Rhetorical Structures and Cyclical Patterns in Forestry Research Articles

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ABSTRACT

There have been a considerable number of studies on the research article genre (RA) from different perspectives of form and function. However, limited studies have examined the overall organizational structure of articles with all the main sections of the research article, Introduction-Methods-Results-Discussion (IMRD). There are also variations in the IMRD sections of the research article across different disciplines. The present study sought to analyze a) the rhetorical structure of individual sections of Forestry RAs in ISI journals, and b) analyze the cyclical patterns appearing in each section. A corpus of 40 research articles from five ISI journals were selected for this study. The selected articles were extracted from high impact factor journals in Forestry. The corpus was analysed based on Kanoksilapatham (2005) model as the analytical tool to explore the rhetorical moves in the corpus. Analysis of the research articles revealed that all sections did not follow the same rhetorical structure as specified in Kanoksilapatham (2005) model. On the basis of the analysis, some new moves or steps were realized. In terms of cyclical patterns, the findings pointed to the pervasiveness of salient move cycles in each section. Awareness of the rhetorical structure of RAs functions as an avenue to empower scholars, particularly novice writers, to integrate robustly into the academic community of their discipline.

Keywords: rhetorical structure; cyclical patterns; research article; genre analysis; IMRD

INTRODUCTION

Research papers have been broadly studied over the past three centuries employing Swales' (1990) genre-analysis approach, driven by the fact that the research article (RA) is a significant channel of scientific or academic communication. Swales' primary motivation for devising this text-analytical scheme was to help non-native advanced students to enhance their reading and writing skills of research articles in English (Moreno & Swales, 2018). Habibi and Hyland (2019) advance

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an argument concerning the 'myth' of disadvantage in publication process posed to those non-native English writers. While acknowledging the extensive challenges to gain acceptance for publication in prestigious journals, they concede that such challenges do not merely pertain to non-native English speakers and configuring such problems in this manner hegemonizes a biased view of second language writers and a "demoralising discourse of disadvantage" (p. 5).

From the frameworks proposed for determining the rhetorical structure of RAs, Swales' (1990, 2004) CARS model has been broadly applied in genre analysis studies, including disciplinary (Joseph & Lim 2018), cross-disciplinary and cross-cultural research (Nwogu,1997; Hirano, 2009) and diachronic studies (Hyland & Jiang, 2018). Several studies have also been conducted on RAs rhetorical structure, ranging in focus from individual RA sections (e.g., Amnuai and Wannaruk 2013; Joseph & Lim, 2018; Lim, 2006; Peacock, 2011; Rubio, 2011), to overall RA sections (e.g., Nwogu, 1990; Kanoksilapatham, 2015; Shi & Wannaruk, 2014; Ye, 2019, Lu et al, 2021). The rhetorical structures of RAs are proven to vary according to disciplinary fields. It follows that professional progress and visibility depend not merely on the research content, but on the researcher's ability to mould the content into the appropriate rhetorical structure as well (Joseph, 2018). There have been disciplinary studies into the generic structure of RAs (Ye, 2019; Kanoksilapatham, 2005; Nwogu, 1997), inter-disciplinary studies (Peacock, 2011; Samraj, 2005) and intra-disciplinary studies (Kanoksilapatham, 2015, Shi and Wannaruk, 2014; Samraj, 2005). Given the centrality of inter and intra-disciplinary variations in terms of rhetorical structure, it is apt to enquire where to place a main hard science field like Forestry, as an established applied science, in the topographic map of knowledge fields (Joseph & Lim, 2018). A gap in prior genre-oriented literature is the scarcity of studies on the overall rhetorical structure of Forestry RAs, except on selected sections (e.g., Joseph and Lim, 2018, 2019 on Forestry Discussions; Joseph, Lim and Nor, 2014 on Forestry Introductions). In regards to the dissemination of research findings in this field, it appears apt to note the critical role that forests have served in the development of human societies and civilizations throughout history. Examining the rhetorical structure of research articles, attending to content via identification of communicative purposes aids writers, novice writers in particular, in writing coherent research articles. In addition to rhetorical structure, the present study also seeks to investigate the ordering or cyclical patterns of moves in Introduction, Methods, Results, and Discussions (IMRD) of Forestry RAs. Cyclical patterning refers to the information concerning the ordering patterns of rhetorical units (moves and steps) in different genres. A firm knowledge of textualization regularities and variations ascribed to move cycles in RAs is necessary for a more solid comprehension of rhetorical structures across disciplinary fields. Awareness of the cyclical patterns and ordering moves in RAs appears to be required for RA writers. If scholars are unfamiliar with such patterns, they are likely to be at the risk of applying queer or radically divergent ordering patterns of rhetorical moves. Through familiarity with the most typical cyclical patterns, undeniably, they would have more flexibility in writing research articles, which means that they can maintain their creativity within an approved framework.

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METHOD

CORPUS

In this study, 40 research articles were randomly compiled from five high impact Forestry journals published in 2015 and 2016. The corpus was limited to a period of 2 years (2015- 2016 as the most recent years that the data was collected for the research) to control for the rapid changes occurring within any discipline. Surprisingly, Devitt, (2015) reprises 'time' as significant as 'genre' in prompting rhetorically patterned and textually different performances across genres.

The articles in this corpus were all empirical articles published in leading, peer-reviewed Forestry journals. The journals selected are Agricultural and Forest Meteorology, European Journal of Forest Research, Forest Ecology and Management, Urban Forestry, and Urban Greening. These five journals cover a wide range of Forestry-related topics. Concerning the selection of journals, factors such as impact factor and index were considered as such information on journals is annotated in Journal Citation Report (JCR). According to JCR provided by ISI web of knowledge, all the selected journals had high impact factors thus giving a representation of well-written articles in the field of Forestry. Four empirical articles following IMRD format were randomly selected from each journal. Theoretical and review articles were excluded as their rhetorical structure may differ from that of data-driven empirical articles (Crookes, 1984).

DATA ANALYSIS

Following Swales' (1990) move analysis framework, the present study adopted Kanoksilapatham's (2005) model to analyze the rhetorical structure of Forestry RAs. The list of moves and their elements, which make up the coding scheme in this model, are based on rhetorical moves identified by previous genre-based studies (e.g, Brett, 1994; Crookes, 1984; Hopkins & Dudley-Evans, 1988; Nwogu, 1997; Posteguillo, 1999; Swales, 1990; Swales & Naijar, 1987; Thompson, 1993; Williams, 1999; Wood, 1982). She contends that her framework could be used for learners from multiple yet overlapping disciplines, including the basic hard sciences (Biology and Chemistry), the natural sciences (Environmental science and Ecology), the health/clinical sciences (Medicine, Veterinary science, and Pharmaceutical science), and several applied sciences (Industrial technology, Biotechnology, and Food science). In order to analyse the research articles, the following steps were taken: a) Codifying and labelling the moves in each of the IMRD sections of the research articles based on the framework by Kanoksilapatham (2005). To explore the rhetorical units, the researcher firstly numbered the paragraphs in each IMRD section as paragraph 1, paragraph 2, paragraph 3, and so on. Next, applying Kanosilapatham's (2005) framework, the moves and steps were codified as 1-0 in each paragraph. If a move or step was present in a paragraph, even more than once, its frequency was considered 1. By adding up the move/step frequencies in all paragraphs, the overall frequency was calculated. To lable the new moves, the researcher applied her accumulated knowledge in this resaerch area, besides verifying their reliability with two co-raters. b) Analysing the moves and steps to determine the degree a certain move or step is obligatory, quasi-obligatory or optional, based on Lim's (2014) criteria (100% are obligatory, between 51% to 99% quasi-obligatory and below 50% optional). c) Examining the sequencing of moves to detect their cyclical patterns. It is noteworthy to point out that since genre analysis studies are qualitative, it is integral to involve in interpretive measures of both bottom-up and top-down judgments. As to reliability, in this study, inter-rater reliability was conducted,

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seeking assistance from two PhD holders in English Language discipline to cooperate as co-raters. To measure reliability, the formula A/ (A+D) ×100 was applied where A is the number of agreements and D is the number of disagreements. In this study, the percentage agreement was found to be 97.5 which is an acceptable rate (Al-Zubaidi 2013, Biber, Connor, & Upton, 2007).

RESULTS AND DISCUSSIONS

The Introduction sections guide readers into the research paper by anchoring the study in the previous research, uncovering the gap and offering questions and objectives of the study. In this section three moves were realized including Move 1. "Announcing the importance of the field"; Move 2. "Preparing for the present study" and Move 3. "Introducing the present study" as reported in Table 1.

TABLE 1. Moves and Steps in the Introduction Sections

Move/Step	Frequency	Number of RAs	Percentage	Status
Introduction Section				
Move 1: Announcing the importance of the field		**40/40**	**100%**	**Obligatory**
Step 1: Claiming centrality of the topic	16	17/40	42.5%	Optional
Step 2: Making topic generalizations	123	34/40	85%	Quasi-obligatory
Step 3: Reviewing previous research	208	40/40	100%	Obligatory
Move2: Preparing for the present study		**39/40**	**97.5%**	Quasi-obligatory
Step 1: Indicating research gap(s)	70	36/39	92.3%	Quasi-obligatory
Step 2: Presenting positive justification	14	18/39	46.1%	Optional
Step 3: Making hypothesis(es)	17	15/39	38.4%	Optional
Move 3: Introducing the present study		**40/40**	**100%**	**Obligatory**
Step1: Stating Purpose(s)	63	40/40	100%	Obligatory
Step 2: Presenting the hypothesis	22	9/40	22.5%	Optional
Step 3: Describing procedures	46	32/40	80%	Quasi-obligatory
Step 4: Offering procedural justification	5	6/40	15%	Optional
Step 5: Presenting findings	10	9/40	22.5%	Optional
Step 6: Stating value of the present study	10	8/40	20%	Optional

Move 1: "Announcing the importance of the field" establishes significance of the study in the respective field by entangling it into the previous research. This communicative function was realized in three steps as shown below:

Step 1: "**Claiming centrality of the topic"** comments on whether the topic is worthy to conduct research on by underscoring importance of the study.

1) "Seed size is one of the key seed traits that occupy an important position in the life history of a species". [RA19]

Step 2: "Making topic generalizations" is applied to make topic generalizations by attesting the relevance of the writer's research in the field.

2) "An urban forest can be described as the woody vegetation within a city that includes street trees located on both public and private lands, urban parks, and other trees located on residential properties, commercial land, and other lands". [RA9]

Step 3: "Reviewing previous research" cites the specified scholarly knowledge on the research topic.

3) "A recent study (R) reported that tree uprooting and snapping were more common on slopes and plateaus in the Central Amazon, with fewer uprooted or snapped trees in valleys". [RA1]

Note: (R) refers to Reference.

Of all realizations in Move 1, Step 3 was unwaveringly present, reflecting the pervasiveness of established knowledge in Forestry. This finding supports some studies in hard science (Samraj, 2002 in Conservation Biology and Wildlife Behavior; Kanoksilapatham, 2005 in Biochemistry; Swales and Najjar, 1987 in Physics). It is in contrast to findings in Computer science by Posteguillo (1999), probably due to new introduction of this field.

Move 2: "Preparing for the present study" seeks to derive readers' attention on a presented gap by concentrating on the inadequacies in the prior studies that necessitates more research, or by justification of the gap through hypothesis raising on account of the literature. Move 2 is realized through the following steps:

Step 1: "Indicating the research gap"

4) "To the best of our knowledge, this is the first attempt for adult conifer trees in Asian countries". [RA20]

Step 2: "Presenting positive justification"

5) "*In order to overcome this difficulty, a model has been developed that enables the prediction of cone yields considering variation in misting. It also allows the adjustment of the prediction to small changes in climate." [RA17]*
*R refers to reference.

Step 3: "Making hypothesis(es)" functions to formulate a prediction on the expected findings following the presented gap.

6) "We expect that the leaf distribution patterns are closely related to the drag parameters, because they create the porous structure of the crown." [RA20]
In Forestry Introductions, Move 2 Step 1 was pervasive, being realized in 92.3% of the corpus, far more frequent than Move 2, Step 2 in 46.1% and Move 2, Step 3 in 38.4% of the corpus.

Move 3: "Introducing the present study" consists of six steps in forestry. It unfolds the present study by enlisting questions, hypotheses, procedures, procedural justifications, underscoring findings and stating value of the study.

Step1: "Stating Purpose(s)"

7) "The aim of this study was to investigate the impact on survival, growth and biomass allocation in beech and oak seedlings grown under different shade conditions." [RA2]

Step 2: "Presenting hypothesis(es)"

8) "As the climatic-environmental gradient selected is long (140 km), the prognosis was that most of the tree species would show a unimodal response curve, i.e. a skewed or symmetrical Gaussian response curve (R), letting us estimate the realized niche width of each tree species from the HOF models." [RA5]

Step 3: "Describing procedures"

9) "The relative contributions to bird conservation of the two management regimes are considered and examined using simulations of plantation areas under different proportions of the contrasting management regimes." [RA4]

Step 4: "Offering procedural justification"

10) "*Both approaches benefit from the same amount of realized information." [RA14]*

Step 6: "Stating the value of the present study"

11) "Given the diversity and complexity of ecological requirements and preferences of bird species, studies that investigate local-scale responses to habitat changes are useful both for informing post-wildfire management decisions and for understanding landscape-scale species and community patterns and trends." [RA3]

Move 3 Step 1 and Step 3 were documented in high frequency in Forestry RAs (100% and 80% respectively), whereas the other steps in Move 3 were all optional, suggesting that enlisting procedures is favoured in this field. Occurrence of this step in Introductions indicates that stating procedures is not withheld until the Methods section, in congruence with Warranuk and Shi' (2014) findings. It appears that Forestry authors value procedures by highlighting it in Introductions, attending the smooth duplication of similar research by other scholars in this field as an applied science. Presentation of findings (Step 5) was documented in a low frequency, in contrast to Swales and Najjar's (1987) study of Physics articles and Kanoksilapatham's study of Biochemistry articles. It can be suggested that findings in Forestry Introductions serve as attention catchers to comprehensive attention in the Results sections. This study also identified the cyclical patterns of moves realized in the Introductions. Table 2 reports on the frequency of most common move cycles in the Introduction sections of the Forestry corpus.

TABLE 2. Cyclical Patterns in Introduction Sections

Cycles	Frequency	Percentage
M1-M2	35/40	87.5%
M2-M3	23/40	57.5%
M1-M3	21/40	52.5%

As to the cyclical patterns, the most predominant move cycle in the Introductions was Move 1- Move 2 in 87.5% of the corpus. Likewise, in Maswana, Kanamarub, and Tajino's (2015) study of 67 engineering research articles from 5 subdisciplines (Structural engineering, Environmental engineering, Electrical engineering, Chemical engineering, and Computer science), the findings revealed that the frequency of these two moves was greater than the number of the articles, indicating that Move 1 and Move 2 are cyclical, particularly in Environmental engineering, a field bearing overlaps to Forestry in some aspects. An important distinctive feature of Move 2 is its cyclical nature (Crookes, 1984; Hopkins & Dudley-Evans, 1988). Table 3 reports the findings on the opening and closing moves in Introduction sections of forestry RAs.

TABLE 3. Frequency of Opening and Closing moves in the Introduction Sections

Move	Opening Move/s		Closing Move/s	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Move 1	40	100%	-	
Move 2	-	-	2	5%
Move 3	-	-	38	95%

In the present study, regardless of the length or cyclical nature of moves, all Introductions began with Move 1 (100%), consistent with some studies in hard science disciplines (e.g. Berrenkotter & Huckin, 1995; Crooks, 1984; Swales & Najjar 1987). As to the closing moves, the majority of articles were ended with Move 3 (95 %). Kanoksilapatham (2015), in an attempt to identify cyclical structure of individual RA sections, noticed move cycling particularly in longer Introductions.

The Methods section presents results from the move analysis of the Methods sections. Methods sections was composed of five moves in Forestry RAs: Move 4. *"Describing materials"*; Move 5. *"Describing experimental procedures"*; Move 6. *"Detailing equipment"*; Move 7. *"Presenting equations"*; and Move 8: *"Detailing statistical procedures"*. Table 4 presents information on the moves and steps in the Methods sections.

TABLE 4. Moves and steps in the Methods sections

Move/Step	Frequency	Number of RAs	Percentage	Status
Methods				
Move 4: Describing materials		**40/40**	**100%**	**Obligatory**
Step 1: Detailing subjects	46	35/40	87.5%	Quasi-obligatory
Step 2: Detailing the source of subjects or materials	27	21/40	52.5%	Quasi-obligatory

Step3: Providing the background of subjects or materials	83	30/40	75%	Quasi-obligatory
Move 5: Describing experimental procedures		40/40	100%	Obligatory
Step 1: Documenting established procedures	34	20/40	50%	Quasi-obligatory
Step 2: Specifying the data gathering location/time	40	29/40	72.5%	Quasi-obligatory
Step 3: Detailing procedures including the limitations	208	39/40	97.5%	Quasi-obligatory
Step 4: Providing background of procedures	104	32/40	80%	Quasi-obligatory
Move 6: Detailing equipment	67	24/40	60%	Quasi-obligatory
Move 7: Presenting equations, models, algorithms and their background	54	25/40	63%	Quasi-obligatory
Move 8: Describing statistical procedures	100	37/40	92.5%	Quasi - obligatory

Move 4: "Describing Materials" enlists materials or subjects used, sources they are extracted from plus providing the background of subjects.

Step 1: "Detailing subjects" refers to subjects in the study including a wide range of possibilities from trees and animals to pieces of land.

12) "Cardeiro (Scleronema mincranthum Ducke) and mata-matá (Eschweilera) were selected." [RA 1]

Step 2: "**Detailing the source of subjects or materials"** elaborates on the source that provides the subjects, for example an organization or a manufacturer.

13) "Annual rainfall for this period was 2610, using data from an EMBRAPA experimental station, located 50 km east from EEST (R)." [RA 1]

Step 3: "Providing the background of subjects or materials" includes additional background information regarding materials used such as, the justification for the inclusion / exclusion of certain subjects, the description and the properties or the characteristics of the subjects.

14) "Scleronema and Eschweilera are among the most frequent genera in our study area (R) and both are listed as ''hyperdominant" in the entire Amazon basin, with Eschweilera represented by 52 species (R)." [RA1]

Move 4, Step 1 was the most common move in the Forestry corpus, occurring in 87.5% of the papers. The prevalence of this step indicates that in Forestry, location of data is of high importance because experiments are mainly conducted outside laboratory.

Move 5: "Describing experimental procedures" offers justifications to employ a particular methodological procedure and validates whether the study is executed methodologically.

Step 1: "Documenting established procedures" details experimental processes that have been already established by science, education, or public health, standard practices and established methods which are widely familiar to scientists.

15) "Trees that were selected for winching followed procedures consistent with previous studies (R)." [RA15]

Step 2: "Specifying the data gathering location/time" offers an account of the location (e.g. a farm or field) and time of the study. Owing to the nature of Forestry, as experiments tend to be conducted in contexts other than laboratory and the fact that time appears to play a critical role in conducting experiments, a step specifying the location/time of the research was realized in this study.

16) "Surveys were carried out in a PPM-infested black pine stand planted within the Monte San Michele forest area (Province of Florence, Italy)" [RA12]
17) "In the autumn of 2009, 54 merchantable standing black spruce trees were selected at each study site for destructive sampling." [RA9]

Step 3: "Detailing procedures including the limitations" provides a description of standard procedures or applied models and sometimes their limitations.

17) "To find the center of mass of each trees, we recorded trunk diameter at 1 m intervals (and DBH) after each tree fall and weighed every 1 m section of the tree with a 300 kg load capacity balance." [RA10]

Step 4: "Providing background of procedures" refers to the literature on the experimental methodology to justify and comment on the application of a specific procedure.

18) "Our sample size, 1000 points, goes beyond the minimum requirements presented by Congalton and Green (2009) and is comparable to recent studies by Nowak and Greenfield (2012) and Richardson and Moskal (2014)." [RA9]

Move 5 was realized in 100% of Forestry corpus, occurring more frequently through Step 3 (97.5%). It appears that by referring to the followed procedures, Forestry scholars intend to allow the readers to get an accurate configuration of the procedures, rendering them the opportunity to replicate the study. This step also signaled a high frequency in a study by Cotos, Huffman & Link (2017) in a range of disciplines from soft sciences to hard sciences including forestry.

Move 6: "Detailing equipment" presents equipment by bolding information related to the apparatus, like the manufacturer's name, to further facilitate replication of the methodology for readers.

19) "Red/far- red ratio (R/FR) was measured in March 2014 with a Skye SKR 110 sensor connected to a display meter (Skye Instruments, Powys, UK) that reports quantum flux at 660 and 730 nm." [RA6]

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Move 6 was realized in 60% of the Forestry corpus, at a considerably higher rate compared to Kanoksilapatham's (2005) study of Biochemistry RAs. However, findings from this study almost correspond with Nwogu' s (1997) study of Medical research papers in which this step was found to be present in the overall corpus.

Move 7: "Presenting equations, models, algorithms and their background" is used to identify variables in the experiments embedded in the form of formulas, algorithms or models.

20) "Furthermore, the position of the inflection point is controlled by only one parameter, which contributes to maintain the model's structural simplicity. Thus, gT was calculated as: gT (Tm) = A ∗exp Σ−(T 1 − Tm) + 1ΣΣ." [RA13]

This move was identified in 63% of the corpus, as a quasi-obligatory move. The presence of this move in more than 50% of Forestry research articles indicates that it is a robust engineering field because in such hard science fields (engineering) equations, algorithms and models, for example optimization models, are proved to highly contribute to the creation of knowledge.

Move 8: "Describing statistical procedures" functions to present statistical approaches applied to analyze the data.

21) "*To check the first hypothesis (trees in valleys are more resistant than trees on plateaus), we compared Mcrit of species groups versus topographic position (as a factor) by means of one-way ANOVA." [RA1]*

This move occurred in 92.5% of Forestry RAs, being considered a quasi-obligatory move, in harmony with results from some former studies, such as Ye (2019) in Energy engineering and Shi & Wannaruk (2014) in Agriculture sciences. In contrast, in Kanoksilapatham' (2005) study of Biochemistry RAs, this move was scarcely realized in just 13% of the corpus. This finding could be attributed to the tendency of scholars in Forestry as an applied science, to attend the accuracy of outcomes by applying precise statistical procedures. As to the cyclical patterns in the Methods section, the sequence of moves did not follow the same order as specified in Kanoksilapatham's (2005) model, probably due to the nature of this section which is content-based. Table 5 reports findings on the most common move cycles in the Methods sections.

TABLE 5. Cyclical Patterns in Methods Sections

Cycles	Frequency	Percentage
M4-M5	39/40	97.5%
M5-M8	25/40	62.5%
M5-M6	22/40	55%
M7-M5	16/40	40%
M7-M8	13/40	32.5%

In the present study, Move 4 - Move 5 tended to be the most frequent cycle, being realized in 97.5% of the corpus, concordant with Kanoksilapatham's (2015) study of three engineering fields (Civil, Software, and Biomedical). In a study by Cotos and Huffman (2017) in a range of

disciplines, soft sciences and hard sciences, Move 4 -Move 5 cycle was also documented in most fields studied. Table 6 presents information on the opening and closing moves in the present corpus.

TABLE 6. Frequency of Opening and Closing Moves in Methods Sections

Move	Opening Move/s		Closing Move/s	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Move 4	29	72.5%	-	-
Move 5	10	25%	6	15%
Move 6	-	-	-	-
Move 7	1	2.5%	4	10%
Move 8			30	75%

As to opening moves, the major part of Forestry RAs (72.5%) began with Move 4. *"Describing materials"*. This finding is in contrast with the study by Kanoksilapatham (2005) in which the major portion of papers (61.66%) began with Move 5. *"Describing experimental procedures"*. As for the closing moves in the current study, the move that pervasively ended this section was Move 8 in 75% of the RAs.

The Results section provides information on the move analysis of individual communicative moves applied in the Results section. Like the Methods sections, this section has attained insufficient attention, although it serves an integral part in the composition of RAs and reporting the findings of a research, in a detailed and unbiased account. This section is divided into four main communicative moves, including Move 9. *"Stating procedures"*, Move 10. *"Justifying procedures or methodology"*; Move 11. *"Stating results"*; and Move 12. *"Stating comments on results"* as reported in Table 7.

TABLE 7. Moves and Steps in the Results Sections

Move/Step	Frequency	Number of RAs	Move/Step	Status
Results Section				
Move 9: Stating procedures		**28/40**	**70%**	**Quasi-obligatory**
Step 1: Describing aims and purpose(s)	10	5/28	17.85%	Optional
Step 2: Presenting the hypothesis(es)	13	11/28	39.28%	Optional
Step3: Listing procedures or methodological techniques	68	22/28	78.57%	Quasi-obligatory
Move 10: Justifying procedures or methodology		**11/40**	**27.5%**	**Optional**
Step 1: Detailing methods resembling those used in the study	4	5/11	41.66%	Optional
Step 2: Commenting on whether methods yielded successful results	8	9/11	75%	Quasi-obligatory
Move11: Stating results	**257**	**40/40**	**100%**	**Obligatory**
Move 12: Stating comments on results		**36/40**	**90%**	**Quasi-obligatory**
Step 1: Explaining the results	60	30/36	83.33%	Quasi-obligatory

Step 2: Making generalizations or interpretation of results	53	27/36	75.00%	Quasi-obligatory
Step 3: Evaluating the current findings with regard to the previous studies or hypothesis	11	9/36	25%	Optional
Step 4: Stating limitations	4	2/36	5.5%	Optional
Step 5: Summarizing	13	9/36	25%	Optional

Move 9: "**Stating procedures"** aims at transiting evenly from the Methods to the Results, by rephrasing the research objectives, hypotheses and the experimental methodology before detailing findings of the study.

Step 1: "**Describing aims and purpose(s)"** recapitulates objectives of the study for a second time after it was once mentioned in Introductions.

22) "*In evaluating the tree canopy cover of Tallahassee (M9-S1) through the use of the point-based sampling approach (M9-S3), we estimated that 49.1% of the land within the boundary of the city was covered with trees in 2013. [RA9]*
This is an example of a dual move (<M9.S1-M9. S3>), composed of Move 9-Step 1 and Move 9, Step 3.

Step 2: "Making hypothesis" functions to present hypothesis(es) of the study.

23) "Along DCA1, the height of the response (h) ranged from 88 per cent for Pinus sylvestr to 42 per cent for Pinus pinea (Table 1, Figure 4a); probabilities below 14 per cent were predicted for the remaining tree species." [RA5]

Step 3: "Listing procedures or methodological techniques" functions to provide the readers with information on the procedures or research methodologies.

24) "*To depict the effect of discount rate on the optimal management schedules of P. pinea (M9.S1), two additional discount rates were tested, namely 1 and 5 % (M9.S3)". [RA17]*
This is a dual move <M9-S1_M9-S3>, as well.

Move 9 occurred in 70% of the research articles, in harmony with a study of three subfields of engineering by Kanoksilapatham (2015) that showcased a high frequency of this move in the Results section. Move 9, Step 1. *"Describing aims and purpose(s)"* was present in only 2 out of 40 (17.85%) of the RAs, indicating that in forestry aims and purposes are mainly presented in Introductions. Move 9, Step 3. "*Listing procedures or methodological techniques"* was realized at high frequency in 78.57% of the corpus. It suggests that Forestry scholars highlight procedures in their studies as it also occurred in high percentage in Introductions (80%).

Move 10: "Justifying procedures or methodology" justifies the employed methodology in the study, ensuring readers of the procedural validity.

Step 1: "Detailing methods resembling those used in the study" describes the applied procedures by attributing it to the cited knowledge in the field.

25) "Among the architectural attributes related to tree resistance to wind, the measure of slenderness; quotient of height and diameter have been used as a indices of tree stability for Scots pine) and Norway spruce (Picea abies) stands (R)." [RA1]

Step 2: "Commenting on whether methods yielded successful results" offers the rationale behind a specific method through evaluation of the positive outcomes achieved by such methods.

Move 10 was realized in only 27.5% of Forestry research articles and it was considered as an optional move. Findings from the present study contradicts results by Kanoksilapatham (2005) and Warranuk and Shi (2014) that documented this move in high frequencies. It could be suggested that Forestry researchers tend to adopt novel approaches in their studies.

Move 11: "Stating results" objectively reports, presents, or highlights the findings obtained. It is considered as a crucial move in the Results sections.

27) "There seemed to be a significant difference between the estimated percentage tree canopy cover using the random point-based approach with NAIP imagery within ArcGIS and the estimated percentage tree canopy cover using the random point- based approach with Google Earth imagery." [RA9]

Highlighting the expected findings by translation of the numerical data into written text, this move was evidenced in 100% of the corpus, compatible with studies by Nwogu (1997) in Medicine, Kanoksilapatham in Civil, Software, and Biomedical engineering (2015), Maswana et al. (2015) in Chemical engineering (2015), and Ye (2019) in Energy engineering. This move, however, was found to be a quasi-obligatory move in Computer science (Posteguillo, 1999), as most researchers in this field chose to provide comments on their findings rather than just giving a neutral account of numbers.

Move 12: "Stating comments on results" provides comments on the obtained results by explaining the results and making generalizations and evaluating the findings with regards to the previous studies.

Step 1: "Explaining the results" offers explanations accounting for the results.

28) "As a result, photointerpretation error due to close, subjective classifications along the edges of tree crowns seems minimal, but likely contributes to some of the differences observed between sampling systems and imagery products." [RA9]

Step 2: "Making generalizations or interpretation of results" formulates comments on the significance of the results.

29) "*It means that the financial maturity of the stand, which mainly depends on the largest trees, occurred in both stands at similar diameter." [RA17]*

Step 3: "Evaluating the current findings with regard to previous studies or hypothesis(es)" concerns evaluation of the findings against the author's expectations.

30) "This is considered to be acceptable given the complexity of the choice experiment, and the similarity in response rates achieved in other studies using discrete choice experiments (R)." [RA11]

As it is evidenced in all these examples, various steps of Move 12 present interpretive comments that go beyond a simple factual reporting of the results. Move 12 was frequent, occurring in 36 out of 40 of the RAs, or 90 % of the entire corpus, regarded as a semi-obligatory move in Forestry RAs. Move 12 Step1 that gives an account of the reasons behind results, occurred in 81.25% of the corpus. Move 12 Step 2. was documented in 75% of Forestry corpus, as a quasi-obligatory step, consistent with Shi and Wannaruk's (2014) study. Move 12, Step 3 concerns evaluation of the findings against the author's expectations with regard to the past research. Evidenced in 25% of the overall corpus, this step was considered as an optional step, compatible with findings from Shi and Wannaruk' (2014) study. As it is substantiated in the examples, Move 12 represents comments on the findings rather than simple factual reporting of results. The co-occurrence of steps can occur in many possible orders. As a result, no definite order of steps was found in Move 12. Examination of cyclical patterns in Forestry RAs revealed some dominant sequences in the Results sections. Table 8 shows the frequency of the most prominent cyclical patterns of moves in the Results sections.

TABLE 8. Frequency of Cyclical Patterns in the Results Sections

Cycles	Frequency	Percentage
M11-M12	35	87%
M11-M9	23	57.5%
M9-M12	11	27.5%
M9-M10	6	15%

Cycle Move 11-Move 12 recurred frequently in 87% of Forestry RAs, in support of Kanoksilapatham' (2005) study. It is suggested that Forestry scholars do not necessarily reserve their comments for the Discussion sections. In Forestry articles, the comments move (M12) usually follows individual results (M11) in an alternating manner, as opposed to sequential, through several consequent cycles. However, in Brett's (1994) study in Sociology, as a soft science, the comment Move (M12) was related to a set of results (M11) sequentially rather than reporting every individual result, in an alternating manner. Table 9 reports on the opening and closing moves in Forestry RA corpus.

TABLE 9. Frequency of Opening and Closing Moves in the Results Sections

Move	Opening Move/s		Closing Move/s	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Move 9	10	25%	2	5%
Move 10	2	5%	-	-
Move 11	27	67.5%	25	62.5%
Move 12	1	2.5%	13	32.5%

The move predominantly both starting (67.5%) and ending (62.5%) the Results section was Move 11, partially congruent with Kanoksilapatham's (2005) study in that in her study this often ended the Result sections. It indicates that Forestry researchers place considerable emphasis on numerical announcement of data findings.

The Discussion section presents the finding on the analysis of individual moves and steps obtained from this section. The function of Discussion sections is to contextualize the research by attributing it to previous work within the larger research field. A total of 4 moves were actualized in this section: Move 12. *"Contextualizing the study"*; Move 13. *"Consolidation of results"*; Move 14. *"Limitations of the study"*; and Move 15. *"Further studies suggested"*. These Moves and their characteristic steps are displayed in Table 10.

TABLE 10. Moves and Steps in the Discussion Sections

Move/Step	Frequency	Number of RAs	Move/Step	Status
Move13: Contextualising the study		**31/40**	**77.50%**	**Quasi-obligatory**
Step1: What is already known of previous studies	32	25/31	80.64%	Quasi-obligatory
Step 2: Detailing conclusions, claims, deductions or research gaps based on the previous research	25	16/31	51.61%	Quasi-obligatory
Step 3: Stating aims or hypothesis of the study	13	11/31	35%	Optional
Move 14: consolidating results		**40/40**	**100%**	**Obligatory**
Step 1: Restating methodology	45	23/40	57.50%	Quasi-obligatory
Step 2: State selected findings	240	40/40	100%	Obligatory
Step 3: Referring to previous literature	124	37/40	92.50%	Quasi-obligatory
Step 4: Explain result or difference in findings	140	38/40	95%	Quasi-obligatory
Step 5: Making overt claims or generalizations	130	39/40	97.50%	Quasi-obligatory
Step 6: Exemplifying	18	14/40	35%	Optional
Step 7: Stating the value of study	64	24/40	60%	Quasi-obligatory
		29/40	**73%**	**Quasi obligatory** -
Move 15: Stating limitations of the study				
Step 1: Limitations of findings	33	15/29	51.72%	Quasi-obligatory
Step 2: Limitations of the methodology	40	22/29	75.86%	Quasi obligatory -
Step 3: Limitations of claims made	6	5/29	17.24%	Optional
Step 4: Limitations of previous studies	7	4/29	13.79%	Optional
Move 16: Suggestions for further research	**45**	**21/40**	**53%**	**Quasi obligatory** -

Move 13: "Contextualizing the study" reflects the importance of situating the findings in the broader academic world. The analysis of this section revealed that Move 13 is characterized by three major steps.

Step 1: "What is already known of previous studies" presents general established knowledge of the topic or previous research. In effect, it offers justifications for the tendency towards a specific method by pinpointing certain information from previous studies.

31) "*Direction of slope aspect and orientation of valleys with respect to the prevailing wind direction can have a considerable influence on the magnitude of wind speed experienced at a location(R)*." [RA1]

Step 2: "Detailing conclusions, claims, deductions or research gaps based on the previous research" concerns presentation of generalizations, claims, deductions, or research gaps of the present study based on the previous research. It allows scientists to go beyond the results and place their work under the scrutiny of the discourse community.

32) "In contrast, Q. pyrenaica presents traits related to a stress tolerance with a more conservative growth strategy than Q. petraea (R)." [RA5]

Step 3: "Stating aims or hypothesis of the study" presents the purposes or the predicted assumptions of the study.

33) "*The study presents a method to integrate stochastic cone yields of P. pinea in the optimization of stand management*." *[RA17]*

The importance of situating findings from the study in the broader academic world was reflected in the fact that the Move 13 was present in almost over three quarter (77.5 %) of the corpus. It could be suggested that Forestry authors, admitting the significance of presenting results in the Discussion sections, intricately situate their work in the interest of the scientific discourse community, providing a persuasive, detailed picture of the study. This step was found to be present in 80.64% of the corpus, considered as a quasi-obligatory move/step, comparable to results in Agricultural sciences (Shi & Wannaruk , 2014), and in Forestry RAs (Joseph & Lim, 2018). In Joseph & Lim's (2018) study, Move 13 Step 1 and Move 13 Step 2 were documented to converge under one single step: "*Presenting related information* "(see Joseph & Lim, 2018 for further details).

Move 14 "Consolidating results" is conceived to be the boldest move in Discussion sections. It conventionally highlights the strengths of a study and defends their research achievements. It hinges the general findings to the followed approach in the study and relevant cited knowledge, creating a kernel battlefield to compare or contrast the current results with those generated by other studies, while embedding the author/s' intuitive explanations, as well.

Step 1: "Restating methodology"

34) "*The ideal morphological traits for selecting plants that are tolerant for salt sprays included (i) epigeous dry matter, (ii) total leaf area and (iii) percentage leaf damage." [RA10]*
Move 14, Step 1 was evidenced in 57.5% of the RAs. It could be suggested that Forestry authors find it advisable to restate methodology in Discussion sections to probably add to the promotional validation of the results

Step 2: "State selected findings"

35) "It should be of no surprise that the standard errors are relatively small, and therefore slight differences in sample means might be considered statistically significant" [RA7]

Step 3: "Referring to previous literature"

36) "In this study, our findings show similarities to other recent findings (R) that indicate tree canopy cover estimates can be statistically significantly different when different sampling approaches or imagery sources are employed" [RA9]
Actualizing in 92.5% of the corpus, this step is quasi-obligatory in Forestry RAs, supporting results by Ye (2019) and Shi and Wannaruk (2014).

Step 4: "Explaining results or difference in findings"

37) "*A slight difference in our study was the tendency for a change to a positive (non-significant) response to summer temperatures of the current growing season at our study site after 1959." [RA18]*

Step 5: "**Making overt claims or generalizations"**

38) "These results suggest that the simple mechanistic model using fixed representative drag coefficients for species (Chiba 2000; Nakao et al. 1993; Torita et al. 2010) would introduce significant errors into the calculation of the critical wind speed for individual trees." [RA20]

Step 6: "**Exemplifying"**

39) "For example, when employing point-based sampling, the differences in canopy cover between using NAIP imagery and Google Earth imagery were 4.6% and 1.1%". [RA9]

Step 7: "**Stating the value of study"**

40) "In any case, this is a baseline study that has shown that tree species occupying environments with sharp contrast through the gradient or transitional environments between different morpho structural units have broadest niches..." [RA5]

Move 14 was realized in 100% of the corpus, as an obligatory move, supporting findings from studies by Kanoksilapatham (2005) and Wannaruk and Shi (2014). Of all the steps in Move 14, Step 2 which presents the selected findings was realized in 100% of the RAs, as the only obligatory step. It is worthy to note that this step played a pivotal role in fashioning cycles of Move 13 and Move 14. Identically, it was an obligatory move in several studies in hard science fields, (Kanoksilapatham, 2015; Ye, 2019; Shi & Wannaruk, 2014).

Move 15: "Stating limitations of the study" makes explicit the scientists' views on the *"limitations of findings"* (Move 15 Step1); *"limitations of methodology"* (Move 15 Step2);

"limitations of claims made" (Move 15 Step3); and *"limitations of previous studies"* (Move 15 Step 4). The realizations of Move 15 are illustrated in the following examples:

Step 1: "Limitations of findings"

41) "In addition to model limitations, the remaining discrepancies between observations and simulation results may be due to … ." [RA13]

Step 2: "Limitations of the methodology"

42) "In addition, the sampling method for the last inventory in Valsaín was different than for previous inventories, which…." [RA8]

Step 3: "Limitations of claims made"

43) "This latter finding, in combination with low overall nematode parasitism, requires further investigation to ensure that …" [RA6]

Step 4: "Limitations of previous studies"

44) *"Theoretical studies, in which the experiments have been conducted from the wood technological or timber use perspective, limit the understanding of the biomechanics of living plants (R)"* [RA 1].

Move 15 Step 2 which accounts for limitations attributable to the methodology was the most frequently applied step in this move (75.86%), suggesting that Forestry authors value mentioning limitations of their study methodology as they are committed to make the readers aware of any constraints they have experienced in their research in case they need to conduct identical studies arise.

Move 16: "Suggestions for further research" offers recommendations for further research.

45) "But given the availability of tree-ring width chronologies worldwide (i.e., ITRDB) a similar approach could be applied with a new calibration scheme with other DVMs and other tree species." [RA13]

Move 16 was realized in 53% of Forestry RAs, considered as a quasi-obligatory move, congruent with the results from Forestry RAs by Joseph & Lim (2019). In making recommendations for further studies, Forestry researchers tend to draw on the insights gained from the limitations of their own research or notable knowledge gaps they have discovered after completing the study. As to the cyclical patterns in the Discussions, the integrated nature of this section, which is both explicit (when reporting results and citing established knowledge or previous research) and speculative (when making claims or offering explanation), allows the authors to have greater freedom to manipulate the rhetorical devices available. Table 11 shows the frequency of the most salient cyclical patterns of moves in the Discussion sections.

TABLE 11. Frequency of Cyclical Patterns in Discussion Sections

Cycles	Frequency	Percentage
M13-M14	33/40	82%
M14-M15	26/40	65%
M16-M14	14/40	35%
M15-M16	5/40	12.5%

The most highly frequent cycles in this study were Move 13-Move 14 in 82% of the RAs. Some previous researches have shown that Discussion sections usually display cyclical patterns particularly when several pieces of results are presented serially (Dudley-Evans, 1988). Swales and Feak (1994) concede that by the time the reader reaches this section, all crucial details of the study are already known. Therefore, the authors are free from rhetorical constraints and have more flexibility in deciding what to include. Table 12 reports on the frequency details of opening and closing moves in this section.

TABLE 12. Frequency of Opening and Closing Moves in Discussion Sections

Move	Opening Move/s		Closing Move/s	
	Frequency	Percentage	Frequency	Percentage
Move 13	27	67.5%	-	-
Move 14	13	32.5%	25	62.5%
Move 15	-	-	2	5%
Move 16	-	-	13	32.5%

Regarding the opening moves in Forestry RA Discussions, the move to begin this section was Move 13. "Contextualizing the study", in 67.5% of the corpus. The finding obtained from this study is consistent with Holmes (2001), Dobakhti (2011), and Joseph & Lim (2018). The main move, to close the Discussion sections was Move 14. *"Consolidating the results"* in 25 out of 40 (62.5%) of the RAs. It is likely that the reason behind closing this section by Move 14 is the criticality of this move in this section, as it had a high frequency percentage (100%).

CONCLUSION

Drawing on the findings of the present study, certain rhetorical units (moves and steps) were realized in the discipline of Forestry which were different from Kanoksilapatham's (2005) model. Given the fact that the rhetoric based disciplinary variations have been a topic of increasing concern in academic writing, especially research article domain, results from this study would contribute to the dissemination of Forestry knowledge in rhetorically and linguistically structured research papers.

In the current study the following new moves and steps were realized in the IMRD sections of the discipline of Forestry RAs. In the Introduction sections, Move 2 Step 2. *"Presenting positive justifications"*, Move 2 Step 3. *"Making a hypothesis"*, Move 3 Step 2. *"Presenting the* hypothesis", Move 3, Step 4. "Offering procedural justifications", Move 3, Step 6. "Stating the *value of the present study"* were found as idiosyncratic to Forestry. As to the Methods sections, Move 4 Step 1. *"Detailing subjects and their location"*, Move 5 Step 2. *"Specifying the data*

gathering time", Move 7. *"Presenting equations, models, algorithms and their background"* were actualized as new communicative units. In the Results sections, no new move or step was found. Ultimately, in Discussion sections, Move 12 Step 3. *"Stating aims or hypothesis of the study"*, Move 14 Step 7. *"Stating the value of study"*, Move 15 Step 4. *"Limitations of previous studies"* were realized.

Indeed, several researchers who have continued the tradition of move analysis following Swales (1990, 2004), have started to note remarkable disciplinary variations in RAs rhetorical organizations examined in divergent as well as convergent fields. Rationally, there must be exceptions to the proposed rhetorical frameworks associated with different disciplines as in cases authors choose to apply their own rhetoric, detaching certain moves or steps and attaching some others they find functional to communicate their communicative goal while adjusting the order of rhetorical units to suit their targeted rhetorical objective. Nevertheless, where a specific discipline frequently and systematically applies a framework, the overall model can be developed through study to expand disciplinary variations in academic writing.

Question 2 of the study sought to examine the cyclical patterns of moves in each IMRD sections of Forestry research articles. The most frequent cyclical pattern realized in the Introduction sections was Move1-Move 2. In the Methods sections, Move 4 -Move 5 tended to be the most frequent cycle in 97.5% of the corpus. As to the opening and closing moves in the Methods sections, the present study revealed that 72.5% of the entire corpus started with Move 4. *"Describing materials"*, the move that pervasively tended to end this section was Move 8. *"Detailing statistical procedures"* in 75% of the research articles. In the Results sections, cycle Move 11-Move 12 recurred frequently. The move predominantly both starting and ending the Results section was Move 11. *"Presenting results*. In the Discussion sections, the most highly prevalent cycles in this study were Move 13 -Move 14. in 82% of the RAs. As to the opening moves in the Forestry Discussion sections, the move that was likely to begin this section was Move 13. *"Contextualizing the study"*, in 67.5% of the corpus. The main move, to close the Discussion sections was Move 14. *"Consolidating the Results"* in 62.5% of the RAs.

Identifying the cyclical patterns allows the writers to become familiar with most typical cycles, while it protects them from creating awkward cycles. Awareness of the cyclical and ordering patterns of moves in RAs appears to be required for RA writers to perceive the criticalness of certain communicative units compared to others. Likewise, if scholars are unfamiliar with such patterns, they are likely to be at the risk of applying queer or radically divergent ordering patterns of rhetorical moves. Through familiarity with the most typical cyclical patterns, undeniably, they would feel more flexibility in writing research articles. That means they can maintain their creativity within an approved framework. Referring to the analogy of a specific dance, rhetorical principles like dance movements are meant to be prone to some degree of flexibility while following a set template, in order to be creative. Dancers in different types of dance genres (take the case of Ballet), Classical ballet, Neoclassical ballet, and Romantic ballet, for example, follow their typical, however, not highly unique, schemes to communicate their intended goal. Dances, in general, are comprised of moves as writing genres do. Given that the different realizations of a genre, for instance research articles in various disciplines tend to follow certain practiced mega, at the same time micro, principles, it could be deduced that research in this domain can benefit the academic society in general and disciplinary communities in particular. Results from the current study could reveal specific points on the rhetorical structure of Forestry research articles to further prompt forming its solid communicative core by elucidating on both communicative as well as formal properties of papers in this field.

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