

PalArch's Journal of Archaeology of Egypt / Egyptology

Demystifying Discussion Section in Engineering Laboratory Reports

¹Veeramuthu Veerappan, ²Mokhtarrudin Ahmad, PhD, ³Wei Hui Suan, PhD, ⁴Afzal Md Aris

^{1,2,3,4}Faculty of Applied Communication, Multimedia University, Cyberjaya Selangor, Malaysia

**Veeramuthu Veerappan, Mokhtarrudin Ahmad, Wei Hui Suan, Afzal Md Aris:
Demystifying Discussion Section in Engineering Laboratory Reports -- Palarch's Journal
Of Archaeology Of Egypt/Egyptology 17(9). ISSN 1567-214x**

Keywords: Discussion section, Laboratory reports, Genre analysis, Academic discourse

ABSTRACT

This study examines the genre of Engineering Laboratory Reports (ELR) discussion section written by Electrical Engineering Undergraduates in a higher learning institution. The aims of this study are to identify the rhetorical moves and combinations of move patterns used by engineering students to write discussion section of ELR. A genre analysis is deemed important to identify writing patterns and convention practices of engineering undergraduate students thus a corpus of N= 35 was selected from electrical engineering students in their third and fourth year of study. This study adopted an interdisciplinary approach to address the analytical framework based on Genre Theory and Ngowu [1] analytical model was used for data analysis. The procedures of the move analysis were based on Biber [2] BCU Approach. A pilot test was conducted to determine the model that fits the best to describe moves and steps of ELR. The study benchmarks a move or step to be present in at least 60% of the reports. The results show Presenting Experimental Outcomes as the main move followed by Step 1 Restating purpose or procedures of experiment as an optional step while Step 2 Stating Specific outcome and Step 3 Interpreting outcomes as mandatory steps. The two steps in discussion section (step 2 and 3) are in cyclical pattern and most frequently occurred along with move 4. Step 3 is extensively written by employing various thinking skills that are explicitly written without much manipulation and speculation to the information. As discipline-specific writing continues to gain importance in EAP context, this study determines ways to help students to acquire discipline-specific literacy and to shed light on discoursal research methodology.

1. Introduction

To many non-native English speakers around the world, English has become more than another language one can learn or choose to ignore – it has become a vital tool for professional activities. For students of science or technology, it is learned not just as a subject but also for service [3]. In other words, it is not simply learned for the sake of learning, but for academic purposes, to perform professional activities, or for some other specific purposes. This is called

English for Specific Purposes (ESP). The purpose of this research is to conduct a rhetorical analysis on the moves and steps of Discussion section in engineering laboratory reports (ELR) of university students in writing for academic purpose.

A pragmatic and cost-effective approach to ESP derives from the analysis of ESP texts. In the same way, ESP's progress has adopted various approaches in analyzing text from the early study of register analysis that identifies grammatical elements of scientific communication [4] to rhetorical analysis [5] functional approach associated with Bates [6] to the prominent and most widely used approach which is genre analysis [7]; [8]. All these study stems from the belief that text is used for specific purpose in specialist environment. The specificity of ESP text depends on the context of use, be it for academic writing, business or professional activity. ESP texts have certain characteristics that distinguish them from general text, and linguistic elements that emerge from the use of different approaches to analyse text from different genres.

2. Statement of Problem

Writing has been regarded by educators and learners as most difficult skill to teach, learn or acquire for both native and non-native learners as cited by Megawati [9]. The poor writing performance of engineering students in university has remained major course of concern. The non-content writing instruction elicits complaints from most ESL teachers teaching writing in faculty of engineering. [The Ministry of Education (MOE) Malaysia identified three weaknesses in learner's writing namely the inability to: develop interesting and thoughtful ideas; present ideas clearly and coherently and plan paragraphs or essays cohesively. The engineering students in this university face a lot of difficulties in writing their laboratory reports due to poor writing skills (Faculty of Engineering), and this affects their overall academic result. According to Snow and Brinton [10], it is likely that students who cannot write good assignment will be less successful than those who are competent. The problem exists in 2 levels; firstly, the university's engineering students' failure rate is high and this is causing low number of enrolment in this faculty (Faculty of Engineering) and students who can't cope tend to change their course study to other faculties such as to Faculty of Management or Faculty of Computing and Informatics. Many are still in probation period and unable to complete their studies within the course structure (Faculty of Engineering). Learners with language learning problems are not motivated to engage with writing activity [11].

Secondly, the other perspective from the literature reviews; Jordan [12] stated that classification of the purpose of communications into two domains, that is work and professional study is not always the case. The inclusion of written report in the current syllabus, which is an English subject that prepares students for workplace communicative purposes is not enough to enforce engineering undergraduates with adequate writing skills to write effective ELR as only few written genres are taught for occupational purposes such as resume, memo, email and informative reports to address the target needs at work, and these genres are written based on small scale survey questionnaire addressing general

Commented [AA1]: No reference as we are making a general statement right?

issues. Thus, there is a tantamount need to analyse engineering undergraduates' laboratory reports in view of their academic needs. The current EAP courses are not offered for students at degree level. Upon discussion with a faculty professor who is also the engineering content specialist, it came to understanding that the undergraduate students will be involved in conducting laboratory experiment for at least one subject per trimester and they will also be required to write at least two laboratory reports for that particular subject in a trimester.

Thirdly, Malaysian ESL classroom comprise learners from diverse background tend to differ in learning preference and abilities as cited by Mariam [13]; Azizah [14]; and Asmah [15]. Given the problems in writing, specifically in report, lab report, technical writing and final year project, it is worth to study the needs of engineering students in writing and the factors influencing writing. The gaps in current writing instruction strengthen the need for new courses to be introduced. Hence a genre analysis is deemed important to identify writing patterns and conventions practice of undergraduate students.

Research Questions

1. What are the rhetorical moves that are used by engineering undergraduates in the discussion section of written laboratory reports?
2. What are the combinations of move patterns used by these undergraduates in writing the discussion section of the laboratory reports?

3. Theoretical Framework

Genre Theory [7]; [8] is used to conduct genre and linguistic analysis on engineering laboratory reports to determine its rhetorical moves and steps. [7] assumed that all these move-based models can be used across various discipline areas. The CARS model is now often found in modified version to suit rhetorical purposes of writers across disciplines with the systematic and detailed analysis to address writing issues pertaining to that particular discipline and this results in interesting findings too.

Bhatia [8] theorises that under the large umbrella of discourse analysis in multidisciplinary fields such as literature, linguistics, psychology etc., comes the notion of genre which analyses text in detail explanation beyond register level. In view of this perspective, [8] shows that genre analysis moves from surface linguistic description to deeper functional explanation which he termed as "thick description".

Genre Theory

What is it about the term and the area of study it represents that attracts such attention? What is it that will bring together under one terminological roof literary scholars, rhetoricians, sociologists, cognitive scientists, machine translators, computational linguists and discourse analysts, ESP specialists and language teachers? What it is ... that will allow us to bring into the same fold, advertising copywriters, business communication experts and Plain English campaigners? Candlin [16]

Genre theory has extended the study of discourse analysis from a linguistic inquiry to description and explanation on why do members of specific discourse community use the language the way they do? The answer to this question attempts to clarify not only the communicative goals of a discourse community but also the cognitive strategies used by its members to achieve their communicative goals. This interpretative aspect of genre theory has made significant factor for its wide use in current genre-based studies. This concept has gained wide acceptance among scholars, leading to more variations in its interpretations.

A systematic understanding of Genre Theory and its application can be achieved by considering four different perspectives on discourse. Genre exists in colonies that have systematic relationship with each other. These perspectives are interacting with each other by offering different views of the world which is called the universe of discourse [17]. In the real-world perspective, the concept of genre refers to Halliday [18] whom had defined the concept in terms of field, mode and tenor to study the different function of language. They termed these variations across genre as register variation that can be seen in journal articles, medical register, engineering register and many others.

Genre analysis

The most prominent ESP genre analytic framework was established by Swales [7], [19]. The ESP school which is the primary focus of this study is the most influential in the teaching of specialist varieties of English to second language learners and also the most familiar to ESP practitioner Bhatia [8], [20]; Flowerdew [21], [22]; Hyland [23], Johns [24]; Swales [7], [19]; Swales and Feak [25], [26]. It is undoubted that genre-based approach to writing instruction as some ESP based theorist have agreed [27] is an approach that addresses the analysis of learner's target genre needs for both workplace and academic purpose. In conceptualizing classroom teaching and learning, the ESP genre-based approach is specific in nature and rarely moves beyond its premises "to expose students to a variety of texts within specific genre and provide them with an understanding of how contexts and purposes of these selected texts are relevant to their structure and lexicogrammatical features [23].

English for Engineering

The deterioration of English among Thai Engineering undergraduates is an issue of concern among many language educators at tertiary level in Thailand. According to Wattanasakunpusakon [28], there are few reports on needs analysis among engineering students in Thailand, and the education system focuses more on designing English language courses without addressing the needs of students in ESP [29]. The effectiveness of these courses is still doubtful as it did not consider students' specific needs.

The courses in engineering should focus more on the learners acquiring communication skills and specific terminology in engineering [30]. In his

research he identified 5 attributes which could enhance engineering students' language proficiency which are 1) written language proficiency, 2) spoken language fluency, 3) national/regional dialects, 4) technical terminology and 5) professional jargons. He added that the incorporation of oral and communication skills in engineering courses throughout the curriculum such as the presentation skills and written communication as part of on-going assessment will prepare these undergraduates with required skills at workplace. ESP courses which are based on on-going analysis of employer's needs should be administered to meet specific job requirement [31]. A study was conducted to investigate the language skills and components in ESP textbooks in Iran and this study also examines the extent which these ESP courses have succeeded in meeting job requirements of engineers. The findings showed the ESP courses at the universities can set a ground for engineering undergraduates' future job prospects nevertheless these courses are not adequate enough to account for the future job specification of individual engineers where the requirements might differ for each individual.

Genre Analysis in Engineering domain

Engineering writing has been regarded as an essential by higher learning institutions as well as the employees. This study entails to investigate the writing produced by undergraduate engineering students. According to Finkelstein [32] materials such as textbooks in engineering often emphasis "research, development, and manufacturing technical on written documents to communicate complex information to wide array of audiences for various purposes". Most of these documents are presented in different types of genres. A clear understanding of genre can be discussed upon providing a definition of the use of these genres in engineering domain.

Engineering Genres in Academic Domain

The constitution of effective communication differs from each disciplines and professions. What makes a good written text in nuclear physics may not necessarily be well accepted among engineering audiences. In recognition to the specific characteristics of engineering discipline, many universities are taking a step further by moving from general English technical communication to discipline specific writing courses designed for engineering students [33]. The objective of offering such courses is to facilitate the acquisition and integration of rhetorical skills and strategies necessary for engineering students for academic and workplace purpose. Among the learning outcomes would be the student's ability to write in a typified and situated engineering context and text interaction with expert and experienced writers.

Table 1: Summary of previous genre studies using engineering corpus

Study	Discipline	Genre
McKenna [34]	Structural, environmental, communication engineering	engineering reports
Maswana, Kanamaru, Tajino [35]	Structural, environmental, electrical, chemical, and computer Science engineering	engineering research articles
Dalton [36]	chemical engineering	L2 student memo reports
Kanoksilaphatam [37]	Chemical Engineering	Research Articles
Flowerdew [38]	Environmental engineering	L2 student and L2 professional Recommendation reports
Promsin [39]	electrical engineering	abstracts of L2 students research theses
Luzón [40]	computer, industrial chemical engineering	L2 student research reports
Koutsantoni [41]	electrical engineering	research articles
Ward [42]	chemical, civil, electrical, industrial, mechanical engineering	Undergraduate textbooks

Genre analysis in Malaysian context

Fakhrudin [43] examined the laboratory reports of civil engineering undergraduates. They assert that civil engineering students need to be equipped with good technical knowledge supplemented by linguistic knowledge to be a successful. Seven highly rated civil engineering reports were analysed from two fields which were soil and geotechnical engineering by using Eggins & Slade's [44] six steps of principled genre analysis. Interviews with content specialist were also conducted to gain insight on the nature of writing civil engineering laboratory reports. Based on the findings and analysis conducted, they found that civil engineering lab reports involve 14 obligatory moves (Title page, Introduction, Objective, Equipment/Apparatus, Theory, Procedures, Result, Data collected, Calculation, Question, Answer, Conclusion, Attachment and Reference). They asserted that students will be able to construct a genre in a discourse community if they are able to justify why this particular genre is written the way it is supposed to be written. This study is an exemplary study within Malaysian context to show other researchers on how a genre analysis can be conducted on engineering laboratory reports.

Genre Analysis in technical writing

The early studies of scientific and technical English viewed genre as a register, a type of discourse with text representing it has some common features Barber [45] and Ewer and Latorre [46]. Their studies defined the specific characteristics of scientific genre but not much focus was given to the variation of this genre across other disciplines. Other much recent studies Swales [7] and Bhatia [8] began to analyse scientific and technical English by combining linguistic features and the meaning and function of these features changes in different genres. The features and conventions of genre is then explained according to its communicative purposes within a social context in which the genre is written. Swales [47] stated that genre analysis has now evolved by not only looking at linguistic features in isolation, but it is now an analysis of social context, culture, ideology and organization of a discourse community and the practices of this community.

4. Analytical Framework

This study adopted an interdisciplinary approach to address the analytical framework. This framework is constructed based on the key elements of Genre Theory and models of ESP traditions in genre analysis. Genre theory is used in this study due to its relevancy to describe and explain why members of a discourse community use the language the way they do, and in this study, the targeted discourse community are the engineering undergraduates. The ESP tradition views a genre has a shared set of communicative purposes and in tandem to this study, the rhetorical structure of ELR's are based on decisions to interact within a discourse community and is well received and understood by the practicing community. The choice of adopting this approach is made to determine the rhetorical moves and steps in written ELR's because genre analyses provide detail explanation beyond register level from surface linguistic description to deeper functional explanation. Thus, with the use of this framework, I am able to investigate the discourse used in the university as a communicative practice among engineering undergraduates.

Ngowu's (1997) genre analysis framework

Table 2: Moves and Their Discourse Functions

Move	Discourse function
9: Highlighting Overall Research Outcome	} Discussion Section
10: Explaining Specific Research Outcomes	

Ngowu [1, pp 125]

The analytical model used for this study is from Ngowu's [1] model. This model was used to analyse research articles in medical field. Ngowu's [1] study outlined eleven Moves scheme in which nine are normally required in a medical research articles and two are optional moves. These moves were sub-

divided into three categories which are initial, middle and final Moves. The first four moves were meant for introduction section, followed by three Moves for methodology, two for results, and the last three Moves were for discussion and conclusion. This study of medical research paper is used as a prototype version in examining the moves and steps of undergraduate engineering laboratory reports as it provides comprehensive guidelines on the categories of moves and steps extracted from research articles. Nevertheless, some modification has to be made with inclusion of other moves and exclusion of some to make the study reliable to analyse undergraduates who are mainly novice writers.

The last section under Ngowu's [1] model is the discussion section. There are four distinctive moves under this section. Move 9, Highlighting Overall Research Outcome, represents the first

move in the Discussion section. The focus of move 9 is to accept or refute attainment of main research objective. This move is signalled by:

- (a) Explicit preparatory statements; e.g. (i) *The result of this study suggests that OC use has no significant effect on the risk of breast cancer in women under 45 years of age.* (b) *The use of explicit lexemes; e.g. The major aim of this trial--to show whether injection of paternal cells.*
- (b) In move 10, Explaining Specific Research Outcome, the writers are found to extensively elaborate fundamental aspects of their research such as to restate main observation of the study, indicate its significance, interprets the findings and make justification by reference to procedures adopted for the study. Move 10 contains a) *a specific outcome*, b) *interprets the outcome*, c) *indicates the significance of the outcome*, d) *contrasts present and previous outcomes* and e) *indicates limitations of the outcomes* [1, pp 132]

Table 3: Summary of Ngowu's Framework for Discussion Section

Moves and steps	Summary of Ngowu's Framework for Discussion Section
Move 9	<i>Highlighting Overall Research Outcome:</i>
Move 10	<i>Explaining Specific Research Outcomes:</i>
M10S1	<i>(1) Stating a specific outcome.</i>
M10S2	<i>(2) Interpreting the outcome.</i>
M10S3	<i>(3) Indicating significance of the outcome.</i>
M10S4	<i>(4) Contrasting present and previous outcomes.</i>
M10S5	<i>(5) Indicating limitations of outcomes.</i>

5. Methodology

This study aims to be conducted descriptively and it consists of investigating the rhetorical moves and steps of authentic ELRs. It employs qualitative research design for conducting genre analysis by illustrating, clarifying and elaborating the moves and steps that occurs in ELRs. Descriptive research is usually done to depict people, situations, events, and conditions as they

naturally exist. The major sources from which information is obtained are physical settings, records, documents, objects, materials, and people directly involved [48, pp 31-32].

Sampling

According to Morse [49], the sample size in a qualitative study depends on few factors such as; the quality of data, scope of study, nature of topic, amount of information obtained from each subject, the qualitative method employed and the design of the study. In this study which has a narrow scope of investigating the rhetorical moves and steps of electrical engineering students' ELRs, the number of ELRs under analysis is $N=35$. This number represents the total population of electrical engineering students who write ELRs in third and fourth year of study.

Based on an interview with a content specialist, the yearly intake for electrical engineering students in faculty of engineering are less than 100 students. In each semester, these students are required to write at least two ELRs. The ELRs collected from students and content specialist are those that have obtained high ratings in assessment, with each rated more than 4 marks out of 5 marks. The ratings are based on students' ability to write ELRs that contain clear explanation of the objectives of experiment, ability to explain diagrams and charts that reports on the findings, presenting results, a clear discussion, concluding remarks and has very little grammatical and spelling errors. The total number of reports collected at the beginning were $N=55$, but after scrutinising each report for its richness in content, language and organization, only $N=35$ were selected. The selected reports are found to be rich in information that could provide more input to this research.

Genre Analysis Procedures.

The genre analysis presented in this study follows the guidelines and procedures of a move analysis study described by Kanoksilapatham [50, pp 34] BCU Approach. These researchers identified 10 general steps that are used for corpus-based move analysis. These steps are adapted and modified to fit the needs of this study. The descriptive genre analysis presented in the table below follows the general methodological steps of a move analysis described in previous research that identified 10 general steps that are frequently used for a corpus-based move analysis. These steps have been modified to fit the design of the present study.

Table 4: Procedures for move-based genre analysis [50, pp 34]

Step	Description
Step 1	Determining rhetorical purposes/objectives of the ELR genre
Step 2	Determine the rhetorical function/the meaning of each moves and steps of each text segment, IMRDC in its local context; identify the possible move types of the genre

Step 3	Group functional and/or semantic themes that are either in relative proximity to each other or often occur in similar locations in representative texts. These reflect the specific <i>steps</i> that can be used to realise a broader <i>move</i> .
Step 4	Conduct a pilot-coding to test and fine-tune the definitions of move purposes manually by hand using a highly rated ELR
Step 5	Develop coding protocol with clear definitions and examples of <i>move types</i> and <i>steps</i> .
Step 6	Code full set of texts, with inter-rater reliability check to confirm that there is a clear understanding of move definitions and moves/steps are realised in texts.
Step 7	Add any additional steps and/or moves that are revealed in the full analysis
Step 8	Revise coding protocol to resolve any discrepancies revealed by the inter-rater reliability check or by the newly 'discovered' moves/steps, and re-code problematic areas.
Step 9	Conduct analysis in move features and/or other corpus-facilitated analyses.
Step 10	Describe corpus of texts in terms of typical, alternate or optional move structures and metadiscourse features.

Firstly, a genre analysis was conducted on 35 ELRs written for academic purpose to identify the rhetorical moves and steps among electrical engineering undergraduate writers. Genre analysis will also enable the study to identify variation in moves and steps in discussion section of ELRs. Genre analysis is an effective way to find out how sentences were combined into discourse [3]. Discourse analysis which is also called genre analysis or textual analysis focuses on the text rather than the sentence, and on the writer's purpose rather than on form [51]. This method of analysis will be useful in analyzing authentic materials and in this study, the analysis of engineering laboratory reports. In practice, according to West [52], this approach tended to concentrate on how sentences are used in the performance of acts of communication and to generate materials based on functions. Hence, genre analysis will assist educators to determine the type of suitable writing skills and tasks that can be generated and incorporated in future courses.

Students' written ELRs are collected from the faculty archive after getting permission from the dean of faculty of engineering. The ELRs are selected from those written by electrical engineering undergraduates. In order to obtain well written ELRs that will provide rich information, 55 ELRs were selected in the preliminary selection session. Then further considerations were made to refine the ELRs into those rated with an average score of above four out of five marks. Finally, upon scrutinizing the 45 reports, 28 ELRs are selected based on criterion discussed above. Besides that, five content lecturers have been approached to obtain an addition of 7 more ELRs of good quality written by students that could provide reliable data for analysis. These data from 35 ELRs

are firstly used to conduct genre analysis to determine rhetorical moves and steps manually.

Secondly, a comprehensive rhetorical moves and patterns of ELRs are determined from discussion section by using the categories outlined by Ngowu's [1] model of move analysis on medical research articles. A pilot test was conducted on ELR's prior to the decision of selecting Ngowu's [1] framework, and the result of the pilot study showed more than 60% occurrence in the moves and steps similar to framework in IMRDC sections of ELR's. Further analysis on 15 ELR's complete with examples of moves and steps showed similarity that matches more than 60% to the description given in this framework thus making it the most suitable framework that can be replicated and modified to suit this study. Most novice writers are not familiar with the Discussion format, while the experts have researched articles based on sub-sections in isolation, yet the credit for a breakthrough study of a complete rhetorical structure based on IMRD section goes to Ngowu's [1] study.

Table 5: Pilot Coding on ELR's Discussion Section

ELR 1	-Stating the extent of meeting objectives by discussing the results. <i>Ngowu's M10 Explaining Specific Research Outcomes</i> -Discussing the suitability of the method to obtain reliable result. <i>Ngowu's M10S1 Stating a specific outcome</i>
ELR 2	-Stating the reason for conducting this experiment. <i>Ngowu's M3S1: Reference to research purpose</i> -Explaining models used in the experiment. <i>Ngowu's M10S2 Interpreting the outcome.</i> Providing mathematical evidences on how results are obtained. <i>Ngowu's M10S1 Stating a specific outcome</i> -Explaining how the analysis was conducted. <i>Ngowu's M5S2 Recounting experimental process</i>
ELR 3	Stating the ability to achieve objective, provide details on methods used to achieve objective. <i>Ngowu's M9 Highlighting Overall research outcome</i> -Substantiating findings with the use of effective method. <i>Ngowu's M10S3 Indicating Significance of the outcome</i>
ELR 4	Presents the major findings and its key features <i>Ngowu's M10S1 Stating a specific outcome.</i> Presents general precautions and steps taken to address errors from recurring. <i>Ngowu's M10S5 Indicating limitations of outcomes</i>
ELR 5	Inclusion of charts with some explanation of findings <i>Ngowu's M10S1 Stating a specific outcome</i>

to determine the model that fits the best to describe moves, steps and linguistic features of an ELR. To improve the accuracy of the moves, steps and pre-determined linguistic features, and to maintain a higher reliability for coding

procedures and results from the findings, meticulous thoughts are given to prepare coding scheme, coder selection, coder training, coding practice sessions, coding moderation and individual coding.

Kanoksilapatham [53] states that it could lead to questions on validity and reliability of qualitative research. In Kanoksilapatham [54], a clear procedure to address the reliability of move identification between inter coders was developed. This procedure is applied in this study to ensure reliability of two different coders are addressed. In view to Kanoksilapatham [54] study, the collaborating coder is selected based on his experience as a content specialist who has vast experience in teaching engineering subjects, reading engineering books, periodical, articles and write research articles in the engineering field for publication purpose. The coder is also familiar in evaluating undergraduate students' ELRs which are submitted to him every trimester as part of a coursework to fulfil subject requirement as what Kanoksilapatham's [50] use of multidimensional methods to conduct genre analysis has clearly addressed the importance of genre studies to determine the inter-rater reliability among coders.

There are two coders involved in the development and modification of the coding scheme. The first coder is the researcher himself who is a language expert and has experience teaching language related subjects to undergraduate students for more than 15 years. The second coder is an Associate Professor in engineering who has been with the university for more than 5 years and has a PhD in Engineering. The reason of including another coder apart from the researcher is to address the issue of reliability in coding. These two coders concurrently read two identical samples of authentic ELR's written by engineering students and identify the major sections and moves associated with this genre. Then these two coders identify the moves in ELR based on initial coding scheme developed for this study. The reliability shows more than 87% agreement between both coders on similar moves associated in Discussion section.

Coding protocol with definitions and examples of move types and steps for Discussion

Move 1: Interpreting Experimental Outcomes

Move 4 Step 1: Relating major findings of the experiment to the objectives

1) *From our experiment, we found out that magnetic flux affect Hall voltage and conductivity.*

If current flows through the germanium, that will produce a magnetic field perpendicular to the current, Hall voltage will be generated between the two opposite sides of the germanium. **(ELR 10)**

2) *A differential protection system protects the primary and secondary windings of the power transformer as well as against phase-to-phase faults.*

(ELR 4)

3) *As the temperature increase the Hall Voltage increase and decrease again.*

(ELR 14)

4) *With increase of magnetic flux, Hall voltage increases and conductivity decreases. More magnetic flux will help induce more Hall voltage and conductivity will decrease.* (ELR 10)

Move 1 step 2: Substantiating the findings with justification

1) *Speed is getting low, while the slip and the efficiency is getting bigger. These happens due to increase in loads.* (ELR 7)

2) *In general, when using differential protection to protect a three-phase power transformer, the secondary windings of the line current transformers should be connected in wye when the power transformer windings are connected in delta, and vice-versa.* (ELR 4)

3) *Conductivity can be related to Hall voltage through the Hall coefficient. Conductivity is reciprocal of Hall coefficient and since magnetic field affect Hall voltage, then it will affect the conductivity.* (ELR 10)

4) *As the temperature increase the Hall Voltage increase and decrease again. This is because when the temperature increases the more energy electron will gain and this increase the mobility of the electron and faster electron pass through the semiconductor this make hall voltage increase.* (ELR 14)

6. Discussion Section

The Discussion section of Engineering Laboratory Reports (ELR) consist of one main move, Presenting Experimental Outcomes, and this is followed by three steps which are Step 1 Re-stating the purpose and/or procedures of experiment, Step 2 Stating Specific Outcome and Step 3 Interpreting Outcome. The analysis on 35 ELR's reveals that the rhetorical organisation of ELR's are different from the Methods and Results sections as there are no clear boundaries to these steps mentioned above. It was noted that ELR 8 and 28 were written by combining the Results and Discussions under the same heading. The Move and steps above were also not written in sub-sections and only one main heading is usually bold typed or italicised in most ELR's. The co-occurring step that overlaps with each other makes the analysis more complex than the other sections in this study.

This study replicated Ngowu's [1] model to conduct rhetorical analysis on undergraduate laboratory reports. In Ngowu [1], *Move 10 to Explain Research Outcomes* is modified to *Presenting Experimental Outcome*. The reason for this modification is due to the fact that ELR's were written for reporting laboratory experiments and this is believed to best suit in this study, whereas the names of two other steps in this study, Step 2 Stating Outcomes and Step 3 Interpreting Outcomes are maintained as of Ngowu's [1] model as they were found to be matching to the context under study.

Characteristics of Move and steps in Discussions

This section presents the analysis of Move and steps of the Discussion section which depicts the Move and Steps for clearer recognition. The Move 4, Presenting Experimental Outcome is the highlight of the experiment conducted. This move is found in all 35 ELR's or 100% of the total reports. Move 4 Presenting Experimental Outcome, is followed by Move 4 Step 1

Restating the purpose and/or aim of the experiment, Move 4 Step 2 Stating Specific Outcomes and Move 4 Step 3 Interpreting Outcomes. The analysis of ELR corpus shows that generally most of the discussions were written objectively with explanation and interpretation to the findings.

Move 1: Presenting Experimental Outcomes

The data analysis shows that Move 4 Presenting Experimental Outcomes is a conventional move in ELR genre as it occurred in all 35 ELR's or 100% of the reports. An extract from ELR 28 is exemplified to present Move 4, Presenting Experimental Outcome.

Move 1 Presenting Experimental Outcome *Design of a 3rd order Butterworth low pass filter with cut-off frequency of 19.4k Hz when C is set to 0.01 μ F*

After we connect the oscilloscope and the power supply on the board, we will get the curve as shown in page 9

The overall Pass-Band gain is $= 20 \log \left(\frac{V_{out}}{V_{in}} \right) = 20 \log \left(\frac{3.3}{1} \right) = 10.37$

The result shows the magnitude response of 5th order Butterworth low-pass filter with 19.4kHz cut-off frequency.

When considering filters of the same order but different type, we notice the following from graph: Chebyshev has higher value of V_{out} max than Butterworth. Chebyshev is less stable than Butterworth in the midrange. f_c of chebyshev is $> f_c$ of Butterworth. Chebyshev filter has a sharper roll-off than Butterworth filters.

The extract above is taken from ELR 28, and it shows that an entire Discussion section consists of four sentences that consolidates the outcome of an experiment to achieve one of the objectives. Evidence of mathematical formulas and calculations are frequently reported in this section. In most cases, the data shows that formulas are used as an underpinning theory to achieve an experimental outcome in engineering laboratory reports. The last example shows that a comparison was made to *different types of filters, Chebyshev and Butterworth*. The discussion of this ELR is brief and concise as the comparisons were written in points without much elaboration.

Move 1 Step 1: Restating the purpose and/or procedures

This move is aligned in tandem to statement of finding and the analysis also shows that Move 4 Step 1 Re-stating the purpose and/or procedures occurred in almost 18 ELR's or more than 50% of the ELR's. The following extracts exemplify Move 4 Step 1 found in the corpus.

- ELR 3 *The space wavelength λ_o , can be calculated from the given equation $\lambda_o = 0.031m$.*
- ELR 8 *This experiment aims to show that the hall voltage increase with magnetic field and that the hall voltage is proportional to the current.*
- ELR 9 *Since germanium is from Group 5 of periodic table so its majority carrier is electron and the dopant is donor*
- ELR 11 *This study shows power output will increase as the load increase, when the load increases the power output increase as the equation $P_2=(M*n)/9.55$*
- ELR 12 *A differential protection system protects the primary and secondary windings of the power transformer as well as against phase-to-phase faults.*

Move 1 Step 1 depicted in the above extracts briefly state the aim or procedures in conducting the experiment. This step will strengthen the discussion by convincing readers that the experiment has an aim or objective which guides through the experimenter to achieve desired outcome. Restating the aim or objective also guide readers to reflect on the purpose of conducting the experiment. These statements can be seen in ELR 8, 11 and 14. It was noted that in ELR 12, the statement of objective was restated exactly as it was stated in the introduction section with the omission of the phrase “to evaluate”. Meanwhile, the undergraduate students restate certain procedures which they have followed to show that the outcomes are achieved based on the use of correct procedures and this will further strengthen the validity of the experiment and convince the readers that the same procedures can be replicated by others to conduct similar experiments in future.

Move 1 Step 2: Stating Specific Outcome

Move 4 Step 1 is usually followed by Move 4 Step 2 Stating Specific Outcome in most of the ELR's although this is not the case for all the ELR's. It was noted that in 28 ELR's or in 80% of total report, there were more than two specific objectives stated for an experiment This step usually states the specific outcome based on the objectives of the study. In most cases, the objectives are discussed separately from each other. The analysis on 35 ELR's reveals that only in 18 ELR's, move 4 step 1 precedes move 4 step 2, thus it is evidential that in the other 17 ELR's, stating the specific outcome were written first to present experimental outcome. The analysis on 35 ELR's reveals that this step occurred in 35 reports or 100% occurrence in all reports. The extracts below exemplify Move 1 Step 2 found in the corpus.

- ELR 10 *As the armature current increase, the voltage output decreases linearly as there were voltage drop across armature resistance ($=I_a R_a$).*
- ELR 14 *The values of β and r_π in part 5(a) and part 5(d) are different. The β and r_π from Part 5(a) are, 38.78 and 96.27 respectively, meanwhile the β and r_π from Part 5(a) are 19.25 and 93.262 Ω respectively. The difference in β is 19.53 and the difference in r_π is 2.65 Ω .*
- ELR 23 *The grounding type used in the circuit causes to differences in noise voltages. Circuit 1 uses common grounding.*
- ELR 26 *For wattmeter W_1 , phase difference between V and I is ($\phi + 30^\circ$), between V_{AB} and I_B .
For wattmeter W_2 , phase difference between V and I is ($\phi - 30^\circ$), between V_{CB} and I_C .*
- ELR 28 *The result shows the magnitude response of 3rd order 2 dB roll-off Chebyshev low-pass filter with 21.4kHz cut-off frequency. The overall Pass-Band gain is $= 20 \log \left(\frac{V_{out}}{V_{in}} \right) = 20 \log \left(\frac{2.60}{1} \right) = 8.3$*
- ELR 31 *For distribution class arresters the primary impulse overvoltage is lightning whereas for station class arresters the primary impulse overvoltage is switching.*
- ELR 33 *The EMI field is recorded higher near the transmission lines especially at the sharp corner of the line compared to other areas on the circuit.*
- ELR 2 *The value of R_o changes from 90 Ω to 7.89 Ω in Part 5(f). Meanwhile, the value of R_o changes from 0 Ω to $\infty\Omega$ in Part 5(h).*

The above examples illustrate Move 4 Step 2 Stating Specific Outcome. The evidences above show that this step is written concisely as shown in ELR 23, 26, 28 and 2. This step were also written elaborately and detailed in ELR 14 and 31. It is notable that most of the specific outcomes are followed by formulaic mathematical expression as can be clearly seen in ELR 14, 28 and 2. Thus, it can be deduced that engineering laboratory reports apply equations and calculations to achieve experimental outcomes in most instances. Most of the reports in this section were also written objectively without making any generalisations or assumptions. It is also notable that in ELR 10, this step is written to address the relationship between two variables used in this experiment which are the *armature current and voltage output*. Meanwhile, a comparison was also made in discussing this section in ELR 33 to show the significant finding of the experiment.

Move 1 Step 3: Interpreting Outcomes

Interpreting the outcome of an experiment is seen as an important element of ELR's. Based on the analysis on 35 ELR's, this step occurred in 34 ELR's or 97% of the total report, thus making this a conventional step in discussion section. This step is seen as complex as students employ multiple thinking

skills in discussing their findings. In this step, students had attempted to explain the nature of their findings. Some had even written justification and evaluation on the experiments conducted. This step further challenges the students as they are seen to justify the findings with appropriate reasons, usually by relating the findings to the theory or mathematical formulas underpinning the experiment. The students apply higher order thinking skills to make interpretations to the outcomes by not only explaining but also by making justification and evaluating the findings of the laboratory experiments being conducted. Other aspects which were revealed from the data analysis is in analysing the findings and in stating the limitations of the experiment such as errors in measurement etc.

The following extracts from the corpus exemplify Move 4 Step 3, Interpreting Outcomes.

- ELR 35
Explaining *The sensitivity of the Wheatstone bridge circuit can be expressed in terms of the change in bridge output voltage due to a small change in the resistance of one of the bridge arms, generally the unknown resistance's arm.*
- ELR 34
Explaining *When the hole and electron present in a semiconductor they will experience a force call Lorentz force in the same direction so this make them drifting in opposite direction and this will make the recombination occurs*
- ELR 33
Evaluating *The EMI field is recorded higher near the transmission lines especially at the sharp corner of the line compared to other areas on the circuit. The signals will be transmitted through the long micro strip, straight micro strip, parallel line and long wire. Thus, the EMI recording is at those areas.*
- ELR 31
Evaluating *The consequence of failure to protect is a function of the nature of the insulation and whether it is self-restoring (air) or non-self-restoring (solid, liquid, or composite) insulation.*
- ELR 30
Analysing and justifying *The two signals have the same frequencies which means they are the same under frequency modulation. It is because the carrier signal has been modulated by the message signal during modulation and at the output a low pass filter then extracts the message signal which was the output signal.*
- ELR 23
Justifying *The sine waveform is noisy due to electromagnetic interference caused by the digital circuit. High frequency digital signal from the digital circuit may cause electromagnetic emission which can be contribution factor for the noise signals. The coupling path between two circuits also may cause the noise signals.*
- ELR 22
Limitation *I don't think we can use this method to measure the SWR because it will exceed the limit and override the meter itself.*
- ELR 21
Analysing *Form the graph of phase angle difference between E1 and E2 as a function of P2 we can state that when the phase angle increases, the power P2 also increase as well.*

The extracts above depict that students interpret their findings after stating the outcomes. This can be seen in ELR 34 and 35. These statements used phrases such as (*can be expressed in terms of the, due to a small change, When the hole and electron present in a semiconductor they will experience a force call, so this make them drifting*) to explain their findings and by giving reasons and examples to support their explanation. Another extract from ELR 33 shows that an attempt was made to make evaluation to the experiment. This can be seen in the phrase (*The consequence of failure to protect is a function of the nature of the insulation and whether it is self-restoring (air) or non-self-restoring*). In terms of making justification, students provide valid reasons or statements which can be seen from phrases in ELR 23 (*due to, caused by, may cause, which can be and may cause*). The extract from ELR 33 shows that an analysis was made and this is followed by a statement of justification embedded in the same paragraph. A statement of limitation was also observed in reporting the inappropriateness of a method used in the experiment. ELR 21 shows an analysis being made by making comparison as in (*angle difference between E1 and E2*). In summary, the analysis of the Discussion section in ELR's enables the identification of one major move: Move 4: Presenting Experimental Outcomes and this is followed by three steps which are Step 1: Re-stating the purpose and/or procedures of experiment, Step 2: Stating Specific Outcome and Step 3: Interpreting Outcome. The steps occurred invariably with some steps occurring more frequently than the other.

Combination of move patterns in Discussion section

The most prominent move and steps in discussion section are Move 4: Presenting Experimental Outcomes, Step 1: Re-stating the purpose and/or procedures of experiment, Step 2: Stating Specific Outcome and Step 3: Interpreting Outcome. However, this move and steps do not follow a sequential pattern in all ELR's that was examined. Move 4 always occurred to begin the discussion section in most ELR's but the steps identified do not follow the same pattern as they were organised in different sequence by different writers. In this corpus consists of 35 ELR's, step 1: Restating the purpose and/or procedures occurred as the first step in discussing the results in 18 ELR's or 51% of the total reports. This step precedes the other two steps in this section but follows closely upon stating Move 4. Although this step is frequently used to open a discussion, yet it was found that this step was omitted in 17 ELR's or almost 49% of the total reports and all these reports begin the discussion with step 2 by stating specific outcome. Only 2 ELR's began the discussion with step 3 preceding step 2. This shows that the organisation of discussion section is not uniformed and has differing patterns of combination.

Step 2: Stating specific outcomes and step 3: Interpreting outcomes are the two most important steps in the discussion section while step 1: Restating purpose or/and procedures are found to be less frequent, with the only exception to Move 1 which is the utmost important element in this section to present the outcome of the experiments. The analysis also reveals that step 2 and 3 are in cycles especially when two pieces of information are presented serially. Move

3 is found to have most details as students interprets the findings with various thinking skills. In this step, the explanation usually precedes all the other skills as it is the most basic and this is followed by analysing, justifying, evaluating and stating the limitations.

7. Model for discussion

In order to decide the move and steps in this corpus, like all the previous sections in ELR's, the benchmark of having a move or step present at least in 60% of the reports is set and used. The patterns that show the variation in the move and steps are mainly found in the elements that made up this move and steps. This can be seen as in Move 4 that occurred in all the reports and it has very little variation as most students used the same strategy in presenting their experimental outcomes. However, the differences are noted in the elements of the steps such as in step 2 that occurred more frequently than step 1 although step 1 precedes step 2 in most reports. Another variation is seen in step 3 where it consists of various thinking skills as compared to step 1 and 2. This step was also written in detail and the elements are closely related to each other. Hence, move 1, step 2 and 3 are found to be conventional in the discussion section of ELR's meanwhile step 1 is deemed as an optional step as the rate of occurrence is lower than the benchmarked rate. The table below shows the sequence of move and steps that appears in this section. As a whole, this section is constructed based on a specific result obtained from the experiment. The two steps in discussion section (step 2 and 3) are in cyclical pattern and most frequently occurred along with move 4. Step 3 is extensively written by employing various thinking skills that are explicitly written without much manipulation and speculation to the information.

8. Conclusion

Table 6: Model for Discussion Section of ELR

Model for Discussion Section of ELR	
Move 4	Presenting Experimental Outcomes
by Move 4 Step 1	Restating purpose and/or procedures of experiment (Optional)
by Move 4 Step 2	Stating Specific Outcomes
By Move 4 Step 3	Interpreting Outcomes

The discussion section is written to discuss the main findings of the experiment, and it is pre-determined to occur after the introduction, method and result section that follows the standard writing convention of APA. Thus, most of the important elements of an experiment have already been stated in the sections which occurred prior to the discussion section. It is noted that in ELR genre, most discussion were written objectively without manipulation of findings, as it involves mathematical expressions that supports and validates the findings. There is an absence of recursive patterns in engineering ELR discussion section as compared to social sciences where a finding can be

generalised. Therefore, the undergraduate writers are restricted from being rhetorical in reporting their findings and are less flexible in adding other relevant information.

References

- Nwogu, K. N. (1997). The medical research paper: Structure and function. *English for Specific Purposes*, 16(2), 119-138.
- Kanoksilapatham, B. (2007). Rhetorical moves in biochemistry research articles. In D. Biber, U. Connor, & T. A. Upton (Eds.), *Discourse on the move: Using discourse analysis to describe discourse structure* (pp. 73–120). Amsterdam: John Benjamins.
- Hutchinson, T. & Waters, A. (1987). *English for specific purposes: A learning centred approach*. Cambridge: Cambridge University Press.
- Swales, John (1971) *English for Specific Purposes*. Cambridge: Cambridge University Press.
- Lackstrom, Selinker and Trimble (1978) *Rhetorical Function-Shifts in EST Discourse*. TESOL Quarterly Vol. 12, No. 3 (pp. 311-320).
- Bates and Dudley-Evans (1976) *Genre analysis: a key to a theory of ESP?* The University of Birmingham.
- Swales, John (1990) *Genre Analysis*. Cambridge: Cambridge University Press.
- Bhatia, V. K. (1993). *Analysing Genre: Language Use in Professional Settings*. London: Longman.
- Omar, Megawati (2005) *Adjunct Language Instruction For English As a Second Language Engineering Students In The Writing Of Physics Laboratory Reports*.
- Snow, M. A., & Brinton, D. (1988). The adjunct model of language instruction: An ideal EAP framework. *Ending remediation: Linking ESL and content in higher education*, 33-52.
- Isaacson, M. M. G. S. (2001). Using the new basals to teach the writing process: Modifications for students with learning problems. *Reading & Writing Quarterly*, 17(1), 75-92.
- Jordan, R. R. (1997). *English for academic purposes: A guide and resource book for teachers*. Cambridge: Cambridge University Press.
- Mariam, M.N. (2004). A Qualitative Study of Group Writing During Process Writing Lessons. Unpublished doctoral dissertation, University of Malaya, Kuala Lumpur, Malaysia.
- Azizah, A.K. (2002). The effectiveness of cooperative learning in guided writing: A case study of Form Four learners. Unpublished Bachelor's dissertation. Universiti Pendidikan Sultan Idris, Tanjung Malim, Perak, Malaysia.
- Asmah H.O. (1982). *Language and Society in Malaysia*. Kuala Lumpur: Oxford University Press.
- Candlin, C. N., (1993): *Preface to Analysing Genre — Language Use in Professional Settings* by Vijay K Bhatia, ALLS Series. London: Longman.

- Bhatia, V.K. (2002). "Applied Genre Analysis: A MultiPerspective Model", *Ibérica*, 4, 3-19.
- M. A. K. Halliday, Angus McIntosh, Peter Strevens (1968). *The Linguistic Sciences and Language Teaching*. Foundation of Language.
- Swales, John and Feak, C (2004) *Academic Writing for Graduate Students: Essential tasks and skills*, Second Edition March 2005 — Volume 8, Number 4. University of Michigan Press.
- Bhatia, V. K. (1999). Integrating Products, Processes and Participants in Professional Writing. In C. N. Candlin, & K. Hyland (Eds.), *Writing: Texts, Processes and Practices* (pp. 21-39). London: Longman.
- Flowerdew, John (1993). An educational, or process, approach to the teaching of professional genres. *ELT Journal*, Volume 47, Issue 4, October 1993, Pages 305–316.
- Flowerdew, John (2002). *Genre in the classroom: A linguistic approach*. Publisher: Erlbaum, pp.91-102.
- Hyland, K. (2003a). *Second Language Writing* (Cambridge Language Education). Cambridge; Cambridge University Press. doi:10.1017/CBO9780511667251.
- Johns (2003). Understanding learners and learning in ESP genre-based writing instruction. *English for Specific Purposes* Volume 25, Issue 1, 2006, Pages 76-89.
- Swales, J. M., & Feak, C. B. (2000). *English in today's research world: A writing guide*. Ann Arbor, MI: The University of Michigan Press.
- Swales, J. M., & Feak, C. B. (2004). *Academic writing for graduate students: Essential tasks and skills* (2nd ed.). Ann Arbor, MI: The University of Michigan Press.
- Johns (2002). Effective Reflective Practice: In Search of Meaning in Learning about Teaching. Volume: 53 issue: 1, page(s): 33-43. Issue published: January 1, 2002.
- Wattanasakunpusakon, P. (1996). *Ability in using technical English of the engineering students of Rajaman-gala Institute of Technology*. Unpublished master's thesis, Kasetsart University, Thailand.
- Ongsakul, P. (1984). *A survey study of status, problems and needs in learning and teaching technical English in the Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang*. Unpublished master's thesis, Mahidol University, Thailand.
- Riemer, M. J. (2002). English and communication skills for the global engineer: *Global Journal of Engineering Education*. Vol.6, No.1, 91-100.
- Tavakoli (2009) Reassessing the ESP courses offered to engineering students in Iran. *English for specific purposes world*. Retrieved 8 September 2013 from <http://www.esp-world.info/Articles>
- Finkelstein, L. (2005). *Pocket book of technical writing for engineers and scientists*. New York: McGraw-Hill.
- Artemeva, N., Logie, S., & St- Martin, J.(1999). From page to stage: How theories of genre and situated learning help introduce engineering

- students to discipline-specific communication. *Technical communication quarterly*, 8.
- McKenna, B. (1997). How engineers write: An empirical study of engineering report writing. *Applied Linguistics*, 18(2), 189–211.
- S Maswana, T Kanamaru, A Tajino (2015) Move analysis of research articles across five engineering fields: What they share and what they do not- Ampersand – Elsevier.
- Dalton, D. F. (2008). The foreign language engineering writer – what makes a readable report? *Proceedings of the 2008 American Society for Engineering Education 295 Annual Conference & Exhibition*. Retrieved May 6, 2010, from <http://www.asee.org/about/events/conferences/search.cfm>.
- Kanoksilapatham, B. (2007). Rhetorical moves in biochemistry research articles. In D. Biber, U. Connor, & T. A. Upton (Eds.), *Discourse on the move: Using discourse analysis to describe discourse structure* (pp. 73–120). Amsterdam: John Benjamins.
- Flowerdew, L. (2004). The problem-solution pattern in apprentice vs. professional technical writing: An application of appraisal theory. In G. Aston, S. Bernardini, & D. Stewart (Eds.), *Corpora and language learners* (pp. 125–135). Amsterdam: John Benjamins.
- Promsin, P. (2006). An analysis of moves and modality in English engineering abstracts. *NIDA Language and Communication Journal*, 11(11), 43–61. Retrieved November 15, 2008, from <http://www.nida.ac.th/th/lc/>
- Luzón, M. J. (2009). The use of *we* in a learner corpus of reports written by EFL engineering students. *Journal of English for Academic Purposes*, 8, 192–206.
- Koutsantoni, D. (2004). Attitude, certainty and allusions to common knowledge in scientific research articles. *Journal of English for Academic Purposes*, 3, 163–182.
- Ward, J. (2007). Collocation and technicality in EAP engineering. *Journal of English for Academic Purposes*, 6, 18–35.
- Fakhrudin, W. F. W. W., & Attan, A. (2013). Putting knowledge gained into practice in civil engineering lab reports. *Procedia-Social and Behavioral Sciences*, 70, 1501-1512.
- Eggs, S and Slade, D (1997) *Analyzing Casual Conversation*. London: Cassel
- Eggs, Sussane (2004) *An Introduction to Systemic Functional Linguistics*. New York: Continuum International Publishing Co.
- Barber, C. L. (1962) “Some measurable characteristics of modern scientific prose,” in *Contributions to English Syntax and Phonology*, F. Behre, Ed. Stockholm, Sweden: pp. 21–43.
- Ewer, J. R. and Latorre, G. (1967). *Preparing an english course for students of science*. *ELT J.*, vol. 21, no. 3, pp.221–229.
- Swales, J. M., (1998): *Other Floors, Other Voices: A Textography of a Small University Building*, Hillsdale, NJ: Lawrence Erlbaum Associates.
- Mertler, C. A. & Charles, C. M. (2005). *Introduction to educational research*. (5th Edition). Boston: MA: Pearson.

- Morse (2000). Determining Sample Size. Volume: 10 issue: 1, page(s): 3-5. Issue published: January 1, 2000.
- Kanoksilapatham, B. (2007). Rhetorical moves in biochemistry research articles. In D. Biber, U. Connor, & T. A. Upton (Eds.), *Discourse on the move: Using discourse analysis to describe discourse structure* (pp. 73–120). Amsterdam: John Benjamins.
- Robinson, P. (1991). *ESP Today: a Practitioner's Guide*. Hemel Hempstead: Prentice Hall International.
- West R. (1994) *Needs analysis in language teaching*. *Language Teaching*, 27:1-19.
- Kanoksilapatham, B. (2005). Rhetorical structure of biochemistry research articles. *English for Specific Purposes*, 24, 269–292.
- Kanoksilapatham, B. (2003). A corpus-based investigation of scientific research articles: Linking move analysis with multidimensional analysis. (Unpublished doctoral dissertation). Georgetown University, Washington, DC.