Move analysis of research articles across five engineering fields: What they share and what they do not

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HIGHLIGHTS

- The study examines 67 engineering research articles from 5 subdisciplines.
- Six engineering researchers coded full-length articles into moves and steps.
- There are some sections and moves conventional across all subdisciplines.
- No common move patterns exist throughout the papers across the subdisciplines.
- Limited similarities exist, such as the use of Move 5 Step 2 in 3 subdisciplines.

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ABSTRACT

While many genre researchers have examined the rhetorical structure of research articles in various disciplines, few have investigated the complete structure of articles for students in engineering, a discipline that includes a wide range of fields. Using Swales' move framework (1990), this paper analyzes the rhetorical structure of 67 engineering research articles from five subdisciplines: structural engineering, environmental engineering, electrical engineering, chemical engineering, and computer science. Six engineering researchers participated in the study by coding texts of full-length papers into moves and steps. The study found that the abstract, introduction, and concluding sections and some of their moves were conventional across all subdisciplines. The finding of no common move patterns throughout the papers across the subdisciplines is explained by the differences in the nature of research in each field. There were, however, limited subdisciplinary similarities such as the use of Move 5, Step 2 observed in environmental, electrical, and chemical engineering. The study results provide practical pedagogical resources, a theoretical background to guide writing in an engineering school, and implications for collaboration with researchers in specialized fields.

1. Introduction

The genre-based approach is often employed to understand research articles, one of the most important genres in research-oriented universities, by identifying their organizational structure and key linguistic features. Swales (1981, 1990) proposed and developed the concept of a move, a structural segment that has a specific communicative function and purpose, to analyze textual structure. According to Bhatia (1993), a move has a characteristic specific to a genre; thus, knowledge about the function of each move and the structural pattern of the whole text will allow for a greater understanding of a specific genre or, in this study, a research article in the field of engineering.

Much work applying move analysis has dealt with only selected sections (i.e., the introduction, methods, results, and discussion and conclusion sections) of research articles, often drawing upon Swales' move framework (e.g., Brett, 1994; Lim, 2006; Peacock, 2002; Samraj, 2002). Studies that applied move analysis to an entire paper, such as Nwogu (1997) and Posteguillo (1999) are much fewer, and have not closely examined steps, the smaller rhetorical segments composing a move, throughout the papers. Kanoksilapatham (2005) should be noted as an exceptional study that conducted a move analysis of the whole structure of a large number of articles, 60 biochemistry research articles, providing a complete template of rhetorical organization with detailed analysis of both moves and steps. Identifying moves and steps has usually been

performed by ESP researchers through close readings of content with the aid of linguistic keys. Researchers refer to the move framework to identify and code moves. The results of move analyses have been successfully used for developing teaching and learning materials (Chang and Kuo, 2011; Stoller and Robinson, 2013).

Yang and Allison (2004) indicated that in many previous studies only research papers with clear headings of "Introduction", "Methods", "Results", and "Discussion" (IMRD) were analyzed, although many papers do not have a clear IMRD structure. Thus, there is a knowledge gap when it comes to non-IMRD research articles. As for target disciplines, many studies have dealt with a single discipline, primarily experimental scientific research (e.g., Li and Ge, 2009; Nwogu, 1997) and linguistics (e.g., Lorés, 2004; Yang and Allison, 2003). Several multidisciplinary studies have been conducted, such as Basturkmen (2012), Holmes (1997), and Swales (1981, 1990), along with studies on variation within a single discipline (Ozturk, 2007, on linguistics) and across subdisciplines (Samraj, 2005, on wildlife behavior and conservation biology). However, these studies of disciplinary variation tend to focus on limited sections and subdisciplines. The present study thus attempts to make a contribution to knowledge by examining articles in their entirety, describing the rhetorical structure of research articles and variations within a discipline, specifically the discipline of engineering, where there is much need for understanding of writing in the subdisciplines.

1.1. Engineering research articles

Engineering education at the tertiary level is crucial for technological advancement and economic growth in many industrialized and emerging countries; naturally, the need for academic writing training for engineering students has existed for some time (Jenkins et al., 1993). Despite the wide range of subdisciplines that make up the discipline of engineering, researchers have so far concentrated their efforts on understanding certain engineering subdisciplines (e.g., Anthony, 1999, on computer science article introductions; Kanoksilapatham, 2011, on civil engineering article introductions; Koutsantoni, 2006, on hedging use in the fields of electrical and chemical engineering; and Rozycki and Johnson, 2013, on computer science). These studies have shown disciplinary specificities that would benefit graduate-level students and people in the target discourse community. Specificities, however, cannot be defined unless they are compared with other subdisciplines. Understanding the similarities and differences among multiple subdisciplines would particularly benefit both learners at the undergraduate level who have not yet chosen their engineering specialism and EAP teachers who are not engineering scholars and teach students from different engineering subdisciplines. In this regard, this paper considers engineering areas included in the Faculty of Engineering as engineering subdisciplines.

Studies dealing with a range of subdisciplines primarily examined lexical items in textbooks common across subdisciplines (Mudraya, 2006; Ward, 2009). More recently, Kanoksilapatham (2012) examined variations in the rhetorical structure of engineering article introductions in three subdisciplines. However, developing a better understanding of both article rhetorical structures and subdisciplines will require continued research efforts.

1.2. Specialist informants

The literature sometimes mentions participation by researchers in the target field, referring to them as specialist informants (or subject teachers or subject specialists). Consulting specialist informants is useful because they are the insiders of the target discourse community (Noguchi, 2006) and can validate the results of

analysis (e.g., Kanoksilapatham, 2005). Understanding and analyzing whole articles across a range of fields is difficult for ESP researchers who do not belong to the discourse community of the target texts; therefore, the involvement of specialist informants seems necessary. In this situation, setting up a communication channel between ESP researchers and specialist informants becomes important. Among the few studies of full-length articles, Stoller and Robinson (2013) gave chemists a primary role in analyzing the article sections and used the results to inform an ESP course and discipline-specific materials. In the present study, six engineering researchers had a major role in coding the moves of research articles in five subdisciplines included in the Faculty of Engineering at the research site: structural engineering, environmental engineering, electrical engineering, chemical engineering, and computer science.[1]

But is there any difference in the rhetorical structure of research articles across these areas? What do they share? Which features are associated with certain subdisciplines only? In our study, we provide an analytical framework to make engineering researchers' implicit knowledge of writing research articles explicit to ESP researchers, which can ultimately be shared with students. We use Swales' move analysis to identify the complete rhetorical structure of engineering research articles and variations among subdisciplines. The results provide practical pedagogical resources to guide writing in a school of engineering, as well as implications for collaborating with researchers in the various fields of engineering.

2. The study

2.1. Corpus and the participants

Six engineering researchers with doctorates in their respective subdisciplines participated in the study as move coders. We sought the help of disciplinary insiders through the dean of the Faculty of Engineering. Hoping for the participation of as many researchers as possible, we asked for cooperation from researchers from a wide range of fields. Because the participation of engineering researchers was crucial to understanding whole papers, the specialisms of the engineers we recruited determined the subdisciplines in focus. Six researchers participated in the study, each coming from a different subdiscipline, with the exception of two researchers in environmental engineering who analyzed different articles.

The participating researchers selected articles close to their own fields of research from a corpus of articles randomly selected from international journals that were recommended by researchers in the Graduate School of Engineering at Kyoto University. These journals were recommended based on the criterion of being internationally recognized by researchers in the graduate engineering school who themselves read and write for these publications and wish for – or sometimes require – their students to do the same. We compiled the article corpus for this study by collecting the articles that the participating researchers selected. The texts analyzed in the study, therefore, were defined as full-length articles recognized by the discourse community, and their English use was appropriate for research and educational purposes. The articles included those that did not have an IMRD structure. Each researcher analyzed entire articles, which counted a total of approximately 100 printed pages.[2] Thus, the number of articles analyzed for each subdiscipline varied. Originally 10

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[1] Computer science has been included as an engineering subdiscipline, as it is part of the Faculty of Engineering at the university where the study was conducted.
[2] We did not count the words contained in pages.