Facilitating Scholarly Publication: Genre Characteristics of English Research Article Introductions and Methods

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ABSTRACT

This article acknowledges the increasingly important role of research articles (RAs) written in English. To enable scholars who are not competent in English to compete with others academically, this study provides a detailed description of the English empirical RA Introductions and Methods. A dataset of 60 RAs representing top quality journals in biomedical engineering was compiled and subsequently divided into four sub-datasets representing the four major sections. The Introduction and Methods sub-datasets were analysed by genre analysis into 'moves' and 'steps'. Then, the linguistic features pervasive and salient in individual move or step instances were identified. The analysis revealed that each section displayed a schematic structure, consisting of a set of moves and steps. In addition, clusters of lexico-grammatical features associated with a communicative function were identified. This two-tier genre analysis suggests that the structural patterns and linguistic features interact with each other functionally. The findings are pedagogically useful in developing genre competence for scholars to better access the content they need from RAs and to effectively disseminate their achievements in their respective fields.

Keywords: genre analysis; research article; lexico-grammatical analysis; biomedical engineering; Introductions and Methods

INTRODUCTION

Currently, English has been recognised as an international language. Specifically, in the Southeast Asian region, English has attained the status as the working language. The prominence of the language is evident not only in business but also education. For instance, in business, to be able to compete in the world market and to maintain the long run competitiveness in the region and the world, the ability to use the English language is increasingly essential. Within the academia, English is being used in diverse forms of academic communication. Being able to use the English language allows scholars to participate effectively and efficiently in academia.

English RAs serve as one of the platforms on which scholars reveal their discoveries to a wider discourse community. Through this channel, scholars can contribute to the field by publicizing their work which can be evaluated, assessed, and endorsed by their respective community members. Although a large number of academic institutions in several countries have adopted the 'publish or perish' policies (Zuengler & Carroll 2010, p. 637), as remarked by Salager-Meyer (2008), inequality in the world of scholarly writing exists. The visibility of non-native speakers of English as contributors in the realm of RAs is quite limited, compared with that of native speakers.

The challenge encountered by non-native speakers can be multi-faceted, including the difficulty in acculturating themselves to the organizational pattern followed in writing in

English and the grapple with the language itself (e.g., the choice of present tense vs. past tense, active vs. passive voice). In this regard, Canagarajah (2010, p. 661-662), in congruence with Cho (2010), pinpointed that one factor contributing to this low visibility is the fact their style of writing or textual organization is not appreciated in mainstream journals.

Based on this contention, a number of expectations are imposed on non-native speakers. First, they need to engage in innovative academic research. The scenario is exacerbated when they need to disseminate their findings in the style conforming to the journal expectations. This article attempts to prepare scholars who are not competent in English to be able to handle the task of writing RAs, by identifying the schematic structures followed in the Introduction and Methods sections. With reference to Swales' genre analysis framework, a schematic structure consists of a set of 'moves' and 'steps' which are defined by communicative functions. In addition, the linguistic description demonstrates the lexico-grammatical features salient in each move and step. Both the schematic structure and linguistic description will contribute to the increase of non-native visibility in academia. The study also empowers potential scholars with the awareness of both schematic structure and linguistic description, facilitating scholarly publication in an international forum.

SWALES' GENRE ANALYSIS

Genre is a type of spoken or written communication with its own structural organization (Swales 2004). His framework called 'genre analysis' (otherwise known as 'move analysis') states that a text representing a genre consists of smaller units called 'moves' sequenced in a particular order, forming a pattern. Each move possibly consists of sub-units called 'steps.' A move or step has its own communicative function that can be recognised by a set of linguistic features. Based on Swales' analysis of RA Introductions from multiple disciplines, a structural pattern or move structure for this section was proposed in 1990 and revised in 2004, as shown below.

Move 1: Establishing a territory (citations required)*** via
Topic generalizations of increasing specificity
Move 2: Establishing a niche (citations possible)*** via
Step 1: Indicating a gap
Step 2: Adding to what is known
Step 3: Presenting positive justification (optional)
Move 3: Presenting the present work via
Step 1: Announcing present research descriptively and/or purposively (obligatory)
Step 2: Presenting research questions or hypotheses* (optional)
Step 3: Definitional clarifications (optional)*
Step 4: Summarizing methods (optional)*
Step 5: Announcing principal outcomes (PISF**)
Step 6: Stating the values of the present research (PISF**)
Step 7: Outlining the structure of the paper (PISF**)

* Steps 2-4 of Move 3 are optional and not fixed in order.
** PISF (Probable in some fields)
*** Moves 1 and 2 are likely to be cyclical, especially in longer introductions.

FIGURE 1. Swales' 2004 model for RA introductions.

A plethora of genre-based studies were conducted on the Introduction section of RAs in diverse academic disciplines (Posteguillo 1999, Kanoksilapatham 2012). As an extension, other sections of RAs in diverse disciplines were analysed (*Methods* by Bruce 2008, Peacock 2011, *Results* by Ruiying & Allison 2003, *Discussion* by Kanoksilapatham 2007). These studies have demonstrated that, although RA Introductions across disciplines generally

follow the same schematic pattern consisting of three major moves, disciplinary variation in the move pattern can be observed.

Taken together, genre-based studies culminate in the conclusion that genre analysis has proved to be an effective device to capture the organizational patterns followed in diverse text types. These studies also highlight that structural pattern of each discipline is unique. Thus, for non-native speakers to be able to compete in academia, the generic knowledge, as well as of proclivities of their respective discipline, is indispensable.

In addition to the task of identifying structural patterns, genre analysis also sheds lights on the use of linguistic features commonly found across text instances belonging to individual moves and steps. For instance, as demonstrated by Kanoksilapatham (2011a), the step of describing study sites in civil engineering RA Introductions is expressed by the use of simple present tense, common nouns, specific place names, and attributive adjectives. Evidently, both directions of the approach complement each other, contributing to a better understanding of how RAs are constructed.

BIOMEDICAL ENGINEERING

This study focuses on RAs in biomedical engineering, a relatively new discipline that emerged in the year 1952. Today, it is recognised as one of the fastest growing fields of technology. As the name implies, the discipline is a hybrid of biology, chemistry, medicine, informational technology, and engineering. This discipline emphasises the application of engineering principles and techniques to solve biological and medical problems and to improve healthcare and human life quality. Among the prominent achievements and applications of this discipline are various medical devices including cardiac pacemakers, artificial limbs, kidney dialysis machines, and a myriad of other medical devices and treatments (Nebeker 2002).

RAs in biomedical engineering serve as the backbone of communication to contribute to great discovery and effective solutions for health issues. As communication technology grows rapidly, the need to be able to communicate quickly becomes essential. Therefore, scholars in this discipline need to contribute to the field at a more rapid pace than ever in accordance with the rapid growth of communication technology. This study aims to describe the structural organization and linguistic characterization of RAs in this discipline. Among the four conventional sections of RAs, the first two sections of Introduction and Methods are usually distinctly separated, whereas the other two sections of Results and Discussion are likely to be combined. Therefore, to help particularly novice researchers or practitioners who are not familiar with the RA genre yet by giving them a head start in embarking on the task of academic writing, it is thus essential for them to be aware of the rhetorical structures and sets of linguistic features prevalent in these two stand-alone sections.

METHODS

Inspired by the necessity to understand specialised discourse in scholars' discipline, this study is primarily concerned with the move structures of two sections of RAs in biomedical engineering: Introduction and Methods. In addition, to facilitate scholars with the task of expressing each move/step conforming to the expectations of the discourse community, linguistic description of individual moves and steps is provided.

DATA COMPILATION

Research articles in biomedical engineering RAs were systematically compiled to ascertain that the dataset is both sizable and representative of the genre. Some previous genre-based studies selected the journals based on experts' recommendations (Posteguillo 1999). To minimise individuals' subjectivity and enhance the validity of the analysis in terms of the prestige of the journals, the more objective criterion of journal impact factor (JIF, an index of journal prestige based on the number of citations of articles in a journal over the last two years) was consulted.

The top five journals identified were abbreviated as [TMI], [BMR], [TBM], [AOR], and [TNS]. From each of the five journals, 12 experimental RAs were randomly selected, resulting in the dataset of 60 articles. Not every RA in the dataset has all two distinct and independent sections of Introduction and Methods. In summary, two sub-datasets containing 59 Introduction and 53 Methods sections were generated.

DATA ANALYSIS

To address the first objective, the two sub-datasets were analysed using Swales' analysis to determine the sub-units of 'moves' and 'steps'. To address the second objective, an in-depth analysis of the linguistic features in move and step instances was conducted. Upon the completion of the analysis of each section, an overall structural organization or move structure for the section was identified, displaying the typical sequence of moves and steps found in the dataset, the status of each move, and the cyclical patterning of moves (if applicable) .

RESULTS

For each section, a set of moves and steps identified is described in detail. Text instances representing moves and step instances taken directly from the two sub-datasets are presented, with salient linguistic features highlighted. The sources of instances were provided at the end of each move/step instance, indicating the abbreviated journals together with the number of article in the sub-dataset. All citations in the text instances were replaced by (R). Finally, individuals' identity was replaced by XXX. Towards the end of each section, a move structure pertaining to each section is proposed, reflecting the particular sequence of moves and steps, as well as conventional or optional status of a move/step and cyclical patterning.

THE INTRODUCTION SECTION

The analysis of the Introduction sub-dataset reveals that this section consists of three major moves, substantiating previous studies on this particular section (Kanoksilapatham 2005, Nwogu 1997). The moves and steps found are individually described as follows:

MOVE 1: ESTABLISHING TERRITORY

This move establishes the research study being presented. Swales' 1990 model stipulates that this move consists of three steps: Step 1 (Claiming centrality of the topic), Step 2 (Making topic generalizations), and Step 3 (Reviewing previous literature). However, in his 2004 model, a revision was made, eliminating the three steps of Move 1 to accommodate the comment that sometimes it was not easy to distinguish the three steps of Move 1 (Samraj 2002). Swales (2004) remarked that the content of Move 1 usually starts from general to

increasingly specific. In this study, the author opts to retain the three steps of this move to specifically provide non speakers of English with some concrete ideas when writing RAs.

Move 1, Step 1: Claiming centrality of the topic

(1) Heart rate and heart rate variability (HRV) **are important** dynamic measures of the state of the cardiovascular system and the autonomic nervous system. [TBM1]

(2) Position emission tomography **has been** used **increasingly** in the clinical setting to provide metabolic data on cancer and additional processes [TMI2]

The instances claim the importance of the research topic. The linguistic features used to express this particular move/step include present tense verbs, be they present simple tense (*are*) or present perfect tense (*has been*), and lexical items, be they adjectives or adverbs expressing 'importance' or 'popularity' (*important, increasingly*).

Move 1, Step 2: Presenting topic generalization

(3) **Every year** a significant number of patients **undergo** medical procedures for the repair of site-specific bone traumas including nonunion fractures as well as bone abnormalities arising from musculo-skeletal diseases such as osteogenesis imperfecta. [TBM2]

(4) **A consensus statement** on physical activity among people with disabilities, by a multidisciplinary panel of experts, report that inactivity **may** occur disproportionately among people with disabilities in comparison to the general population. [TNS3]

As shown, topic generalization can be accomplished through the use of time reference (*every year*) and present tense verbs (*undergo, may*). The use of these two linguistic features indicates that the statement represents the generally known or accepted statement in the field. Therefore, reference to particular scholars is not made. While instance (4) specifies a source of generalization (*a consensus statement*), it does not refer to particular individuals because a statement is assumed to be known to, or agreed by, biomedical engineering discourse members.

Move 1, Step 3: Reviewing related literature

(5) **Previous research** on OO design metrics **has shown** some of them to be useful for predicting the fault-proneness of classes **(R).** [TSE10]

(6) **Some recent studies (R)** found strong correspondences between the diagnosis of CJD and the detection of signal abnormality in the deep grey matter… [TMI8]

As remarked by Swales (2004), the three steps of Move 1 are of increasing specificity. Compared with Step 2 of Move 1 (Presenting topic generalization), the above representative examples of Move 1, Step 3 are relatively specific, with reference to *previous research* or *some recent studies*. The presence of reference (*R*) clearly serves the function of contextualizing the study being reported, demonstrating its connections to certain previous studies. Even though Swales' 2004 model does not delineate steps of Move 1, the three steps presented above are in congruence with Swales' remark in his 2004 model that the steps of Move 1 are increasing in their specificity.

MOVE 2: ESTABLISHING A NICHE

Move 2 (Establishing a niche) serves the function of establishing a need for research. Similar to Swales' 2004 model, the analysis of biomedical RA Introductions showed that this move

consists of 3 steps as follows:

Move 2, Step 1: Research gap

(7) **Nevertheless,** a significant **drawback** of the laminar prostheses **is** their **inability** to become integrated within the host tissue leading to **low** tensile strength, placing the prosthesis at a **disadvantage** with respect to the reticular mess type(R). [BMR2]

(8) **However, whether** I_f may favor spontaneous diastolic depolarization in individual human atrial myocytes **remains** to be determined (R). [TBM8]

The instances demonstrate explicit critical comments addressing a current gap on procedures, techniques, or existing research for being inadequate or limited by using lexical items with negative connotations (*drawback, inability, low, disadvantage*) together with present tense verbs (*is, remains*). The use of contradiction connectors (*nevertheless, however*) indicates that existing knowledge bears some limitations, and thus remain to be ameliorated.

Move 2, Step 2: Continuing the tradition

(9) Therefore, it **is** necessary to **further** explore the advantages of computer aided diagnosis (CAD) techniques in the MRI clinical environment. [AOR12]

(10) Here, the implementation **is expanded** into three dimensions… [TBM10]

The presence of the current study can be motivated by the fact that the current body of knowledge is not enough and thus needs to be further investigated by additional research. As shown, the features of present tense verbs (*is*), the verb (*expand*), and the adverb (*further*) are concurrently used to express the need for continuing the same line of research.

Move 2 Step 3: Justifying the current study

(11) **Therefore,** there **is** a **pressing need** for devising ways to quantify the gait performance so that their overall performance can be quantified and monitored as a result of treatments. [TBM12]

(12) Model systems **are therefore needed** to enable systematic and quantitative analysis of cellular reactions as functions of the physical and chemical properties of different substrates. [AOR3]

This last step of Move 2 serves the function of justifying the need for the existence of the current study, specifying the expected benefits gained from the study being reported. As shown, the linguistic features of present tense verbs (*is, are*), lexical items with the meaning of demand for research (*need* as a noun and a verb), and adjectives (*pressing*) indicate that immediate attention of the topic is needed.

MOVE 3: PRESENTING THE CURRENT STUDY

Move 3 in Swales' 2004 model consists of seven steps. Some are optional and others are obligatory; some steps are found in certain disciplines only. This section of civil engineering Introductions (Kanoksilapatham 2011a, 2011b) consists of seven steps, whereas eight steps in software engineering (Kanoksilapatham 2012). Therefore, it is interesting to determine whether biomedical engineering RA Introductions conform to the steps delineated, and if so, to what extent. The analysis of the sub-dataset shows that eight steps were found in Move 3, as follows:

Move 3, Step 1: Announcing present research purposively

(13) **The objective** of **this study was** to develop and validate a numerical model for simulating the flow inside a sac-type pulsating VAD. [AOR7]

(14) **We hypothesise** that anisotripic scaffolds presenting a gradient of LN may enhance neurite extension relative to isotropic scaffolds… [BMR8]

The instances show how explicit the step is to express its communicative function of stating the objective(s) and/or hypothesis(es) of the study. Clearly, the deictic center lexical item (*this*), in conjunction with the formulaic expression *the objective* (*the objective of this study*), is used to state the objectives pertaining to this particular study. It is noted that past tense verbs (*was*) are used to indicate that the study accomplished its task of addressing the objectives/purposes. However, variation in verb tenses can be observed. As shown in (14), the verb *hypothesise* is in present tense, suggesting the contemporary nature of the article. In the same instance, the co-occurrence of the action verb *hypothesise* and the second personal pronoun *we* explicitly highlights the researchers' ownership and identity in the study being reported. As shown, this study opted to combine Swales' Steps 1 (*Announcing present research descriptively and/or purposively* and Step 2 (*Presenting research questions or hypotheses*) of Move 3 in his 2004 model together, making a combined step more powerful and reflecting a common function of stating an objective of the study.

Move 3, Step 2: Summarizing methods

(15) **In this paper,** the effects of bio fouling **are studied** in three different model gastrointestinal systems in vitro… [TBM1]

(16) The biomechanics of the TCP and its efficiency in achieving continence **were evaluated** in vitro using isolated porcine and canals. [AOR11]

As stipulated in the model, Step 2 of Move 3 (Summarizing methods) selectively presents methodological procedures. As shown, verb tenses to report methodological procedures vary a great deal (present simple tense - *are studied* and past simple - *were evaluated*). Unlike a number of academic disciplines in which methodological procedures are presented in past tense (Kanoksilapatham 2011a), the choice of tenses is flexible in biomedical engineering. In this regard, this finding substantiates Waard and Maat's 2012 finding in biological research papers. That is, it is possible to use not only past tense but also present tense to describe the method discourse segment because the interpretation of the method propositions can be clearly recognised by the co-occurrence of research activity verbs and passive constructions (e.g., *are studied* and *were evaluated*).

Move 3, Step 3: Announcing principal outcomes

(17) **In this study**, **we report** the fabrication of anisotropic 3D agarose hydrogel scaffolds with gradients of coupled LN-1… [BMR8]

(18) **In this study, we present** an integrated system that incorporates SENC to detect tissue abnormalities based on stiffness. [TBM7]

This step highlights principal findings generated from the current study. A formulaic expression *in this study* in (17) and (18), together with the second person plural pronoun (*we*), serves the function of claiming ownership. Interestingly, the use of present tense and reporting verbs (*report, present*) congruently contribute to the function of announcing the principal outcomes of the study.

Move 3, Step 4: Stating values of the present research

(19) The **novelty** of **this work is** that it establishes the feasibility of transforming a trabeculated HA scaffold into a stronger and tougher implant … [BMR5]

(20) Thus, the studies reported **represent** the **first validated** evidence that the technique is effective with three dimensional experimental data. [TBM10]

To inform discourse community members of the values of the present research, this step emphasises the practical aspect and implications of research findings. Evidently, lexical items with positive connotations (*novelty, first validated*) are used to highlight the research values. Also, the use of present tense verbs (*is, represent*) enhances the validity of the values claimed. Again, the explicit claim of ownership is made by using a phrase controlled by a demonstrative adjective (*this work*).

Move 3, Step 5: Outlining the structure of the paper

(21) The paper **is organised as follows**. The compression assessment criteria for DVT are presented in **Section II** … [TBM5]

(22) … and experiment methods and results **are given** in **Section III and IV**. [TMI5]

This step is found in certain disciplines (Swales 2004). Anthony (1999) reported the use of this step in computer science, helping direct readers to the right part of RAs, facilitating the reading task. In this step, specific sections of RAs are typically referred to (*Section II, Section III*). Present tense verbs in passive voice are also common (*are given, is organised*).

Move 3, Step 6: Justifying procedural decisions

(23) **NOA61 polyurethane** has historically been used as an optical adhesive and **was chosen for our studies based on** the limited toxicity to corneal epithelial cells and the material properties, allowing for consistent replication of nanosized features. [TGR11]

This step provides justifications for certain research activity decisions. The choice of the material (*NOA61 polyurethane, was chosen*) was justified by its inherent characteristics. The use of possessive adjective (*our*) in this move/step indicates the authors' assumed responsibility for the decision made. This particular step was not included in Swales' 2004 model. This step convinces readers that a research activity was wisely and systematically planned and implemented. In so doing, possible doubts can be clarified and eliminated, strengthening the credibility of research findings.

Move 3, Step 7: Providing definitional clarifications

(24) "**Precision" is** a measure of repeatability and shows how reproducible a measurement is; i.e., the degree of agreement between individual measurements of a set of measurements, all of the same quantity. "Precise" means repeatable or reliable, obtaining the same measurement each time. [TMI6]

This step was reported in software RA Introductions (Anthony, 1999). Similarly, this step in biomedical engineering helps readers from different and diverse backgrounds to share the common understanding of particular concepts.

Move 3, Step 8: Suggesting further research

(25) However, **further investigations are required** in order to better understand the

mechanisms of ISMS action and its effective spread in the spinal cord. [TNS7]

The last move/step found in the sub-dataset suggests that scholars are expected to contribute to their respective discourse community by offering suggestions for further research, through the use of *further investigations*. The need is reinforced by the use of the verb *require* in passive construction (*are required*) to indicate that in order to move the field forward, additional studies on the topic are indispensable.

MOVE STRUCTURE OF BIOMEDICAL ENGINEERING RA INTRODUCTIONS

The analysis reveals that the Introduction section, in congruence with previous studies on this section (Nwogu 1997, Samraj 2005), display the 1-2-3 move structure. In addition, repetition of certain moves is evident. To be precise, Moves 1 and 2 are cyclical. The frequencies of individual moves and steps are reported. The status of each move is determined and specified, based on the cut-off point of 60% of occurrence (Kanoksilapatham 2005). The move structure for this section can be summarised as follows:

TABLE 1. Move structure of biomedical engineering RA Introductions (N = 59)

Move / Step	No. of RAs	Percentage
Move 1: Establishing a territory **	59	100.00*
Step 1: Claiming centrality of the topic	44	74.58
Step 2: Presenting topic generalization	58	98.31
Step 3: Reviewing related literature	58	98.31
Move**2** : Establishing a niche **	51	86.44*
Step 1: Indicating a gap	39	76.47
Step 2: Adding to what is known	11	21.57
Step 3: Presenting positive justification	21	41.18
Move**3** : Presenting the present work	59	100.00*
Step 1: Announcing present research purposively	49	83.05
Step 2: Summarizing methods	47	79.67
Step 3: Announcing principal outcomes	27	45.76
Step 4: Stating the values of the present research	16	27.12
Step 5: Outlining the structure of the paper	6	10.17
Step 6: Justifying procedural decisions	3	5.08
Step 7: Providing definitional clarifications	1	1.69
Step 9: Suggesting further research	1	1.69
* = Conventional ** = Cyclical patterning		

As shown, Moves 1 and 3 were invariably present, whereas Move 2 was found quite frequently, with the rate of 86%. Therefore, these three moves were classified as conventional. If all moves are used, Move 1 usually begins the section, and Move 3 concludes the section, resulting in the common move structure of 1-2-3. Moves 1 and 2 are quite cyclical in nature.

At the step level of Move 1, Steps 2 and 3 were the most popular compared with Step 1. It is possible that the emphasis of this discipline on human health is widely recognised, and thus the need to state the centrality of the topic (Move 1, Step1) is not always necessary. Among the three steps of Move 2, Step 1 was quite frequent, whereas Steps 2 and 3 were infrequent. Again, the prevalence of Step 1 suggests the traditional and popular practice of identifying the gap that justifies the presence of the study.

Move 3 features as many as nine steps in this discipline. Steps 1 and 2 were quite prominent, occurring more frequently than the others. These findings indicate that biomedical engineers regard the inclusion of purposive statements and summarised methodology as quite essential in presenting a scientific study.

THE METHODS SECTION

This section usually consists of a number of subsections, sometimes with headings and sometimes without. This section has received scant attention, compared with the Introduction section, partly due to its being highly technical and straightforward. However, the analysis of this section is intriguing. Similar to the Introduction moves, each of the three moves entails a number of steps. The move structure of this section highlights the identity of the discipline of biomedical engineering. The examples, description, and characterization of these three moves (Moves 4-5-6) and their steps are as follows:

MOVE 4: DESCRIBING RESEARCH PROCEDURES

The first move usually found in the Methods section is Move 4: Describing research procedures. This move can be realised by a set of six steps which can be characterised as follows.

Move 4, Step **1***: Announcing objectives*

(26) **To determine** the impact of Zr-ACP and HAP on the stages of cell development,… [BMR3]

(27) **In order to calculate** the divergence measurement for each feature … [TMI4]

As stated by Kanoksilapatham (2011a), the linguistic features of this move/step are rather formulaic, consisting of the use of *to* or *in order to*, followed by infinitive verb form (*determine, calculate*) to serve the function of announcing the research objectives.

Move 4, Step 2: Specifying protocolised procedures

(28) Preparation of liver cells followed a slightly modified **two-step collagenase perfusion technique** originally described by xxx (**R**) for rat hepatocytes. [AOR12]

In agreement with Kanoksilapatham (2005), certain procedures in biomedical engineering are 'protocolised' (*two-step collagenase perfusion technique*), entailing a set of procedural actions. Because the details of the protocol are familiar to scholars in the field, the pertaining details are not provided. This step was not included in Swales' 2004 model.

Move 4, Step 3: Detailing methodological procedures

(29) … a 120% solution of **calcium gluconate was administered** at a dose of **1.84-2.76 mmol/h** into the **lumen** of the return line during therapy. [AOR8]

As shown, a methodological procedure is described, using past tense verbs in passive voice (*was administered*), technical terms (*calcium gluconate, lumen*), units of measurement (*mmol/h*), and numbers (*120%, 1.84-2.76*). In biomedical engineering, life is at stake; thus, precision is essential. Research activity details are described to allow replication of subsequent studies to be possible for validation purposes.

Move 4, Step 4: Providing background of procedures

(30) It **has been** shown **(R)** that for a confocal source the amplitude of the normalised PSF **can** be positive or negative, but its residual phrase is approximately zero. [TMI10]

Occasionally, certain scientific procedures are not yet established. When adopted in a research study, scholars feel obliged to safeguard themselves from possible and potential inquiries by convincing readers that the procedures adopted were carefully selected, and the

choice made was supported by previous studies. Linguistically, this move/step displays the use of citations (*R*), together with the use of present tense verbs (*has been, can*), indicating the contemporariness of the choice.

Move 4, Step 5: Justifying a procedural decision

(31) One major **advantage** of our system is that all tubes for both circuits are located on a connecting element at the left side of the cylinder **(R).** [AOR12]

Scholars in biomedical engineering might need not only provide the background of procedures but also defend why certain procedures were adopted. The word *advantage* advocated by previous scholars (through the use of citations or *R*) can provide assurance to readers that the choice is wisely made.

Move 4, Step 6: Declaring ethical statements

(32) The study received **Internal Review Board approval** and all subjects signed an **informed consent documents**. [TNS3]

This move/step is considered unique in biomedical engineering. First, it has never been reported by previous studies. Second, the reference of an organization or authority (*Internal Review Board*) imposes certain actions on research activities to be executed (e.g., seeking *approval* and *informed consent documents*). The past tense verbs (*received, signed*) suggest that these activities were completed, satisfactorily fulfilling the authority's requirements.

MOVE 5: FEATURING METHODOLOGICAL ISSUES

Another prominent move found in the Methods sub-dataset is Move 5: Featuring methodological issues. This move consists of 3 steps.

Move 5, Step **1***: Describing participants, instruments, materials*

(33) The first **participant** (S1) was a **43**-year-old male C5-6 ISCI quadriplegic classified at ASIA with **lower limb** motor score at **15/50.** [TNS2]

The description of the participant (*participant*) in this study is precise, providing the age, gender, and other physical characteristics as indicated, for instance, by the use of numbers (*43, 15/50*) and specific body parts (*lower limb*).

Move 5, Step 2: Setting apparatus

(34) Each time frame consisted of a **512 x 512 x 231** image array with a **pixel** size and slice thickness of **0.421 mm**. [TMI12]

The instance demonstrates the description of how a picture was taken by specifying the camera setting, displaying numbers (*512 x 512 x 231, 0.421*) and units of measurement (*pixel, mm*).

Move 5, Step 3: Identifying data sources

(35) The aortic valves **were obtained from Eastern** gray kangaroos **under** license **in** Queensland, **under** similar conditions. [AOR6]

As shown, a source of data is described, using the verb *obtain* in past tense and passive voice. Moreover, prepositions (*from, under, in*) together with specific names of geographical locations, environment, or surroundings (*Queensland, Eastern*) enhance the precision of the description.

MOVE 6: REPORTING AND CONSOLIDATING FINDINGS

The last move found in this section is Move 6: Reporting findings. It consists of four steps. The first step presents the findings; the other three consolidate the findings.

Move 6, Step 1: Announcing findings

(36) Grouping images by SNR, **there were 32%, 36%, 21%, and 11%** of images with SNRs near **10, 20, 30, and 40**, respectively. [TMI5]

The instance reveals how findings are presented. This step can be realised by using past tense verbs (*there were*) and numbers (*32%, 36%, 21%, and 11%, 10, 20, 30, and 40*).

Move 6, Step 2: Interpreting findings

(37) …, **indicating** no significant alteration in the hydrodynamic function of the device during the testing time. [AOR6]

The findings generated from biomedical engineering research studies can be strengthened by a number of strategies. One of them is interpreting findings, recognised by the word *indicating.*

Move 6, Step 3: Comparing findings

(38) **Similar** observations were reported by XXX, who tested bio prosthetic valves using a similar glycerine solution **(R).** [AOR6]

Comparison of findings allows the current findings to be contextualised. The linguistic features used to express this function are the adjective *similar* and reference (*R*).

Move 6, Step 4: Explaining findings

(39)This **can** be **explained** by the low signal-to-noise ration in one of the images at these extreme levels. [TBM7]

The presentation, interpretation, and comparison of findings might not be adequate in convincing readers of the credibility of findings. Certain results therefore need to be explained. The key words for this move/step include the verb *explain*, and the modal verb *can* to express a possibility of the account, giving a chance for other scholars to negate or support.

MOVE STRUCTURE OF BIOMEDICAL ENGINEERING RA METHODS

The analysis reveals that this Methods section has three moves, each with a number of steps. Table 2 summarises the schematic move structure of this section.

TABLE 2. Move structure of biomedical engineering RA Methods (N = 53)

Move / Step	No. of RAs	Percentage
Move 4: Describing research procedures **	53	100.00*
Step 1: Announcing objectives	43	81.43

Continued

Continued

Step 2: Specifying protocolised procedures	26	49.06
Step 3: Detailing methodological procedures	53	100.00
Step 4: Providing background of procedures	27	50.94
Step 5: Justifying a procedural decision	33	61.11
Step 6: Declaring ethical statements	14	26.42
Move 5: Featuring methodological issues **	27	50.94*
Step 1: Describing participants, instruments, materials	22	81.48
Step 2: Setting apparatus	11	14.81
Step 3: Identifying data sources	11	40.74
Move 6: Reporting and consolidating findings**	26	49.06*
Step 1: Announcing findings	26	100.00
Step 2: Interpreting findings	2	7.69
Step 3: Comparing findings	2	7.69
Step 4: Explaining findings	1	3.85

* = Conventional ** = Cyclical patterning

As shown, Move 4 was always present. In contrast, Moves 5 and 6 occurred at much lower rates, 51 and 49%, respectively. If all moves are used, Move 4 usually begins the section; Move 6 concludes the section, resulting in the typical move structural pattern of 4-5-6. Every move of this section can be cyclical, but mostly Moves 4 and 5.

At the step level, Move 4, Step 3 (Detailing methodological procedures) and Step 1 (Announcing objectives) were the most popular compared with other steps of this move, similar to the disciplines of biochemistry (Kanoksilapatham2005) and civil engineering (Kanoksilapatham 2011a). However, Steps 5, 4, and 2 of this move were moderately used in the sub-dataset with the occurrence frequencies ranging from 61 to 49%, indicating that a choice of a procedure might not be automatic, but carefully made by providing background (Step 4) and justifications (Step 5). Protocolised procedures (Step 2) are somewhat common in this discipline (49%), suggesting that the discipline can move on with a faster pace by briefly referring to a protocol. Finally, Step 6 (Declaring ethical statements), though with only 26% of occurrence, demonstrates that when a study involves humans, ethical statements are expected.

Move 5 was used in only 27 RAs and consists of three steps. Step 1 (Describing participants, instruments, materials) was the most frequent. Step 3 (Identifying data source), though with a moderate frequency of occurrence, is interesting, revealing that human or animal organs used in the experiment need to be described.

Finally, Move 6 usually concludes the Methods section and was used in only 26 out of 53 RAs. While Step 1 (Announcing findings) was substantially prominent of this move, the other three steps of this move are rare because they share the function of strengthening the findings, the principal function of the Discussion section. Therefore, if the last three steps of Move 6 are used, their presence is minimal.

In summary, a thorough examination of the two sections of English RAs in biomedical engineering demonstrates an organizational structure of each section. The findings reveal the prevailing patterns of the two sections. The patterns presented, though conventionalised, also allow variation both in choice and sequence of moves and linguistic features.

DISCUSSION AND CONCLUSION

This study focuses on two levels of discourse: structural organization and linguistic features. The structural patterns presented depict what constitutes the information to be included in the Introduction and Methods sections of RAs. Judging from the move structure analysis, RAs seem to be a very much gaining ground as an established genre within the ‘international’

community. The moves and sequence of moves display a shared common pattern, most notably depending on the nature of the discipline and the general function of the section.

A close analysis of the lexico-grammatical features reflects how the scholars in biomedical engineering accomplish their communicative functions in each section. For instance, the three moves of the Introduction section are linguistically diverse. Thus, a wide range of linguistic features was observed. For example, whereas the second personal pronoun and possessive adjective (*we* and *our*) are used in some move/steps of Introduction, these linguistic features are not likely to be used in the Methods section. The Methods section is thus recognised to be distant and objective, implying no interaction taking place between the researchers and the readers. For those who are not native speakers of English, juggling the use of linguistic features across the moves within a section and across sections can be a challenge. Evidently, scaffolding is necessarily needed, and as shown by this study, can be complemented by genre analysis.

The outcomes of this study can be beneficial for teachers and students of English, advanced degree students, and practitioners in any academic discipline. It can be concluded that, in addition to content informed by updated scientific experiments and linguistic knowledge--the traditional focus of an English classroom, genre knowledge is indispensable because it has become an essential tool to satisfy the demands of scholars and institutions to disseminate their findings.

In the Southeast Asian context, English as a working language is encouraged for mutual understanding. To move the region forward, each member country is trying its best to be able to compete with the others socially, economically, and academically. Academically, this study contributes to the existing knowledge about the relationship between academic disciplines and RAs. Because RAs play a crucial role in determining awards within higher education, evaluations and rankings of university have focused on academic performance indicated by the visibility of RAs produced by scholars. As a result, inequities that exist in the world of scholarly writing or scholarship particularly in developing countries will be minimised, and the scholars will become fully integrated regionally and internationally. Finally, it should be pointed out that genre is not static but constantly evolves. Thus, a genre-based academic literacy should be seen as on-going and evolving. In relevance to this, changes made at the levels of structural organization or linguistic representation can be expected.

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