**The student Laboratory Report genre: A genre analysis**

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This article provides a move analysis of the student laboratory report, a genre which is central to science and engineering study, and to which students may have had little prior exposure. Using a data set of 60 highly-graded laboratory reports from the BAWE corpus (British Academic Writing in English, Gardner and Nesi, 2013), moves are described, together with typical linguistic features. Laboratory report moves are compared with moves previously identified in empirical research articles (RAs), a genre which has the same macrostructure and also presents experimental findings. The different writer-reader relationships and different purposes in these genres (pedagogical in the laboratory report, and presenting new research in RAs) result in some significant differences in the realization of moves. The findings are potentially useful to teachers of science writing.

**Keywords: Laboratory report, move analysis, genre**

1. **Introduction**

The student laboratory report, which reports on experimental work, is the commonest written pedagogical genre for science and engineering students as reflected in the BAWE corpus (Gardner and Nesi, 2013). As with many tertiary student genres, however, not all students have experience with the genre before going to university. A study by Kalaskas (2013) found that fewer than half of his participants (p. 157) reported that high school had prepared them for writing laboratory reports. Almost all reported feelings of frustration resulting from being ‘unsure of what a lab report is, how and why it is organized the way it is, and why it matters in science in the first place’ (p. 115). This makes the laboratory report an important focus of study.

Another value in studying laboratory reports is that there are similarities between this pedagogical genre and RAs. Most notably these include macrostructural similarities; the Introduction-Method-Results-Discussion (IMRD) structure is ‘standard’ in both (although, as I discuss below, the IMRD structure is not invariable). They also have similarities in purpose, with both serving to present empirical methods and results.

However, despite similarities, the two genres also have important differences related to purpose and writer-reader relationship. RAs report on new research, and situate this work in relation to previous research. Laboratory reports, in contrast, function in student learning of experimental methods. Unlike RA writers, in reports on traditional laboratories, students are expected neither to ask their own research questions, nor design their own methodology. Instead they follow the methodology designed by their professors and provided in their laboratory manual. While RA writers write for peers, other researchers in the field, laboratory report authors write for instructors. As Kalaskas (2013) points out, the lab report functions as a pedagogical genre in which ‘the purpose of doing the report (is) a way to assess, grade, and rank students’ (p. 132). Given that Kalaskas found (p. 155) that students view grades rather than disciplinary learning as the primary reason for writing their laboratory reports, he goes so far as to claim that this pedagogical function ‘subordinates the supposedly primary goal of preparing students for entry into the discipline’ (2013, p. 132). However, although grading may be the most immediate goal for students and instructors, laboratory work and its associated writing are central in the overall design of tertiary science and engineering curricula, whose ultimate goal goes beyond the pedagogical to the preparation of scientists and engineers for the workplace. While a pedagogical purpose for laboratories and their reports was primary for the instructors interviewed by Kalaskas (2013, p.135), most instructors agreed that a purpose in apprenticing students for industry was also important.

Writing a laboratory report is not the only option for the assessment of laboratory work, so its widespread use reflects the need felt by faculty to teach student scientists and engineers the genre, showing that they view it as the appropriate way to express empirical findings. The universality of laboratory reports across experimental disciplines and the long-standing concern shown in teaching laboratories and laboratory writing demonstrates their importance. Lerner (2007) documents the interest at Amherst College in teaching laboratories and laboratory writing since the 1890s. Science education journals reflect continuing interest in ways of teaching laboratories, and in various pedagogical methods, such as the enquiry-based vs. traditional laboratories. In the enquiry-based model of laboratory teaching students are encouraged to ask questions, design experiments and interpret results, modelling the process followed by experimental scientists (Resendes, 2015; Holstein, Steinmetz and Miles 2015). By contrast, in the traditional approach, ‘students perform the activity by following a prescribed procedure’ (Domin 2007, p.141). As a result of the lower costs of the traditional approach and their greater ease of use with large groups, Domin reported as recently as 2007 that this approach remains ‘predominant’ (p.141) in laboratory instruction. Because of its continuing predominance and the resulting greater ease of accessing traditional laboratory reports, reports in this article are limited to those from traditional laboratory sessions.

The science education literature has also explored approaches to teaching laboratory writing. Examples are approaches that stress drafting and peer review (Berry and Fawkes 2010), and students writing collaboratively (Elliot and Fraiman, 2009). However, the linguistic features and rhetorical purpose of laboratory reports have not been considered in the science education literature, and the present study seeks to fill this gap.

In applied linguistics, early work on the laboratory report includes a textbook by Dudley-Evans (1985) on writing laboratory reports. In recent research, the Systemic Functional linguists Martin and Rose (2008, p. 217) place what they refer to as a procedural recount as one in a family of procedural genres. As they note, such procedural recounts tell *what happened* and are thus complementary to procedural texts that tell *how to do something*, such as laboratory manuals; these, as I discuss below, are important methodological sources for writers of laboratory reports. The focus of Martin and Rose’s discussion of this genre is on its IMRD macrostructure (e.g. p. 37), the schematic structure within each section, and language features (e.g. p. 41).

In another relevant study, Gardner (2012) compared a laboratory report and a longer project report (written at the end of the final year of undergraduate study) from the BAWE corpus. She found that the project report was more similar to the RA, in contextualising the study in the literature; by contrast the shorter laboratory report, the focus of the present study, was weighted towards methodology and results.

Another study (Moskowitz and Kellogg, 2005) suggested using RAs to teach the disciplinary conventions of science. Instead I suggest that differences in audience and purpose between laboratory reports and RAs make highly-graded student laboratory reports better models. In recent years there has been an increase in online resources based on models of good student laboratory reports. For example, the BAWE corpus has been used to provide resources on macrostructure and register features of the genre (British Council n.d.). The development at Australian Universities of similar online resources are described in Drury and Mort (2012), Mort and Drury (2012) and Clerehan et al. (2003). These are also based on good student models and also focus on the IMRD macrostructure, the schematic structure (a similar construct to the notion of rhetorical moves), and language features.

In this article I focus on the rhetorical purpose of the student laboratory report, employing a move analysis. Using the BAWE corpus (Gardner and Nesi, 2013), this article presents a move analysis of 60 highly-graded student laboratory reports in one engineering and three science disciplines. My aim is for this analysis to be useful to those teaching writing to science and engineering undergraduates. The article provides a comparison with RA moves, as reflected in published studies, in order to illuminate the differences between the two genres. The differences in purpose, audience and context between laboratory reports and RAs make it important to consider the features of the laboratory report in its own right, and suggest that ESP teachers need to be cautious when using RAs as models for their students.

1. **Genre and move analysis**

Genre is a complex and contested concept, but usually defined in terms of the purpose that users seek to achieve. For Swales (1990, p.58) a genre is employed by members of a discourse community who share particular communicative purposes; in the case of laboratory reports, this purpose is reporting on experimental work. By producing the genre, writers respond to these communicative purposes and to the ‘environment of [the genre’s] production and reception, including its historical and cultural associations’ (Swales 1990, p.46).

Miller’s (1984) influential article extends this idea of purpose to that of social purpose. For Miller, the social action that a genre accomplishes rather than the form is the defining characteristic of genre. Miller argued that recurring situations give rise to typified responses to those situations, and these typified responses, or genres, become the way we get things done in a particular social or cultural context. In the case of laboratory reports, these are motivated by the need, in the recurring situation of the undergraduate laboratory, to convince readers (the laboratory instructors) that experimental work has been carried out appropriately. The typified language and rhetorical features of laboratory reports are recognized by readers as the appropriate way to achieve this purpose.

To describe genres (usually for teaching purposes), an important method, and one valuable for genre-based writing teaching, is move analysis. Moves are ‘semantic and functional units of texts that have specific communicative purposes’ (Biber, Connor and Upton, 2007). Each move has its own purpose and contributes to the overall purposes of the text. Move length varies from less than a sentence to much longer stretches (Biber et al, 2007, p.31). Moves are identified both rhetorically (by attending to the move’s purpose) and linguistically (by attending, for example, to use of sentence connectors, tense, mood etc.). Each move can be realized by one or more steps, the alternative ways of achieving the move’s purpose.

Move analysis, pioneered by Swales (1990), has since been fruitfully employed in investigating the rhetorical moves in such diverse genres as job application letters (Henry and Roseberry, 2001), company audit reports (Flowerdew and Wan, 2010) and grant proposals (Connor, 2000). However, most attention has been on the RA, and given the similarities between laboratory reports and RAs, I begin by briefly reviewing this literature. This review, which emphasizes where possible studies of science RAs, is relevant because the macrostructure found in RAs (Abstract-Introduction-Method-Results-Discussion-Conclusion) is also found in laboratory reports.

Swales (1990) suggested a 3-move schema for article introductions, the CARS (create a research space) model. This model identifies how RA introductions establish the importance of the subject under study (Move 1), the need for the present research (Move 2), and how the author’s research will answer that need (Move 3). In her analysis of 60 Biochemistry RAs, Kanoksilapatham (2007) identified three similar moves in the Introduction; however, reflecting disciplinary variation, her steps had variations from Swales’s (1990).

Studying RA Methods sections, Lim (2006) used move analysis and interviews in analysing a corpus of twenty Business Management articles. He identified 3 moves relating to Data collection procedures, Variables measurement, and Data analysis procedures. Again, the influence of disciplinary variation is seen in the Biochemistry RA moves identified by Kanoksilapatham (2007): Describing materials, Describing experimental procedures, Detailing equipment and Describing statistical procedures. Peacock (2011) studied moves in RA Methods sections in eight disciplines, finding seven different moves, and distinct differences between the sciences and other disciplines.

Yang and Allison (2003) and Kanoksilapatham (2007) studied RA Results sections. As Yang and Allison found, Results sections function not only to report results, but also to comment on them, indicating overlap with the Discussion section. Kanoksilapatham’s analysis of Biochemistry Results sections found four moves: Restating methodological issues, Justifying Methodological issues, Announcing results and Commenting results.

RA Discussion sections, in which authors analyse findings, and make their claims to producing new knowledge, have been studied by Swales (1990), Yang and Allison (2003), Basturkmen (2012), Kanoksilapatham (2007), Hopkins and Dudley-Evans (1988), and Peacock (2002). Kanoksilapatham found four moves: Contextualising the study, Consolidating results, Stating limitations and Suggesting further research.

Conclusions do not appear to be obligatory in empirical RAs. Often the purposes of summarising the findings and stating the implications of the study are found in the Discussion. Moves found by Yang and Allison (2003) in Applied Linguistics conclusions include Summarising study, Evaluating study and Recommending further research.

RA Abstracts were considered by Lorés (2004) and Hyland (2004). Lorés found two move structures: an IMRD structure and a CARS structure. Hyland (2004) found that abstracts foreground their authors’ claims, promoting their study and stressing membership of the disciplinary community.

Although the IMRD macrostructure is considered ‘standard’ in empirical RAs, Lin and Evans (2012) found that the IMRD structure was not the most frequent RA macrostructure. Instead, in a study of 438 empirical RAs in 39 disciplines, they found separate Literature, Conclusion and joint Results-Discussion sections to be common. Similarly, Yang and Allison (2003) note the ‘influence of neighbouring sections on the organisation of individual sections’ (p.366); for example, an RA without a Conclusion was likely to include Conclusion moves in the Discussion section. In the laboratory report too, Nesi and Gardner (2012, p. 155) report macrostructural variation across the disciplines of Biology, Computer Science, Engineering, Food Science, Physics and Psychology.

1. **Method**

*The data set:*

Sixty laboratory reports from BAWE (called ‘Methodology reports’ in BAWE) were analysed including 15 reports from each of two life sciences (Biological and Food Science), one physical science (Chemistry) and one applied science (Engineering). Unfortunately the BAWE corpus does not distinguish between disciplines in Engineering, so I was not able to disambiguate these. Writers were between their first and fourth years of study (see Table 1) at four UK universities (Gardner and Nesi, 2013). To control variables, only L1 English writers were selected. BAWE assignments all received distinction or merit grades (see Table 1), equivalent to A and B grades in the US system (Nesi and Gardner, 2012). Because the analysis aimed to identify rhetorical moves in highly-graded assignments, where possible I selected distinction rather than merit assignments. These grades were assigned by ‘subject tutors’ (Nesi and Gardner, 2012, p.6), a term used in the British system ‘to include professors, teaching fellows and other academic tutors who set assignments for students’ (2012, p.18). As Nesi and Gardner (2012, p.6) state, as far as is possible, inclusion of assignments awarded these high grades maximises the chance that the assignments conform to disciplinary expectations. Where possible, assignments by different writers were selected. However, because of the size of the corpus, these choices were not always possible.

Table 1: Laboratory reports analysed

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Year of study | | | | Assignment grade | | |
|  | 1 | 2 | 3 | 4 | Distinction | Merit | Unknown |
| Biology | 7 | 6 |  | 2 | 11 | 4 |  |
| Food Science | 4 | 9 | 2 |  | 10 | 5 |  |
| Chemistry | 7 | 3 | 5 |  | 14 | 1 |  |
| Engineering | 10 | 3 |  | 2 | 11 | 2 | 2 |
| Totals | 28 | 21 | 7 | 4 | 46 | 12 | 2 |

*Coding moves:*

In conducting my analysis I followed the steps outlined in Biber et al (2007, p.34). These include determining the genre’s rhetorical purpose, determining each text segment’s function in context, grouping functional/semantic themes (the steps), piloting the analysis to fine-tune the coding schema, developing a protocol of moves and steps, coding the full set of texts with inter-rater reliability check, and revising the coding protocol.

Using as an initial guide the RA moves identified by Kanoksilapatham (2007), Swales (1990), Lim (2006), Yang and Allison (2003), and Lorés (2004), I coded the sixty laboratory reports in the data set. Macro-sections in the laboratory reports included the Abstract (also called Summary), Introduction (or Background, Literature or Theory), Methods (Experimental or Procedure), Results (Observations), Discussion and Conclusion sections.

*Interater reliability:*

To evaluate the reliability of my coding and the coding protocol, a Linguistics PhD candidate independently coded 25% of the reports. After an hour long training session, the rater coded four texts. Differences were discussed and agreement reached. The rater then coded twelve more texts. An interrater reliability analysis using the Kappa statistic was performed using an on-line calculator (Statstodo, n.d.), to determine inter-rater consistency. Cohen's Kappa Unweighted = 0.8686, SE = 0.0254, 95% CI = 0.8188 to 0.9184. This indicates ‘almost perfect’ agreement between the two raters (Viera and Garrett, 2005). Agreement between raters was calculated with regard to moves, rather than steps. Where raters coded different steps within the same move, this was accepted as agreement about what the rhetorical purpose of the text segment was, as steps are alternative realisations of the same rhetorical purpose.

*Consultation with a disciplinary informant*

To check the analysis a tutor of Physics to Engineering students was interviewed. A particular focus of the interview was my analysis of the purpose of the genre and of each move.

1. **Rhetorical moves in laboratory reports**

When asked the purpose of students writing laboratory reports, the disciplinary informant judged this to be primarily the learning of laboratory methods and equipment but also, to a limited extent, the application and reinforcement of theory. He also wanted his students to learn to process and analyse data and express this in writing. This emphasis on learning methods is reflected in the importance of methods in terms of obligatory moves (i.e. present in 80% or more reports) and proportion of words describing method, as the following discussion will show.

Before analysing rhetorical moves, I consider the macro-sections of laboratory reports, as this is important for each move and its purpose.

*Laboratory report macrostructure*

Table 2 shows that all laboratory reports have the four IMRD sections; Biology and Engineering reports typically also have an Abstract; only Engineering reports typically have a Conclusion. These differences account for the greater mean length of Engineering reports (see Table 2).

Table 2 Macro-sections and words in 60 laboratory reports

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Number of reports with each macro-section | | | | | |
|  | Total words | Mean  words/report | Abstract | Intro | Meth | Results | Disc | Concl |
| Biological Science | 20553 | 1370 | 10 | 14 | 15 | 15 | 15 | 2 |
| Food Science | 16354 | 1090 | 3 | 15 | 13 | 13 | 15 | 2 |
| Chemistry | 18139 | 1209 | 5 | 13 | 15 | 15 | 14 | 5 |
| Engineering | 23500 | 1567 | 9 | 15 | 14 | 15 | 15 | 11 |

*Moves in laboratory reports: functions, features and examples*

The 22 moves identified in the six macro-sections are outlined in Tables 3 to 8. Table 9 provides information on move frequency, highlighting five moves that are obligatory (present in 80% or more reports) and three to be usual (in 50-79% of reports). Table 9 also shows total and average word length of moves, giving insight into each move’s importance.

Table 3 details moves in laboratory report Abstract sections. In Move A1, Stating Aim, the writer provides the experiment’s overall aim. This is typically signaled by the words ‘aim’ or ‘objective’ (example b) or alternatively, ‘to’ or ‘in order to’ (example a). An important aspect of this move, shedding light on the laboratory report’s social purpose, is that although the purpose is usually stated in terms of experimental aims, example b expresses writer purpose in terms of student learning, indicating awareness of this central purpose of student experimental work. The disciplinary informant noted that he discourages expression of this pedagogical purpose, expecting a focus on experimental rather than pedagogical aims. It is interesting that the pedagogical purpose is nevertheless recognized and expressed by his students.

Move A2, Introducing topic, makes generalisations about the topic to provide context. Examples c and d show how the writers use this move to put forward a broad statement of the report topic.

Move A3, Stating method, makes a general statement about the experimental method or less frequently, about statistical or data-processing methods. Example e shows the first of these, while example f shows both purposes. Past tense is generally used, as well as passive voice. This move had the longest average word length and most words overall of any in the Abstract (see Table 9).

In Move A4, Stating result, the writer summarises the experiment’s main results. This move was usually signaled in phrases like ‘the results showed’, ‘were found/determined/identified/proved to be’ (examples g and h), and ‘it was observed that’.

Move A5, Providing Discussion, draws a conclusion or summarises the experiment’s implications (example i). Again, in recognition of the laboratory report’s purpose in teaching laboratory techniques, in a few cases, Move 5 referred to the future usefulness of the techniques learnt to the writer (example j).

Table 3: Moves in laboratory report Abstracts

|  |
| --- |
| **Abstract** |
| **Move A1 Stating aim**   1. To investigate how the boiling point of Cyclohexane varies with pressure. (BAWE6210e) 2. The aim of the practical was to illustrate and give practical learning on the principles involved in the production of clarified fruit or vegetable juice. (BAWE6023i) |
| **Move A2 Introducing topic**   1. Oximetry is an important device to monitor patients within a medical environment. (BAWE0347e) 2. The study looks at how biotic indices are used to determine the quality of water. (BAWE6013h) |
| **Move A3 Stating Method**   1. This was achieved by setting up a circuit which had resistance and inductance connected in series. (BAWE0228d) 2. This practical used the sweep netting technique to collect species in four various habitats, and then the Shannon diversity index was used to calculate the diversity of each site. (BAWE6035c) |
| **Move A4 Stating Result**   1. The chromosomal gene order was found to be thr, arg and xyl, ilv, leu, pro, his (BAWE0007a) 2. The models proved to be inaccurate and could not supply sufficient modelling of the deformations. (BAWE0249h) |
| **Move A5 Providing Discussion**   1. Through this experiment it can be seen that the Peregrine Falcons eggs had suffered the greatest reduction in eggshell thickness as a result of the introduction of DDT. (BAWE6013c) 2. It is also possible to conclude that MATLAB is a very efficient program for problems involving data modelling and visualisation, providing an excellent basis for analysis. (BAWE0341d) |

Table 4 shows the three moves in laboratory report Introduction sections, together with examples of each step. Steps in the obligatory Move I1, Establishing topic, include claiming importance (Step 1), and reviewing literature (Steps 2 and 3). Step 1 of Move I1, Claiming importance is signaled by using the word ‘important’, (examples k) or referring to real world applications(example l).

Although explicit reference to other works is sometimes provided in Laboratory report introductions (Move I1, Step 3, Referring to literature), more commonly (as Gardner (2012) found) explicit reference is omitted; instead information clearly drawn from other sources (for example students’ lectures or reading) is baldly stated without providing the origin of the information (Move I1 Step 2, Referring to known information: see examples m and n). This difference reflects the writer-reader relationship as teacher and student; a purpose of the report is that the writer display knowledge to the reader; also, an assumption may be that the reader knows where the writer got the information, or that the reader provided the information in lectures or laboratory manual. As in Step 3, Step 2 is expressed in the present tense, the tense used to express facts/accepted truths (Myers, 1989). The literature referenced in Step 3 was usually textbooks (examples o and p). This reference to textbooks, a genre that summarises for students all findings accepted by the research community (Myers, 1992), is another difference from RAs.

Move I1, Step 4, Providing diagram/graph/equation, reflects the mathematical nature of laboratory reports, particularly, in my data, those from Engineering, Chemistry, and Food Science. Diagrams and equations are not provided in full in BAWE, so I provide no example.

Move I2, Advancing hypothesis, was a relatively infrequent move that was signaled by use of words indicating prediction such as ‘hypothesis’ (see example q), ‘expect’, and ‘it is likely’ (example r).

The obligatory Move I3, Introducing experiment, includes two steps, Stating purpose, and the very frequent Describing procedures. Stating purpose was similar to Move A1, Stating aim, in that it was signaled explicitly by the use of ‘aim’, ‘goal’ or ‘purpose’ (example s) or implicitly by ‘in order to’ or ‘to’ (example t). Again, although the purpose was usually stated in research terms, occasionally writers recognized a student learning purpose. This is evident in example s, where the stated purpose is developing conceptual understanding.

Move I3, Step 2, Describing procedures, often used words such as *purpose*, *aim*, and *objective* to describe the experiment’s procedures and was often structured as lists. Either the past tense, passive voice, was used (example v), making this move similar to Move M2, Step 1 (Detailing procedures) in the Method; alternatively moves were expressed more generally using passive voice but present tense and modality, as possible procedures that can be used (example u). The frequency of this step reflects the importance of method in laboratory reports.

Table 4: Moves and steps in laboratory report Introductions

|  |
| --- |
| **Introduction** |
| **Move I1 Establishing topic** |
| Step 1: Claiming importance   1. Determining the protein composition in foods is important so that one can use the recommended intake for a group of individuals and help provide a rich source of protein. (BAWE6084a) 2. It finds many varied applications owing to its surfactant properties, for example in pharmaceuticals as a drug solubilizer. (BAWE6123i). |
| Step 2: Referring to known information   1. The most common mechanisms of genetic exchange are transformation, transduction and conjugation. (BAWE0007a) 2. The calculated values of i (the Van't Hoff factor) for each acid give an indication of the extent of dissociation of each acid. (BAWE6208c). |
| Step 3: Referring to literature   1. (Stated in Holtzapple Reece, page 550) (BAWE0198a) 2. Clonal diversity maybe maintained in a population if there is variation in relative fitnesses of clones, due to selection caused by variation in the environment (Vrijenhoek 1979; Maynard Smith 1980; Weeks & Hoffmann 1998). (BAWE6147b) |
| Step 4: Providing diagram/graph/equation |
| **Move I2: Advancing hypothesis**   1. Thus the obvious hypothesis established was that enzyme activity will be greatest in the mitochondrial fraction. (BAWE0141c) 2. So it is likely that the theoretical value of 'I' will be higher than the value calculated from experimental data. (BAWE0021a) |
| **Move I3: Introducing experiment** |
| Step 1: Stating purpose   1. The purpose of this experiment was to develop understanding of: <list>Current, voltage and power in an AC circuit […]</list> (BAWE0228d) 2. …in order to identify the genes present and predict their function (BAWE0067a) |
| Step 2: Describing procedures   1. With a knowledge of the reference beam intensity, in terms of a power, the number of incident photons can be calculated, and hence with the experimentally determined absorption, the total absorbed photons can be found. (BAWE6123h) 2. The V-notch method of determining flow rate was used because it is accurate and simple, leaving little room for human error in carrying it out. (BAWE0348e) |

Table 5 shows the three moves in laboratory report Method sections: Listing materials, Describing experimental procedures and Detailing statistical/data-analysis procedures. Move M1 often consisted merely of a list of materials and equipment (example w), or mention of deviations from the materials and equipment in the laboratory manual (example x). This move was usual in the engineering reports but optional in the other disciplines.

The role of the laboratory manual is interesting in that laboratory report writers often expected the two documents to be read together. In some cases, writers neglected to detail procedures, merely referring the reader to the manual (Move M2, Step 2, examples aa and bb). Sometimes this was the only move in the Method section. This move was evident across the four disciplines. This is another move that stresses the pedagogical purpose of student laboratory works as student learning of methods; as these methods are carefully outlined in the laboratory manual they need not be repeated by the student writer.

Move M2, Step 1, Detailing procedures, was one of the most frequent moves in the laboratory report (see Table 9). In this move, almost all writers used the past tense and passive voice (see example y). A small minority, however, used the imperative mood (see example z), writing the move as instructions, as found in the laboratory manual. This misconstrues the relationship between the student writer and professor/tutor reader. The writer’s role is to report on what they did, not to give instructions on doing the experiment. The disciplinary informant reported that some of his students initially draw on the laboratory manual as a model; this is written as instructions using imperatives. This may account for instances such as example q.

Because BAWE does not contain diagrams, no example of Move M2, Step 3, is provided. In Step 4, Providing background to procedure, the writer justifies the procedure in terms of intended outcomes (example cc) or in terms of why this procedure was selected (example dd). In Move M3, Detailing statistical/data-analysis procedures, the writer states how the data will be analysed (see example ee).

Table 5: Examples of moves and steps in laboratory report Method sections

|  |
| --- |
| **Method** |
| **Move M1: Listing materials**   1. <list>Sodium metabisulphite Ascorbic acid Citric acid (powder form) Fresh lemon juice Control (nothing added)</list> (BAWE6023i) 2. 25ml pipettes were used in place of 20ml pipettes. (BAWE0679b) |
| **Move M2 Describing experimental procedures** |
| Step 1: Detailing procedures   1. Twenty adult apterous aphids (Acyrthosiphon pisum) were placed onto bean plant cuttings at the 4-5 leaf stage. (BAWE6147b) 2. Place a pond net into the stream. (BAWE6013h) |
| Step 2: Referencing procedure in laboratory manual/other source   1. The method followed was as described in the laboratory manual. (BAWE0032b) 2. The equipment was set up as shown in fig 2 of the briefing sheet. (BAWE0228d) |
| Step 3: Illustrating procedure with diagram |
| Step 4: Providing background to procedure   1. The kicking disturbs the stream bed and the inhabitants go into the net. (BAWE6013h) 2. Chromatography is a widely used technique for separating mixtures as it is often inexpensive and can be used to generate both qualitative as well as quantitative information. (BAWE6090e) |
| **Move M3: Detailing statistical/data-analysis procedures**   1. The species diversity will then be calculated using the Shannon-Weiner diversity index. (BAWE6011i) 2. Each attribute was scored using a line scale …The line scale allows the panellist to score each of the attributes from 'zero' to 'maximum'. Analysis of variance (ANOVA) was then used to show any statistical differences between the attributes of the four samples (BAWE6085g) |

There are three moves in the Results section: Restating methodology, Announcing results, and Commenting on results. As my aim is to be useful to teachers of writing to undergraduate students, I have, in addition, provided a more elaborated model of the Reporting results step, in which Pointing to results, Displaying results, and Calculating results are separate steps from Reporting results.

Move R1, Restating methodology, has two steps. Step 1, Listing procedures, includes both a recount of procedures (example gg), or, more commonly, statement of data analysis/processing procedures (example hh). Both types use the past tense and passive voice. In Step 2, Justifying methodology, writers explained what reasoning (example ii) or constraints (example jj) prompted a particular methodology.

The four steps of the obligatory Move R2, Announcing results, all concern the reporting, displaying and calculating of results. In Step 1, the writer explicitly directs the reader’s attention to a figure or graph, in the Results section or appendix. These were either in the imperative mood (example kk) or used phrases such as ‘Table 1 shows’ or the present tense and passive voice of verbs such as ‘are listed’, ‘are displayed’, etc. (example ll). As tables, graphs, and formulae are only nominally indicated in BAWE, I provide no examples of Step 2, Displaying results, and Step 4, Calculating results.

In the highly frequent Step 3, Reporting results, the writer states in words the results that are displayed in their tables, figures and calculations. As shown in example mm, the copula ‘was’ or equivalents like ‘equals’ were common; in addition passive voice and past tense as in example nn and the second sentence of example mm were common.

In Move R3, the writer moves beyond reporting to interpret the results. In Step 1, Explaining results, the writer may give information that assists the reader in understanding displayed results (example oo) or may interpret results (example pp). In Step 2, the writer evaluates the results’ accuracy (example rr) or usefulness (example qq). The disciplinary informant stressed the importance of providing estimates of error (as in example rr) in disciplines such as Physics and Engineering.

Table 6: Examples of moves and steps in laboratory report Results sections

|  |
| --- |
| **Results** |
| **Move R1: Restating methodology**  Step 1: Listing procedures   1. Three sets of tests were performed by three patients of similar physical description: Male, age 18-20. (BAWE0347e) 2. The natural logarithm of each k value was calculated, as was 1/T. (BAWE0188a)   Step 2: Justifying methodology   1. This procedure is the fairest way of measuring the true gradient of a line of best fit through the data points. (BAWE0021a) 2. Young's modulus would also normally be calculated, but there is no gauge length to calculate the strain so Young's modulus cannot be calculated. (BAWE3090a) |
| **Move R2: Announcing results** |
| Step 1: Pointing to results   1. Refer to printed excel spreadsheets. (BAWE6035c) 2. Species are listed in table 1.0. (BAWE6007f) - |
| Step 2: Displaying results (figure, table, graph) |
| Step 3: Reporting results   1. Our re-crystallised product was a white solid. It was found to have a melting point in the range of 110 - 114oC. (BAWE6207b) 2. Table 4: The rate of ATP in hydrolysis in isolated CF 1 is greatly reduced by the presence of Tentoxin (79%) in comparison with that of the control. (BAWEB0265e)   Step 4: Calculating results/Stating Chemical equation |
| **Move R3: Commenting on results** |
| Step 1: Explaining results   1. Both speeds have been illustrated on the same graph, due to the fact that there are 4 sets of points, compared to 6 in the performance characteristics graphs. (BAWE0329e). 2. The TLC plate clearly shows that the reaction still contains the starting materials. (BAWE0382b) |
| Step 2: Evaluating results   1. The models proved to be so inaccurate that estimations could not be made rendering the models useless. (BAWE0249h) 2. An estimate of the accuracy of the figures in the table can be made using the estimates of the error in the individually measured quantities in section 6.2. Errors in equation (6) are <list>'s' ± 0.5%'r' ± 1.6% (therefore r 2 implies error 1.6 2 = 2.56%)'t' ± 3.75% (therefore t 2 implies error 3.75 2 = 14%)</list> With these, the uncertainty in the gradient can be estimated as the sum of the errors of its erroneous constituents. i.e. 0.5% + 2.56% + 14 = ± 17.06%. Hence a reasonable estimate of the error in the moment of inertia calculated from experimental data is ±17%. |

Table 7 shows the four Discussion section moves. These four moves are inter-related (see Figure 1), and function together in interpreting the results, explaining results in the light of known information, in the light of how the experiment was carried out, and drawing conclusions from them.

|  |  |
| --- | --- |
| Move D2, Step 1 Restating methodology | The thermal efficiency values for water and milk were calculated. |
| Move D1 Contextualising discussion | This is also known as the regeneration efficiency and calculates how efficient a machine is at regenerating the energy. |
| Move D2, Step 2, Stating selected findings | For water the TE value was 80.8%, much higher than the TE for milk which was 65.3%. |
|  | […] |
| Move D2, Step 3, Interpreting results | The differences for the two liquids are not the same because water remains at a constant volume so the heat transfer for the two stages is also constant, while the volume of milk is reduced so there is a difference. |
| Move D2, Step 6 Accounting for (un)expected/ unsatisfactory results | This is expected as milk has components which will restrict volumetric flow rate compared with pure water.  […] |
| Move D3, Stating limitations | The Brookfield viscometer does not give particularly accurate results and this was discovered while taking the measurements. |
| Move D4, Making suggestions for improvements | On reflection it appears that a spindle type 1 should possibly have been used for the first few readings of each sample to give a higher reading as the majority were very low and made it very difficult to read. |

Figure 1: The inter-relatedness of steps in the Discussion section (extract from BAWE6004e).

Move D1, Contextualising Discussion, demonstrates to the reader the writer’s familiarity with the theory and ability to explain their results in the light of the theory. The disciplinary informant noted his students’ desire to ensure that their results are in line with the expectations of theory. Move D1 is illustrated in Figure 1 and in example ss. Like Move I1, Steps 2 and 3 in the introduction, it usually employs the present tense, signaling factual information.

The obligatory Move D2, Interpreting results, is the most frequent move in the corpus, suggesting that this purpose is central to the Discussion section. It is realized in 8 steps; usually there are more than one of these, typically in recycled sequences of steps, especially Steps 2 (Stating selected findings) and 3 (Interpreting results). Step 2, usually using the past tense, refers to a specific measurement (example uu), while step 3, usually using the present tense explains what measurements mean, or places them in a broader context (see Figure 1 and example vv). This shift from past to present tense indicates a shift from describing a time-bound incident in the past to explaining it in terms of timeless scientific principles.

In Step 1, Restating methodology, the writer reminds the reader of elements of the methodology which are pertinent to the interpretation of the results (see Figure 1 and example tt). As in the Detailing procedure move in the Method section, the passive voice and past tense are invariably used.

In Step 4, Comparing results with literature (example ww), writers evaluate their findings by comparing them with published values. Step 6 (see Figure 1 and example xx) similarly evaluates how expected a result is and tries to account for any deviations. Modals ‘could’ ‘would’, ‘must have’, ‘should have’ and ‘may be’ as well as conditionals, such as ‘if’ and causal connectors such as ‘because’ are common in this step .

In Step 7, Substantiating results, the writer provides supporting evidence for their interpretation (example yy, Table 7), or reassures the reader that the method was reliably executed (example zz). Based on the results and the writer’s interpretation, Step 8 comes to an overall conclusion on the experiment (examples aaa and bbb). This step typically uses the present tense, reflecting the writer’s attitude that their finding aligns with accepted scientific principles (Myers 1989).

Moves D3 (illustrated in Figure 1 and example ccc) and D4 (see Figure 1 and example ddd) are also often recycled. Writers used Move D3, Stating limitations, to note any problems with methodology, results, or sources of error/uncertainty; in Move D4, Making suggestions for improvements, writers make suggestions for how to redress these limitations. Both these moves serve to show the reader that the writer can evaluate their work’s accuracy and reliability, is aware of limitations and has given thought to solving them.

Table 7: Examples of moves and steps in laboratory report Discussion sections

|  |
| --- |
| **Discussion** |
| **Move D1: Contextualising discussion**   1. Troutons rule states that for most un-associated liquids, ΔHvap is roughly independent of temperature. (BAWE6210e). |
| **Move D2: Interpreting results** |
| Step 1: Restating methodology   1. However, the enzyme and other clarifiers were not tested together. (BAWE6023i) |
| Step 2: Stating selected findings   1. Polymer 5B had the smaller rate constant of 0.000412 compared to Polymer 5A which had a rate constant of 0.000536. (BAWE0382a) |
| Step 3: Interpreting results   1. A general trend shows that as the test temperature increases the fracture energy increases. From observation of the broken samples it can be said that brittle fracture occurred. (BAWE6159i) |
| Step 4: Comparing results with literature   1. This value is slightly lower than the value given by R. Stone which quotes a maximum bmep value of 11.2 bar at 3500 rev/min. (BAWE3091a) |
| Step 5: Displaying figure/table/graph/equation |
| Step 6: Accounting for (un)expected/ unsatisfactory results   1. The major inaccuracy in this experiment may be due to the reagents (such as benzyl alcohol) are prone to breaking down over a period of time when heated. (BAWE0188a) |
| Step 7: Substantiating results   1. This homology was confirmed by the MACAW alignment, the resulting schematic of which is below (BAWE0067a) 2. The samples were also randomly numbered and any markings on the chocolate had been removed. This again ensures no favouritism is given to a specific sample. (BAWE6085g) |
| Step 8: Making claims/Drawing conclusions   1. The results gained from this experiment show that Falcons are more sensitive to DDT than Sparrow Hawks. (BAWE6013c) 2. Thus, one would be tempted to say that the Weighed Diet Diary is one of the best, if not the best, method for assessing a subjects' diet. (BAWE6156d) |
| **Move D3: Stating limitations**   1. There are also some possible sources of systematic error in this experiment… For example, there was one calibration error noticed on the Venturi Manometer when measuring for speeds of 3000rpm. (BAWE0329e) |
| **Move D4: Making suggestions for improvements**   1. If the experiment were conducted again more spots would be placed on each plate, thus giving more data, also observations would be made at regular time intervals and for a longer complete time. Tests should also be conducted to ensure that the bacteria are starved and are likely to form flagella. (BAWE0043c) |

The final section of the laboratory report is present in only 20% of the reports (see Table 9), this section being more usually combined with the Discussion section. The Conclusion appeared most frequently in the Engineering laboratory reports. The purposes served by Moves C2, C3 and C4 in the Conclusion are identical to the purposes of Move D2, Step 8, Move D3 and Move D4, and therefore examples are not provided. In Move C1, the writer summarises the study (see Table 8, example eee).

Table 8: Examples of moves and steps in laboratory report Conclusions

|  |
| --- |
| **Conclusion** |
| **Move C1: Summarising study**   1. This report has provided an insight into how a PC based control system can be used to gather engine performance data. The data collected by the CADET system for the Rover K16 engine gives a detailed insight into the engines performance characteristics. (BAWE3091a) |
| **Move C2: Drawing conclusions/Making claims** |
| **Move C3: Noting limitations** |
| **Move C4: Suggesting further investigation/improvement** |

Tables 3 to 8 show that there is overlap between macro-sections. This is particularly the case between the Discussion and Conclusion, with 3 of the 4 Conclusion moves being found also in the Discussion. However this overlap is also found between Introduction and Method, with Move I3 Step 2 (Describing procedure) in the Introduction having overlap with Move M2 Step 1 (Detailing Procedure) in the Method. The difference here is the specificity of these moves, with Move M2, Step 2 being more specific to the report’s experiment than Move I3 Step 2. Overlap is also found between Results and Discussion, in that Move M2 Step 3 and Move D2 Step 2 both have a Reporting results move; similarly Move R3 Step 1 and Move D2 Step 3 both have an Interpreting results move.

This overlap between Introduction and Methods may partly be a result of the sketchiness of some Methods sections, which may merely refer the reader to the practical manual, with Methods moves common in the Introduction. Similarly, Results sections may be limited to graphs or tables, making ‘reporting results’ moves usual in the Discussion.

1. **Quantitative Results**

Just as no macro-section was found in all 60 reports, there was no move found in all reports. Thus, in the discussion that follows I treat moves that appear in 80% or more of reports as virtually obligatory. Those present in more than 50% (but less than 80%) I regard as usual, while those in less than 50% of reports I treat as optional.

Obligatory moves are the five bolded ones in Table 9. Each corresponds to the core function of the macro-section in which it occurs. The first two obligatory moves (Move I1, Establishing topic; Move I3, Introducing experiment) are in the Introduction. They perform the core function of the Introduction by introducing theory that will be relied upon in reporting on the experiment (Move I1), and introducing methodology that will be used to do it (Move I3). The most frequent step in Move I1 is Step 2 (Referring to known information). It is a long move, averaging 57 words, and taken together with the far less frequent but functionally identical Step 3 (Referring to literature), makes up 10% of the 60 laboratory reports. Move I3 is realized by two steps, Stating purpose and Describing procedures. Like Move M2, Step 1 in the Method section, Describing procedures is a long move (averaging 54 words).

The third obligatory move, Move M2, Describing experimental procedures, performs the Method section’s core purpose. It is realized by four steps: Detailing procedures; Referencing procedure; Illustrating procedure; Providing background to procedure. Of these, Detailing procedures is greatly the most prominent, accounting for 16% of the total words in the 60 reports, and having the longest mean word length of all steps: 86 words. Clearly, explaining what was done in the experiment and how it was done is a key purpose of the Method section and of the laboratory report as a whole.

In the fourth obligatory move, Move R2 (Announcing results), I have distinguished four steps including Pointing to, Displaying, Reporting and Calculating results. In this move the writer paves the way for the analysis of the results which takes place largely in the Discussion section.

The fifth obligatory move (Move D2, Interpreting results) accounts for 26% of words in the data set. It is a complex move with eight possible steps. As noted above in my discussion of Figure 1, these steps typically occur together and are recycled several times. I will discuss the four most frequent of these. The first of these four steps is Step 2, Stating selected findings; this purpose is usually achieved briefly (mean length 25 words). This step is virtually identical to Move R2, Step 3 (Reporting results) in the Results section; in it the writer returns to a finding, usually already reported in the Results section, for the purposes of discussing it further. This step is likely to be used together with Step 3, Interpreting results, and Step 6, Accounting for (un)expected results. In these, the writer explains at more length (mean lengths 44 words and 43 words) what the results imply, and why they are/are not what was expected in theory. In step 8, Making claims/Drawing conclusions, a less frequent move, the writer draws a conclusion based on this discussion.

A further three moves (underlined in Table 9) I categorize as usual moves in that they occur in more than 50% of reports. Firstly, Move R3, Commenting on results, is similar to Move D2, Step 3 Interpreting results, but situated in the Results section. In the second usual move, Move D1, Contextualising discussion, the writer draws on relevant theory that may have already been explained at greater length in the Introduction section. In the final usual move, Move D3, Stating limitations, the writer considers limitations of the method or results.

Table 9: Moves and Steps in laboratory reports

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | % reports with at least 1 occurrence | | | | |  | N in data set | Mean word length | Total words |
| Biol | Food | Chem | Engin | Total |  |
| Abstract | 67 | 20 | 33 | 60 | 45 |  |  |  |  |
| Move A1 Stating aim | 40 | 20 | 33 | 53 | 37 |  | 20 | 25 | 495 |
| Move A2 Introducing topic | 33 | 0 | 7 | 27 | 17 |  | 13 | 34 | 448 |
| Move A3 Stating Method | 47 | 7 | 7 | 60 | 30 |  | 23 | 47 | 1081 |
| Move A4 Stating Result | 53 | 0 | 7 | 40 | 25 |  | 16 | 28 | 455 |
| Move A5 Providing Discussion | 47 | 0 | 0 | 33 | 20 |  | 12 | 38 | 457 |
| **Introduction** | 93 | 100 | 87 | 100 | 95 |  |  |  |  |
| **Move** I**1 Establishing topic** | **80** | **60** | **87** | **93** | **80** |  | **219** | **45** | **9856** |
| Move I2: Advancing hypothesis | 27 | 0 | 0 | 13 | 10 |  | 7 | 34 | 237 |
| **Move** I**3: Introducing experiment** | **93** | **93** | **60** | **93** | **85** |  | **153** | **20** | **3117** |
| **Method** | 100 | 87 | 100 | 93 | 95 |  |  |  |  |
| Move M1: Listing materials | 20 | 20 | 27 | 67 | 33 |  | 22 | 20 | 449 |
| **Move M2 Describing experimental procedures** | **100** | **73** | **93** | **93** | **90** |  | **227** | **60** | **13582** |
| Move M3: Detailing statistical/data-analysis procedures | 40 | 27 | 20 | 47 | 33 |  | 29 | 39 | 1129 |
| **Results** | 100 | 87 | 100 | 100 | 97 |  |  |  |  |
| Move R1: Restating methodolgy | 40 | 27 | 53 | 53 | 43 |  | 52 | 29 | 1485 |
| **Move R2: Announcing results** | **100** | **87** | **100** | **100** | **97** |  | **174** | **20** | **3504** |
| Move R3: Commenting on results | 67 | 27 | 60 | 60 | 54 |  | 93 | 39 | 3598 |
| **Discussion** | 100 | 100 | 93 | 100 | 98 |  |  |  |  |
| Move D1: Contextualising Discussion | 60 | 93 | 47 | 47 | 63 |  | 104 | 25 | 2604 |
| **Move D2: Interpreting results** | **100** | **100** | **93** | **93** | **97** |  | **610** | **32** | **19691** |
| Move D3: Stating limitations | 53 | 73 | 33 | 53 | 53 |  | 69 | 37 | 2555 |
| Move D4: Making suggestions for improvements | 47 | 73 | 40 | 47 | 52 |  | 54 | 37 | 1994 |
| Conclusion | 13 | 13 | 33 | 73 | 33 |  |  |  |  |
| Move C1: Summarising study | 7 | 7 | 20 | 47 | 20 |  | 16 | 39 | 617 |
| Move C2: Drawing conclusions/Making claims | 13 | 7 | 13 | 60 | 23 |  | 16 | 41 | 661 |
| Move C3: Noting limitations | 7 | 7 | 7 | 47 | 17 |  | 12 | 31 | 366 |
| Move C4: Suggesting further investigation/improvement | 7 | 0 | 7 | 20 | 8 |  | 6 | 21 | 127 |

Counts in Table 9 exclude moves concerning tables, figures or calculations, as BAWE includes these only nominally.

As the above discussion shows, the four core functions of laboratory reports – introducing theory, detailing methods, reporting results and interpreting results – appear primarily, but not solely in the four IMDR macro-sections. The first core function - introducing theory – appears in both Introduction and Discussion sections. The second core function - detailing methods – appears in all four IMRD sections. It is rehearsed at some length in the Introduction, in greater detail in the Method, and is touched on again in the Results and Discussion sections. Both reporting and interpreting results functions appear in both Results and Discussion sections.

Table 9 also shows some suggestive differences between the four disciplines, although not the expected life vs. physical sciences split. Differences include the greater incidence of the abstract in Biology and Engineering, and of the conclusion in Engineering. Moves R1 and R3 in the Results sections were only optional in Food Science, while more frequent in the other three disciplines. Move I1 was similarly usual in Food Science, but obligatory in the other three disciplines. On the other hand, Move D1 was obligatory in Food Science, usual in Biology and optional in Chemistry and Engineering. Given the size of the data sets, no firm conclusions about differences between disciplines can be drawn. Further research into such differences would be useful.

1. **Conclusion**

I argue above that differences in purpose, audience and context between the RA and laboratory report make good student examples better models than RAs for undergraduate science students. Below I consider some of the differences between the two genres consequent on these differences in purpose and audience, before discussing a genre-based approach to teaching the laboratory report.

Laboratory reports and RAs have significant similarities in macrostructure, but also significant differences pointing to the genres’ different social and communicative purposes. A first difference is the recognition by writers in Move A1 (Stating Aim), Move A5 (Providing Discussion), and Move I3 Step 1 (Stating purpose) that the laboratory report has a dual purpose: reporting the results of the present experiment and also student learning. The second of these is absent from RAs, and the first, while present in the RA, is more complex in requiring a purpose related to a gap or new findings. Another difference between RA and Laboratory report Abstracts is that Move A3, Stating Method, had the longest average word length of any in the Abstract. This suggests the importance in laboratory reports of describing method over making claims, which Hyland (2004) found to be prominent in RAs.

In its Introduction, although the laboratory report covers a similar three steps to the RA, it performs different rhetorical work in the sense that, because the writer of reports on traditional laboratories has been told, usually by the reader, what experiment to do and how to do it, so the writer has little need to establish or occupy a niche or gap. This is reflected in the low frequency of Move I2, Advancing hypothesis, which is the single step showing any similarity to Swales’s (1990) Move 2, Establishing a niche. The only similarity between Move I3, Introducing experiment and Swales’s Move 3, Occupying the niche, is the Stating purpose function. Moves announcing present research, announcing principal findings (found by Swales (1990) and Kanoksilapatham (2007)), and indicating structure were almost absent from the laboratory reports in the study.

Another important genre difference is the literature referred to, and the way that this reference is made. RAs refer almost exclusively to other RAs, and follow strict conventions for crediting them. Writers of laboratory reports refer largely to textbooks and laboratory manuals; typically this information is unreferenced. This difference distinguishes the RA writer’s view of the literature as other researchers’ knowledge claims, which must be critically assessed, as well as credited to those researchers. Writers of laboratory reports in contrast regard the information they use from other sources as accepted knowledge (Myers, 1992) that they can use to understand concepts and analyse findings of their experimental work.

The intertextual role of the laboratory manual is important in pointing to the pedagogical nature of the laboratory report. Students sometimes omit the Method section altogether, apart from a brief reference to the experiment being performed as outlined in the laboratory manual. Their assumption may be that the reader is very familiar with the laboratory manual, possibly its author, and is at least able to refer to it. Indeed the reader is likely to have designed the methodology; all this suggests laboratory work’s purpose as student learning of experimental techniques.

The differences in Results sections between RAs and reports on traditional laboratories, including omission of research questions or hypotheses, is partly a reflection of length and complexity, but also of difference in purpose. The experimental work laboratory report has been designed by the teacher for the purpose of student learning of laboratory techniques, thus distinct from the central aim of RAs in testing hypotheses and producing new knowledge.

The Discussion section of laboratory reports shows similarity with Discussions in RAs. Both have moves functioning in contextualising, interpreting, stating limitations, and suggesting improvements. In both, the moves and steps in the Discussion are inter-related and are recycled to achieve the purpose of interpreting and explaining the results and showing awareness of sources of error or limitation. One difference is that in RAs, the contextualizing move of the Discussion functions to show how the writer is extending and building on others’ work. In laboratory reports, in contrast, the contextualising move (D1) demonstrates to the reader the writer’s ability to explain their results in the light of the theory. As Yang and Allison found in RAs, there is overlap in the laboratory report between Discussion and Conclusion.

My goal in presenting this analysis of what successful students do in their laboratory reports is to provide useful information for science and technology writing teachers (see also Parkinson, in press). This description of moves in laboratory reports, their typical length, frequency, and difference from RAs, and the typical realization of each move can guide writing teachers in assisting students to analyse the features of Laboratory report exemplars and produce their own reports. Such work is particularly useful to non-native speakers. In addition to focusing on move structure such analytical work should ideally also concern language features such as those pointed out in my discussion of moves above.

One example of teaching the move structure is Cheng’s (2008) use of genre analysis tasks to sensitise graduate students to the move structure of RAs in their fields. Responding to work done on move analysis in class, students read and responded to the genre structure of assigned sections of particular RAs. Cheng analyses how one student writer followed a pattern of *naming a move → outlining its content→ defining its purpose(s) → analysing language features/discipline-specific practices in the move*.

Peacock (2011) suggests teaching move structure using the following sequence. Firstly he suggests introducing students to the concepts of moves; then telling students the names of moves; telling students the function of each move; providing examples of moves; noting that moves may be recycled; and finally showing students sample texts as models, firstly with the moves marked and then without marked moves.

To teach the language features of particular genres, Swales and Feak (2004) give attention to the tense typically used to express certain meanings, for example expressing purpose (2004, p.263) or citing literature (2004, p.254). In my own teaching of the laboratory report I provide students with an exemplar of a section of a report with the tense and mood of verbs highlighted. During class discussion students are able to note patterns across the report: for example the use of the past tense and passive voice in the Method section. Students then identify tense and mood in another text before writing their own texts. Swales and Feak also suggest a focus on typical realisations of a move (e.g. p.250). Drawing on the above analysis, a teacher could use examples a and b (Table 3) to suggest the typical realisation of Move 1, Stating aim, in phrases such as ‘the aim of the practical was…’ and ‘In order to…’.

Laboratory work, and by extension, laboratory writing, are focal sites of development of knowledge, skills and an empirical way of thinking for science and engineering students. Laboratory work provides access for students to their chosen communities. Both the similarities and the differences between laboratory reports and RAs are important and useful for student writers. The similarities in macrostructure and register between the laboratory report and RA are a step toward discourse community membership for students, while differences in purpose, such as the pedagogical purpose of laboratory reports and the announcing of new knowledge in RAs are functional for student development.

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