstract Sections	Present Tense	Past Tense	
Introduction (I)	94.12%	5.88%	
Purpose (P)	30.00%	70.00%	
Methodology (M)	20.69%	79.31%	
Result / Product (R)	13.33%	86.67%	
Conclusion (C)	44.44%	55.56%	

When considering the linguistic feature in terms of verb tense used in writing up a research abstract, normally any research abstract would be written up using either the present tense or the past tense. In addition, it was also possible that each section in a research abstract was written using different tenses. Table 5 above demonstrated the percentage of the preferred verb tenses used in each section of the research abstracts from all the examined subdisciplines of Chemistry. It is obvious that past tense was used in almost all sections of the research abstracts in Chemistry, especially in the result and the methodology section in which the past tense was used for 86.67% and 79.31%, respectively. There was only one section, the introduction, which was written mostly by the present tense (94.12%). According to Paltridge and Starfield (2007), the present tense would be used if an abstract aimed to summarize the whole content of that research, meanwhile, the past tense would be used if the researcher aimed to make a report of what had been done in that research. The result related to the use of the verb tense of this study seemed to be in accordance with such a claim. The nature of the research in Chemistry was mainly to report or explain the conducted experiments which, basically, were done in the past. Therefore, it was not surprising why past tense turned out to be the most dominant in almost all sections of the research abstracts in the examined disciplines. For the introduction section, the present tense was dominant since the details in this section were often related to scientific facts, natures of each chemical substance, various theories, and frameworks, etc., so the present tense could be used to write these up.

Therefore, it could probably be concluded that the choice of verb tense was not random or subjective, but probably depended on the nature of each research disciplines. For example, according to Darabad's study (2016), the analysis of the linguistic feature related to the use of verb tense showed that the abstracts in two disciplines, i.e. Applied Mathematics and Applied Linguistics, were written using the present tense the most, while Kosasih (2018) found that the introduction, purpose, and conclusion section of the research abstracts from four disciplines, i.e. Public Administration, Management, Fisheries Management, and Mathematics Education, were written up using present tense in the highest frequency while the methodology and result section were written up using past tense.

5. Conclusions

The move analysis of English research abstracts in Chemistry published in the international conference proceedings showed that there were some similarities and differences in the move patterns and linguistic features among the abstracts from six sub-disciplines in Chemistry. Considering the move pattern, the I - P - M - R - C move was used in the highest frequency, yet, in general, the five-move pattern was



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not the dominant pattern across all the disciplines since the percentage of the four-move patterns used in writing the abstracts was higher than the percentage of the five-move pattern.

In addition, the Methodology move and the Result move were found to be mandatory and exist in almost all the examined research abstracts, meanwhile, the Introduction move, the Purpose move, and the Conclusion move were likely to be omitted sometimes. Furthermore, the analysis of the linguistic feature related to verb tense also revealed that the research abstracts in Chemistry from all disciplines were written up using past tense rather than present tense, except for the introduction part which was written using the present tense in a higher percentage.

Finally, it is hoped that this research would yield fruitful benefits for teachers, students, and those who are interested in the Discourse Analysis and other related fields. The analysis of the rhetorical structures and the linguistic features existing in the research abstracts in Chemistry may help the students to gain more insightful knowledge about the norms and styles of writing a research abstract in Chemistry in different disciplines and be able to produce quality and impactful research abstracts. Furthermore, it is hoped that the results from the analysis of this study will help the teachers, especially those in the field of English for Specific Purposes or teaching writing courses, in the lesson planning when they have to teach or guide their students to write a research abstract in the related field.

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