Institute of Technology Management and Entreprenuership

RHETORICAL STRUCTURE OF TECHNICAL RESEARCH ARTICLES

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Nurul Farahin Binti Musa

Master of Science in Technical Communication

2015

RHETORICAL STRUCTURE OF TECHNICAL RESEARCH ARTICLES

NURUL FARAHIN BINTI MUSA

A thesis submitted
in fulfillment of the requirements for the degree of Master of Science
in Technical Communication

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک

Institute of Technology Management and Entreprenuership

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2015

DECLARATION

I declare that this thesis entitle “Rhetorical Structure of Technical Research Articles” is the results of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : .....

Date : .....

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Technical Communication.

Signature : .....

Supervisor Name : .....

Date : .....

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRACT

Research articles have been regarded as one of the most common medium to communicate new findings to the academic community. Genre analysis is one of the most common ways to analyse the rhetorical structure of a text and has been proven to be useful in providing an insight on how the structure a text is constructed including research articles. Previously, there are many genre analysis and rhetorical organisation studies on research articles from different disciplines. Some of the studies focused on the whole structure and some of them focused on discrete section of research articles. This study attempts to identify the macrostructure of technical research articles and the most frequent move for each section in technical research articles. The present study adopts a corpus-based analysis. The corpus for this study comprises 60 journal articles from an engineering discipline, retrieved from the Scopus websites. The findings revealed that there are similarities and differences in terms of the application of moves between the proposed framework and the present corpus. The most frequent move for each section is also identified. Some of the moves in the framework from the previous studies are not applicable in the present corpus and some are. Findings from this study suggest that there are crucial moves in each section of research articles which need to be understood and adopted by writers in writing a research article and understanding the macrostructure of research articles can help the writers to prepare their research articles in a proper way and be accepted in international journals.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRAK

Artikel penyelidikan adalah salah satu medium yang sering digunakan oleh para penyelidik untuk menyampaikan penemuan baru dalam bidang teknologi mahupun akademik. Genre Analisis adalah salah satu cara yang popular untuk menganalisis struktur sesuatu teks dan telah terbukti berguna dalam memberikan gambaran jelas tentang bagaimana struktur sesebuah teks itu ditulis, ini termasuklah artikel penyelidikan. Sebelum ini, terdapat banyak kajian genre analisis dan kajian organisasi retorik artikel penyelidikan dari bidang yang berbeza. Beberapa kajian telah memberi tumpuan kepada keseluruhan struktur dan sebahagian daripada mereka memberi tumpuan kepada bahagian tertentu didalam artikel penyelidikan tersebut. Objektif kajian ini adalah untuk mengenal pasti struktur keseluruhan artikel penyelidikan dalam bidang teknikal dan elemen yang paling kerap digunakan dalam setiap bahagian artikel-artikel penyelidikan dalam bidang teknikal. Korpus digunakan dalam dalam metodoligi kajian ini untuk mengenalpasti struktur keseluruhan artikel penyelidikan dalam bidang teknikal. Korpus untuk kajian ini terdiri daripada 60 artikel penyelidikan daripada jurnal dalam bidang kejuruteraan yang dimuat turun daripada laman web Scopus. Dapatan kajian menunjukkan bahawa terdapat persamaan dan perbezaan dari segi pengunaan elemen dalam setiap bahagian artikel penyelidikan antara rangka kerja yang dicadangkan dan struktur artikel penyelidikan dalam kajian ini. Elemen yang paling kerap untuk setiap bahagian juga dikenal pasti. Akan tetapi, terdapat juga elemen yang tidak digunapakai dalam penulisan artikel penyelidikan dalam bidang teknikal kajian ini. Penemuan daripada kajian ini menunjukkan bahawa terdapat elemen penting dalam setiap bahagian daripada artikel penyelidikan yang perlu difahami oleh penulis dalam usaha menulis artikel yang berimpak. Dengan memahami cara penulisan artikel penyelidikan dengan betul, ia dapat membantu penulis menyediakan artikel penyelidikan dengan cara yang betul dan diterima dalam jurnal dikehendaki.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ACKNOWLEDGEMENTS

Alhamdulillah, praised to Allah SWT with His will and blessing, I am able to finish this thesis. My sincere appreciation is to my main supervisor, Dr Noorli Khamis, without her excellence guidance and patience, I would not made this far. I would also like to thank my parents and my siblings. They were always supporting me and encouraging me with their best wishes. Lastly, I also would like to thank all of my friends, without their ideas and help, I would never made this far. Thank you.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TABLE OF CONTENTS

					PAGE
DECLARATION					
APPROVAL					
ABSTRACT					**i**
ABSTRAK					**ii**
ACKNOWLEDGEMENTS					**iii**
TABLE OF CONTENTS					**iv**
LIST OF TABLES					**vi**
LIST OF FIGURES					**vii**
LIST OF APPENDICES					**viii**
CHAPTER					**1**
1.	**INTRODUCTION**				**1**
	1.1	Introduction			1
	1.2	Research Background			3
	1.3	Problem Statement			4
	1.4	Research Questions			6
	1.5	Research Objectives			6
	1.6	Scope of Work			6
	1.7	Significance of Study			7
	1.8	Definition of Terms			8
	1.9	Summary			9
2.	**LITERATURE REVIEW**				**10**
	2.1	Overview			10
	2.2	Genre			10
	2.3	Genre Analysis			11
	2.4	Research Articles			12
		2.4.1	CARS Model		15
	2.5	Move Analysis			18
	2.6	Corpus-based Analysis			19
	2.7	Studies on the Rhetorical Organisation of Research Articles			21
		2.7.1	Whole Structure		21
		2.7.2	Abstract Section		25
		2.7.3	Introduction Section		28
		2.7.4	Methods Section		31
		2.7.5	Results Section		34
		2.7.6	Discussion Section		36
	2.8	Summary			38

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

3.	**RESEARCH METHODOLOGY**			**39**
	3.1	Overview		39
	3.2	Data Preparation		39
		3.2.1	Corpus Compilation	40
	3.3	Coding Scheme Development		43
		3.3.1	Framework for Move Analysis	45
		3.3.2	Inter-rater Reliability	51
	3.4	Data Collection		53
	3.5	Data Analysis		54
		3.5.1	Software for Text Analysis	55
	3.6	Overview of the Methodological Procedures		60
	3.7	Summary		**62**
4.	**RESULTS AND DISCUSSION**			**63**
	4.1	Overview		63
	4.2	The Most Frequent Move for Each Section of Technical Research Articles		63
		4.2.1	The Abstract Section	64
		4.2.2	The Introduction Section	69
		4.2.3	The Methods Section	80
		4.2.4	The Results Section	90
		4.2.5	The Discsussion Section	99
	4.3	The Rhetorical Structure of Techincal Research Articles		109
	4.4	The Frequency of Differences between the Three Journals		111
		4.4.1	Abstract Section	**111**
		4.4.2	Introduction Section	**112**
		4.4.3	Method Section	**112**
		4.4.4	Results Section	**113**
		4.4.5	Discussion Section	**114**
	4.5	Summary		115
5.	**CONCLUSION**			**117**
	5.1	Overview		117
	5.2	Summary of the Findings		117
	5.3	Implications of the Present Study		118
	5.4	Direction for Future Studies		119
	5.5	Summary		120
REFERENCES				**121**
APPENDICES				**133**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF TABLES

TABLE	TITLE	PAGE
2.1	Swales (1990) IMRD Model	15
2.2	CARS (1990) Model	16
2.3	CARS (2004) Model	17
2.4	Studies on the Complete Structure of Research Articles	21
2.5	Studies on Research Articles Abstract Sections	25
2.6	Studies on Research Articles Introduction Sections	28
2.7	Studies on Research Articles Methods Sections	29
2.8	Studies on Research Articles Results Sections	34
2.9	Studies on Research Articles Discussion Sections	35
3.1	List of Journals	42
3.2	Sample of Research Articles from each Journals	43
3.3	Types of Data Requirement and Data Collection Method	44
3.4	Framework for Abstract section as proposed by Swales (1990)	45
3.5	Framework for Introduction Section as Proposed by Swales (1990)	46
3.6	Framework for Method Section as Proposed by Huang (2013)	47
3.7	Framework for Results Section as Proposed by Amnuai (2013)	48
3.8	Framework for Discussion Section as Proposed by Swales (1990)	49
3.9	Coding Scheme Developed for Each Section	49
3.10	Total Numbers and Percentage of Agreement Among Raters	52
3.11	Cut-off Table	55
4.1	Frequency of Moves in the Abstract Sections of Technical Research Articles	65

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

4.2	Frequency of Moves in the Introduction Sections of Technical Research Articles	70
4.3	Frequency of Moves in the Methods Sections of Technical Research Articles	81
4.4	Frequency of Moves in the Results Sections of Technical Research Articles	91
4.5	Frequency of Moves in the Discussion Sections of Technical Research Articles	100
4.6	Rhetorical Structure of Technical Research Articles	110
4.7	Frequency Differences between the Three Journals for Abstract Section	112
4.8	Frequency Differences between the Three Journals for Introduction Section	113
4.9	Frequency Differences between the Three Journals for Method Section	114
4.10	Frequency Differences between the Three Journals for Results Section	115
4.11	Frequency Differences between the Three Journals for Discussion Section	115

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.1	Theory Framework of Low Publication among NNES Writers	5
3.1	Flowchart of the Methodological Procedures	39
3.2	Tagging Example	54
3.3	Example of WordSmith Tools 6.0 menu	56
3.4	Pop-out window for choosing text for the concordance	57
3.5	Step of loading texts into the program	58
3.6	Calculation for frequency of moves based on the tag	59
3.7	Example of Concordance results for '<ITG>'	59
3.8	An Overview of the Methodological Procedures	62

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	List of Research Articles in the Corpus	113

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CHAPTER 1

INTRODUCTION

1.1 Introduction

Globalisation has impacted almost every aspect in life. The rapid evolvement of technology, one of the results of globalisation, has opened doors to the massive growth of new knowledge and researches. Researches have indeed become a key indicator for academicians' performance in many universities, thus encouraging them to explore new knowledge by conducting studies (Supatranont, 2012). According to Kanoksilapatham (2015), many students and academicians, regardless of their disciplinary background are encouraged to conduct researches to explore new knowledge for career growth and advancement. Along the same line, Hyland (2007) emphasized that at present, universities in many countries have imposed a pre-requisite for their academicians and researchers to publish research articles in international journals for their career advancement. Even for graduate students, many universities have made a requirement that students should have at least one paper published in the international journal before graduating.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

As even the littlest knowledge and discovery can result in the betterment of technology, contributions and sharing in scholarly publications are important. Many researchers use different types of academic papers to present their new findings. Research article (RA) is one of the most preferred genres in academic writing whereby it is written in order to deliver a new knowledge to the members of the academic community (Lee & Swales, 2006). In order to reach wider academicians' attention across the world, the most

preferred language in writing research articles is English. Ever since the English language has been accepted as the main language for scholarly publication, it has become a pre-requisite for a paper to be written in English in order to be published in an international journal.

For new scholars, especially the Non-Native English Speaker (NNES) writers, to publish a scientific paper internationally has been a pressure as they are required to write in English. The language barrier that the writers have to face when writing a research article may possibly be the main reason of the low contribution from the NNES countries. With regards to that matter, several factors that might lead to problems in writing scholarly publication in English among the NNES authors have been identified. Flowerdew (2005) outlined a few problems in scholarly writing among Chinese academicians in the University of Hong Kong which include lack of vocabulary, the influence of first language and inappropriate structure of sections in research articles.

On top of that, in a study on the textual structure of Indonesian writers, Mirahayuni (2010) found that NNES writers have problems in structuring their argumentation appropriately and lack knowledge on the "moves" in their writing. As highlighted by Bhatia (2005), mastery of the rhetorical organisation of a specific genre in academic writing is crucial, especially for the NNES writers to increase the chance of getting published in international publication. It is also equally important for authors to understand the commonly used rhetorical structure of research articles to be able to write a well-organized structure of research articles (Amnuai, 2012).

This, in turn, has led to a growing interest in research publications, especially in academic writing. Since the introduction of the Create a Research Space (CARS) model by Swales in 1990, many studies have been conducted to analyse the organisational structure

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

of research articles across disciplines. Some of the studies dealt with the whole structure of research articles (Kanoksilapatham, 2015; Nwogu, 1997; Posteguillo, 1999); some of them focused on the discrete sections of research articles, for example, Abstract (Li, 2011; Marefat & Mohammadzadeh, 2013; Supatranont, 2012), Introduction (Ahamad & Yusof, 2012; Xu, 2013; Zand-Vakili & Kashani, 2012), Methods (Lim, 2006; Seifoori & Fattahi, 2014), Results (Bruce, 2009; Williams, 1999) and Discussion (Amnuai & Wannaruk, 2013; Arsyad, 2013; Basturkmen, 2012). These studies have shown that there are disciplinary variations in writing research articles.

1.2 Research Background

As the evolution of technology has led to many new ideas being researched, there have been many technical universities established to cater to it. In Malaysia, for example, the Malaysia Technical University Network (MTUN) has been established as an effort to ensure that Malaysia is keeping abreast with the technological advancement. There have been many other learning institutions which have been established for the same reasons, such as Universiti Teknologi Petronas (UTP), Asia Pacific University (APU) and University College of Technology Sarawak (UCTS).

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Similarly, the effort to increase the number of research articles and publications among NNES writers, especially Malaysian authors, is beginning to be the concern of many, particularly when the world ranking of the university is the issue. Hence, there has been a rising awareness on the needs to equip the researchers with the required writing skills to ensure that their research findings are well-written and well-presented to the international audience.

The Ministry of Science and Technology Innovation (MOSTI) has come up with a funding program for all the universities in Malaysia, academicians and researchers with the objective to provide a grant for the researcher to present at least a paper in an international conference; which later, leads to publication in an international journal. Grants provided by MOSTI are placed under specialized schemes such as ScienceFund, TechnoFund and InnoFund. There are also funding programs from The Ministry of Education (MOE) for Malaysian academicians including FRGS (Fundamental Research Grant Scheme), ERGS (Exploratory Research Grant Scheme) and LRGS (Long-term Research Grant Scheme). These fundings provided by MOSTI and MOE are aimed at providing a platform for researchers to generate new scientific knowledge and strengthen the national research capacity and capability.

1.3 Problem Statement

As writing in English for the NNES academicians is difficult (Suryani, Siti Fatimah, Rodziah, Aizan, & Noorli, 2014; Zamari, Yusof, Junid, & Mohd Adnan, 2012), and producing quality research papers with ideas that communicate effectively has become a major challenge for the Malaysian academicians, it has become the main factor why the publication of Malaysians' scholarly writing in international journal is low. According to Ina Suryani et al. (2014), writing a proper structure of a research article is one of the main challenges among Malaysian academicians. With the growing needs for the internationalization of the academic community, all the academicians want to develop awareness and mastery over scholarly writing in order to get their paper published in the international journal and acquire international recognition, especially among the NNES academicians.

Figure 1.1 is the framework that explains the problems faced among the NNES writers in which some of the writers may have a hard time in choosing the right writing patterns to follow and some may not understand how to write a proper and acceptable research articles. This thus leads to a low publication among the NNES writers in a prestigious journal. From the SCImago Journal and Country Rank, the numbers of Malaysians' international publications were only 153,378 documents, while Singapore 192,942. Malaysia was ranked 8th for numbers of publication among the Asian countries and Singapore was ranked 7th. This indicates that although Malaysia is much bigger than Singapore in terms of population, the contribution and the productivity of the research papers are still low in comparison to Singapore.

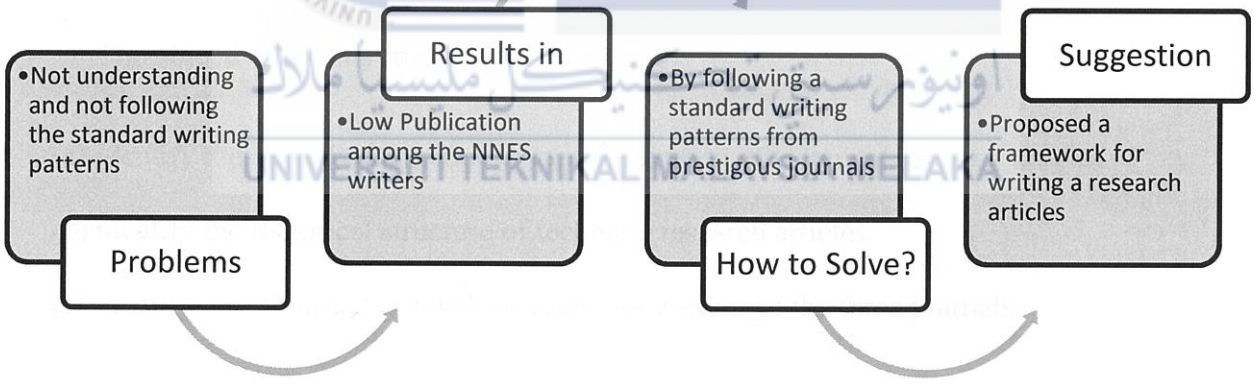

Figure 1.1: Problem Statement Flowchart fot Low Publication among NNES Writers

As mentioned in the previous section, due to the fact that research articles writing is becoming crucial for writers from technical disciplines in Malaysia, there is a need to provide these writers especially the NNES writers the macrostructures of the research

articles to guide them in preparing their papers. It is important for the NNES writers to understand and follow the conventional styles of writing a research article in order for their writing to be accepted and published in the international publication (Jogthong, 2001). Hence, this study serves as an attempt to identify the conventional rhetorical structure of research articles in a technical discipline.

1.4 Research Questions

(a) What are the most frequent moves for each section of technical research articles?

(b) What is the rhetorical structure of technical research articles?

(c) What are the significant frequency differences for each section between the three journals of technical research articles?

1.5 Research Objectives

The objectives of this study are to:

(a) identify the most frequent moves for each section of technical research articles.

(b) identify the rhetorical structure of technical research articles.

(c) identify the significance level for each move amongst the three journals.

1.6 Scope of Work

This study utilized a corpus-based analysis of 60 research articles from engineering discipline. All research articles were retrieved from the top three journals of engineering within a range period of five years (2009-2013). Only research articles with the IMRD (Introduction – Methods – Results – Discussion) structure were selected for the corpus. To identify the macrostructure of the technical research articles, a move-based analysis was

adopted by using an analytical framework proposed by several previous studies. Wordsmith Tools 6.0 software was used to identify the moves occurrence in research articles.

1.7 Significance of Study

To increase the number of Malaysian scholars' publication in international journals, a systematic pattern of writing a proper research article in terms of structural organisation has to be proposed. At the end of this study, a systematic structure in writing a research article is proposed based on the analysis of articles accepted in the Scopus Indexed Journals. It aims to provide insights to Malaysian researchers, specifically those in the technical field, on how each section of research articles in high impact journals is written, thus in the same time helping them to write a research article that possesses similar features and structures for journal submission.

The findings from this study also offer a pool of resources from which the contents of a scholarly writing course aimed for post-graduates and academicians can be developed. Apart from that, a manual of the scholarly writing, namely Technical Research Article Writing, can be devised from the findings too, which subsequently, can be developed into a learning software.

The most significant outcome of this study is the development of the technical research articles corpus, in which more investigations into technical research articles can be conducted from many possible perspectives. To top it off, the fact that the corpus can be updated from time to time in the future offers a wider opportunity for more studies.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.8 Definition of Terms

The operational definitions of some of the salient terms in this study are as follows:

(a) Genre: Genre refers to an acceptable organisation of written or spoken communication applied by a particular academic community. A genre could be a report, thesis and books.

(b) Move: Move refers to a rhetorical unit that performs a set of communicative function in a written or spoken discourse (John M. Swales, 1990). A move could be a sentence or a paragraph in a text.

(c) Step: Step refers to a smaller text unit than a move. It represents a more detailed options on how a move is constructed.

(d) Move analysis: Move analysis refers to an analysis to describe the organisational or move patterns of a genre.

(e) Technical discipline: Technical discipline refers to a discipline devoted to a practical study. Examples of technical disciplines are engineering, technology, law and business. In this study, technical discipline refers to engineering discipline.

(f) Research article: Research articles refer to published academic papers used to convey new knowledge and findings from a study to the academic community

(g) Technical research articles: Technical research articles refer to articles written by academicians from an engineering background.

(h) Rhetorical structure: Rhetorical structure refers to the structure of a text or speech belongs to a particular discourse community.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.9 Summary

This chapter mainly discusses the objectives of the study, problem statements and the issues related to the study. The aim of this study is to identify the rhetorical structure of technical research articles which as a result would assist the technical academicians to prepare a paper for the international scholarly publications.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter includes an overview of the relevant literature review of the genre analysis, move analysis and previous studies on the rhetorical structure of a research article. The review covers theoretical framework of the research articles structure and related research of the genre analysis using the corpus-based analysis in their studies.

2.2 Genre

The concept of 'genre' was introduced by Swales (1990). He defines genre as 'a type of text or discourse designed to achieve a set of communicative purposes', it is also a type of texts or documents written with its own structure and communicative functions (John M. Swales, 1990). Paltridge (2001), on the other hand describes genre as a kind of text which relates form, functions and context. Singh, Shamsudin and Zaid (2012) in their study describe genre as 'a staged, goal-oriented and purposeful social activity that people engage as a member of their culture'.

According to Mirahayuni (2002), genres belong to a discourse community; a community whose membership consists of the practitioners of a specific specialty. Therefore, each genre requires a specific written style and structure organized by their own discourse community, in order for information and new findings to be effectively delivered to the community members. Hyland (2003) mentioned that an investigation on genre

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

approach is very useful in providing ground and basics in writing instructions for the NNES new writers. Genre has been investigated by many researchers to identify the structure of weblogs (Herring, Scheidt, Bonus, & Wright, 2004), newspaper (Kuhi & Mojood, 2014), speech (Karpova & Sheketera, 2014) and online advertisements (Labrador, Ramón, Alaiz-Moretón, & Sanjurjo-González, 2014). However, the most investigated genre in the past decades is research articles. In research articles writing, there are specific patterns and organisations of the research articles that most of the researchers follow.

Different disciplines have different cultures; thus, different organisations are adopted in writing research articles (Swales, 1990). To ensure a research article get published in a scholarly publication, the standard organisation, textual patterns and language use in writing the research article should be properly adhered to. There are variations in textual pattern and organisation of the research articles applied by different disciplines (Hyland, 2007). Genre also enables teachers to facilitate their students to understand the needs to express and communicate information through writing. It can be concluded that genre-based investigation provides teachers in academic writing to prepare materials and activities for teaching students in writing academic papers (Amnuai, 2012).

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2.3 Genre Analysis

In language studies, genre analysis aims at providing a model for socially relevant communicative action especially in writing (Mirahayuni, 2002). The objective of doing a genre analysis is to identify the rhetorical structure of texts in a genre where it belongs to (Kanoksilapatham, 2010). It is also useful in providing a model of writing structure of scientific texts for students and young budding writers to write properly (Abarghooeinezhad & Simin, 2015). In applied linguistics, genre analysis is used to describe the structure and features of a text and believed to help readers to understand and