The Foreign Language Engineering Writer - What Makes a Readable Report?

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Abstract - Writing in a foreign language brings its own set of complex difficulties, not least that the structure, notions and productive skills required by different genres are commonly often not understood by writers writing in their native languages. They have to be taught.

The purpose of this exploratory research is to analyze some of the linguistic and organizational elements of a typical degree-level document (memo report) produced in one of the engineering programmes at the Petroleum Institute in Abu Dhabi, UAE with a view to describing some salient features which contribute to its level of ‘success’ (readability) as judged by the subject teacher grading the document.

Texts were analyzed according to specified linguistic features and use, style and organization. Successful application of these features was a factor in the response of the content teacher to the quality of the report.

Recommendations are made as to how the readability of such documents might be improved by better preparing students to produce them, in particular by developing a better understanding of the relevant genre.

Index Terms – Writing, engineering, foreign language, grammar, lexis, text moves.

BACKGROUND

The Abu Dhabi National Oil Company (ADNOC) operates in all areas of the oil and gas industry. It was established in 1971 and has steadily widened its endeavors through its subsidiaries, establishing an integrated oil and gas industry in Abu Dhabi. The Company manages and oversees oil production of over two million barrels a day and is among the top ten oil and gas companies in the world.

ADNOC established the Petroleum Institute six years ago. The Institute offers five baccalaureate degree programs: chemical engineering, petroleum engineering, petroleum geosciences engineering, mechanical engineering and electrical engineering. As the undergraduate programs mature, the Petroleum Institute will eventually evolve into a fully-fledged research and educational institution providing programs leading to Master of Science and Doctor of Philosophy degrees. Our students are at the undergraduate age, Emirati and ex-patriot males and females. English is the medium of instruction as well as the operating language of the oil and gas industry in this region. This implies a range of issues for the students; not least that writing is perhaps the most complex and difficult (as well as the least liked and most ‘painfully’ acquired) academic skill, particularly for those studying or working in a foreign language.

RESEARCH BACKGROUND

Subject teachers in the degree programmes had expressed dissatisfaction with the readability of student writing from a language perspective. In the light of the above, an exploratory research project was formulated to develop an analysis and description of some of the dominant features (language, organization, and style) of one commonly produced text (memo report). Such a descriptive model could then inform thinking about how to better prepare students to produce effective texts and implications for teaching and curriculum could be articulated.

Our graduate profile includes the following:

- The graduating student will appreciate the critical role played by verbal, written and graphical communications in engineering practice and project management, and will have the corresponding skills to communicate with a range of audiences, and the skills to employ information technologies where appropriate.

To meet this objective, we have a commitment to provide on-going language and communications support to students in our degree programs. Some of these students inevitably encounter a range of problems with written text. This would be true in a native-speaker environment and becomes more significant where students are studying in a foreign language. Further, within the company, (all of our graduates will work for ADNOC) mastery of (English) language and communications skills constitutes part of the performance review of employees. Production of effective written documentation is therefore significant. The Communication Department had been requested to become involved in providing language support to the Institute’s degree programmes as a result of concerns expressed about the quality of the writing of some of the students. Individual teachers were assigned to specific programmes.
researcher worked within the Department of Chemical Engineering.

LITERATURE REVIEW

The field of English for Specific Purposes has grown exponentially from its origins in the 1960s, as English has increasingly become the lingua franca of international communications. This growth is especially notable in the context of education and commerce. Linguists have shown an understandable interest in analyzing the texts commonly produced in these different environments. From its inception rooted in register [1], the linguistic analysis of ESP texts has broadened to include syntactic choices, pragmatics and elements of text organization and structure. Since texts are interactive with a relationship between writer and audience revolving around the communicative purpose of the writer, chosen genre and expectations of the reader, (amongst other things) we require a wide range of tools for their analysis. This is particularly true if our description is motivated by the desire to act on this analysis in order to improve writer awareness, teaching and curriculum and syllabus design [2] as is the case in this paper.

Clarke [3] indicated that while students may be required to write in a particular fashion they are not always clear what this should be and why. The need for pragmatic approaches which include reader expectations is therefore well established [4]. Dudley-Evans’ work on genre analysis [5], [6] is particularly significant in this area and takes a rather pragmatic approach which is also accessible to learners. This is doubly important in our environment since we are dealing with foreign language users and much of the research looks at native English speakers. For example, the concept of a ‘move’ (basically the relationship between grammar and communicative purpose) [6] in the context of the discussion section of a report is one which is not difficult for (foreign language sic) students to grasp and permits a functional analysis of their own texts which can be of significant use in a drafting process. This has informed part of the current work.

The development of an analytical framework for use by a variety of constituents including teachers and students therefore requires the question of linguistic analysis of text to be approached from a functional perspective. For example, nominalization is more functional in a science text than in everyday conversation and therefore the choice of using a nominal group (= noun-phrase), rather than a clause, to express a semantic process is more ‘natural’ to the text. The noun phrase is already a widely researched area of linguistic enquiry. Infinitive clauses are less well researched.

The various realizations of noun phrases were marked and enumerated. Complex noun phrases were broken down into their noun phrase components, since counting them singularly and in their entirety would, in a sense, ‘penalize’ the more sophisticated writer. The second feature looked at was the infinitive clause as an analysis of the reports revealed that this was a significant feature of the purpose and process elements of the report.

Further, comments are made concerning lexical items. As Halliday [10] has pointed out: “Typically, written language becomes complex by being lexically dense: it packs a large number of lexical items into each clause; whereas spoken language becomes complex by being grammatically intricate...” These lexical items are not the field-specific items, as this range of lexis tends to be high frequency and...

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The academic writing process lends itself to reflection and explicit learning in a way that speaking does not, primarily because it is “a highly self conscious, reflective, non spontaneous activity” [8] within which there is a natural opportunity to analyze. A broad functional description of texts as this study begins to do, may therefore more adequately meet the needs of teachers and students to engage in this reflection and ultimately produce more effective texts.

PROCESS

Texts from a class in the Chemical Engineering programme were used to build a corpus for analysis. The students are in the first year of the degree programme and have attained a 500+ in the TOEFL. Our primary concern is not to generate a large quantity of numerical data, but rather to describe qualitative elements of text and though the sample is not a large one, it is sufficient for some primary conclusions and to provide the basis for further investigation [9].

We took the view that the primary reader of the text (audience) should be the major judge of the success of that text. The students are involved in a degree program and their immediate clients are their teachers. Further, these readers are a key element of the discourse community to which the text and writer belong. [5]

We were guided by the grade and perception of the subject teachers as to the notion of ‘excellent’ and ‘poor’ (quality). This would give us a standard of acceptability in their context and allow us to describe features of the optimum text and sub-optimum texts within that context. Initially a range of eleven texts were collected to use as a corpus for the analysis. Five of these were selected for linguistic analysis of noun phrases. A further six texts were used for analysis of infinitive clauses and text moves.

Criteria for evaluation are described below.

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Notions of quantity (appropriate text length) quality (variety of grammar and vocabulary), accuracy (freedom from error) and appropriateness (the right grammar in the right place) were employed as ‘broad-stroke’ criteria.

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known. Rather, it is the discourse vocabulary which tends to be problematic. This sub-technical vocabulary [11], [12], [13], [14] is important as it is not field specific and according to King, “it is often overlooked by teachers and is a cause of problems for students” [15]. Such language can be marked for sectional relevance in different text types. For example, as stated, the infinitive clause is a high frequency feature in the process/method section of the report, and often exemplifies such vocabulary.

As previously stated, the analysis had to be more than simply linguistic and therefore a description of the ‘culture’ of the collated texts was agreed through analysis of the documents and discussion with content teachers as to their expectations of how the reports should look. This meant the:

- Format and conventions
- Structure
- Organization

Each section of each text was then described in terms of expected content load (information) and purpose. A general description was given of dominant linguistic features. Further description was given in the case of infinitive clauses as to how these function in the context of moves within the purpose and method section of the reports. An example is displayed in Fig 1 below.

<table>
<thead>
<tr>
<th>Sectional moves</th>
<th>Objectives (purpose)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State the purpose of the experiment.</td>
</tr>
<tr>
<td></td>
<td>to determine the density of fluid samples.</td>
</tr>
<tr>
<td></td>
<td>densities are used later to find the specific gravity of the fluids.</td>
</tr>
<tr>
<td></td>
<td>...the API gravity which is important to determine oil prices.</td>
</tr>
<tr>
<td></td>
<td>...a model can be designed for reservoir fluids to predict......</td>
</tr>
</tbody>
</table>

**FIGURE 1**

TEXT MOVES EXCERPT

Such a description could be carried out with a range of linguistic features. This would result in a model encompassing a comprehensive description of texts from the different perspectives described.

A writer profile was also created. This is significant in our environment as we have students entering from quite varied backgrounds. Some are direct entry and others have come through various stages of our foundation programme. All have achieved a 500+ on the TEOFL. Such a profile can be used in making curriculum and administrative recommendations such as initiatives relating to grouping students for specific language focus work. It would also allow us to track changes in student writing over time and thereby give valuable institutional research information and which could inform syllabus changes.

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RESULTS AND DISCUSSION

Of the significance of the items identified for analysis and the approach, we would claim the following. The ‘excellent’ text was noticeably longer than its counterparts (899 words). Even though these are memo reports, they cannot be successful if text length is compromised. Features such as variety and frequency are clearly undermined by a reduced text. There was a significantly higher percentage (almost double) of words in noun phrases between the ‘excellent’ and ‘very good’ text. Well formed simple and complex noun phrases were above 98% in the former, falling to 88% in the latter in a considerably shorter text.

An example containing no syntactic (grammar) errors from this text is given below in Fig. 2. The quality is typical of the text.

The program consists of many components, and each contributes to the final outcome. The first step is to test that the temperature chosen is between the Dew Point and the Boiling point to ensure that the system still consists of two states.

**FIGURE 2**

The ‘poor’ text has the fewest number of words (339) and is therefore likelier to contain a higher proportion of noun phrases of some kind; forty three simple noun phrases in this case. The proportion of complex to simple noun phrases is higher at the top end (81/32) and lower at the bottom (43/10).

A typical example with error from this text is given below in Fig 3 below.

The purpose of this project is to apply the analysis of flashing separator in order to take account of heat responsibility in a heat exchanger, so it will provide support the energy necessary so can operate the separator at steady state.

**FIGURE 3**

The general trend across the five texts is almost consistently downward from the ‘optimum’ (excellent) text. However, text length alone is obviously not a definitive marker of a well written text (quantity). The more accomplished writer who produced the ‘excellent’ text wrote more, but also had a greater number of words in noun phrases and a greater number of such phrases, both complex and simple. More importantly, these phrases were substantially better formed overall. Simply, his language competence and proficiency on this evidence is higher and his text evidences the feature of readability resulting in a more positive response from the subject teacher.

For the second feature of infinitive clauses, the results were slightly idiosyncratic with a ‘very good’ text having a smaller word count, less total infinitive clauses and less
lexical range than a ‘good’ text. One issue here is that two grades are given which results in the generic grade; one for content and one for language. This particular text received the maximum grade for content, but a lower grade than the ‘good’ texts for language. This was the only case where the anomaly occurred. It is notable though, that the readability of this text was viewed less positively and therefore the linguistic analysis does in fact hold. Further research should avoid the problem identified above by considering only the language grade and further exploring the responses of the subject and language teacher to the same text [16]. The relationship between content and language grades would clearly be a useful focus for further research.

Differences between the top and bottom end of the scale are certainly revealing. Both the writer of the ‘excellent’ text and the writer of the ‘average/poor’ text demonstrated a high level of appropriateness by concentrating infinitive use within the introduction, and method/stages sections of the document-traditionally where a high frequency of this feature would be predicted given the ‘proposal’ and ‘report’ (purpose) nature of these elements of text [17].

Where they differed substantially was in the range of verbs utilized and the effectiveness of their use (quality, accuracy and appropriateness). A wider variety of appropriate items (words) led to a more positive perception of the readability of the better text. It made more interesting and persuasive reading. A sample from the introduction is given in Fig 4 below.

The purpose of this project is to use analysis of a flash separator to include the heat duty requirements in a heat exchange which provides the energy required to operate the separator at a steady-state.

FIGURE 4
INTRODUCTION EXCERPT

The weaker text was limited to five items with one of these used three times The range of the verbs in this text (excellent) indicates a lexical flexibility from the writer which was not present in the others. This greater variety helped give the text greater readability. It engaged the reader more. Reader expectations are not only about what information we expect to see, but on a more subconscious level, being presented with the language we expect which has been chosen in order to communicate that content.

The two language teachers who read these texts specifically mentioned how the choice of appropriate (expected) vocabulary and grammar in the relevant sections of the report contributed to ease of readability especially with reference to the variety and effectiveness of lexical verbs in infinitive clauses in the purpose and method section of the ‘excellent’ (criteria of quality, appropriateness and accuracy P 3). Such ‘sectional’ analysis and description of documents might therefore be extended and seen as valuable from a teaching and learning perspectives. One of the issues for our students (and perhaps generally for students writing in a second or foreign language) is the absence of an understanding that appropriate choices of grammar are not simply about ‘correct structure’, but also effective style and communication and meeting audience expectation [18].

When the approach was then tested with ‘good’ and ‘average’ lab reports from the electrical engineering programme, a similar profile emerged. In the introduction and approach sections of the reports, an ‘average’ text contained 244 words with seven infinitive clauses. A ‘good’ text contained 345 words for the same sections with twelve infinitive clauses. The former displayed much less lexical variety and frequency in the infinitive verbs with ‘test’ being used four times. Variety in the better text was much more noticeable. Accuracy of application was the same in both cases (100%). This is perhaps to be expected given relative grammatical and structural complexity.

The pattern further held when applied to petroleum engineering lab reports where a similar description can be made, indicating that the approach could be generalized It is significant that the feature appears with high frequency as a driver of text moves (P 3). Further, it was applied appropriately by writers of different quality texts to make similar text moves. The main difference between these texts was one of lexical variety, frequency and range in the verbs employed (quality) and the quantity of text produced. The two features chosen are significant for analysis of academic style memo/report writing. Noun phrases are perhaps more pervasive and generalisable, but to infinitive clauses are also germane in our text area. Further analysis of noun phrases might focus on their functions within clauses and sentences in relation to their complexity, the various and varying natures of post-modifying elements, coordinated phrases etc. In addition, other types of adverbial phrases could be considered such as those indicating sequence/process (temporal or logical), hypotheticals and concessives.

Nevertheless, we have 2 important features pointing in the same direction.

CONCLUSION

While accepting that the above does not constitute an exhaustive analysis and is exploratory in nature, it has shown itself to be useful as the foundation of a model of text description which could be extended and generalized to other texts across a range of academic programmes in our institute with a view to influencing preparation of students to write such documents more effectively. Clearly there were differences in terms of the language proficiency of the writers, which are also influenced by factors other than those analyzed. However, sensitizing weaker writers to the contextual nature of elements of text discourse such as those
looked at here, should result in a better report and improve readability. In turn this should elicit a more positive response from the subject teacher and result in a better grade. It would also (perhaps more importantly) improve the writer’s overall language awareness.

We have been able to describe the texts in terms of significant features which enhance readability as indicated by the assessment of the texts by chemical engineering teachers. It is felt there is enough evidence here to claim that such a multi-faceted description of texts would be useful in illustrating and documenting text types and using such information to inform teaching and curriculum development. As stated, anecdotal evidence from teachers in PI degree programmes has indicated a problem with regard to the quality of writing. Analysis of a range of texts has highlighted some of the linguistic issues. The extent of the problem (i.e. numbers of students, level of proficiency and so on) still needs to be clarified as it is not within the scope of this investigation.

**RECOMMENDATIONS**

It is important to emphasize that tertiary education has a relatively short history in the UAE, but much of great importance has been achieved in that time. Responses to second and foreign language learning issues have had much longer to develop in other countries. The following observations should be seen in that context.

The need for on-going language support and development in degree programmes is clear. In the quest for better student-produced texts, cross-curricular teacher collaboration is a significant element. There are various ways this can be explored and many models of good practice. The three-phase approach of collaboration, cooperation and team teaching described by Dudley-Evans [6] is a very practical example here. A synthesis of some of these elements (specifically collaboration and cooperation) has informed the teaching relationship between the Communication Department and the Department of Chemical Engineering in our institute leading to the development of a parallel syllabus in the opinion of the department head, the quality of student documentation at the end of our first semester of working together was much improved. Attitudinal shifts are important here. As [19] states: “Collaborative and co-operative knowledge cannot in itself be gained from a fixed-term training course alone. Rather, it is dispositional, involving a genuine desire to investigate the conceptual and discourse framework of the subject students are studying, leading to a more systematic attempt to find out how a discipline works”. Further, content teachers in foreign language medium institutes should be encouraged to develop an interest in the interface between language and content. Our most successful ventures (for learners) have occurred with content teachers who understand and are interested in this relationship.

On the text level, comprehensive description of the culture of each document should be given to students in order for them to have a detailed map before they begin.

The intention is to give a description of the purpose and structure of the document and guidance as to the linguistic and discourse elements appropriate to different sections of the text, such as those looked at in this study. Clear description of the informational focus required in different sections of the document should be given. The student then has a schema before embarking on the writing process. This can be utilized in consultation with instructors in the preparation of documents.

Further, it is important to encourage students to take a functional view of why particular language choices are significant in terms of meeting reader expectations and how the language works in order to do that [20]. Description of documents from the perspective of text moves is a very accessible and practical approach here. The features described in this study could easily be discussed in this context. Too often grammar is presented as simply structural and therefore divorced from meaning and purpose. Learners require a more functional understanding in order to select relevant structures and vocabulary for their purpose. Given reasonable concerns about notions of universality in the context of academic discourse [21] it is also worth sensitizing students to notions of range, frequency [22] collocation and meaning within the context of specific disciplines and genres. Teachers may work on helping students develop a more focused lexical repertoire derived from their particular discipline, as suggested by these authors. This again reinforces the reflective and pragmatic nature of ESP.

The concept of ownership is also significant. Students need to be encouraged to effectively proof read and edit documents. The skills involved are complex and developed over time. It is often (wrongly) assumed that this is something which students know how to do rather than being a specific suite of abilities which need to be taught and valued as an important element in the set of skills utilized in the production of professional documentation.

**REFERENCES**