DOCUMENT RESUME

ED 424 783 FL 025 584

AUTHOR	Anthony, Laurence
TITLE	Preaching to Cannibals: A Look at Academic Writing in the Field of Engineering.
PUB DATE	1998-01-31
NOTE	12p.; In: The Japan Conference on English for Specific Purposes Proceedings (Aizuwakamatsu City, Fukushima, Japan, November 8, 1997); see FL 025 575.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Classroom Techniques; Computer Software Development; Definitions; *Discourse Analysis; *Engineering Education; *English for Academic Purposes; *English for Special Purposes; Foreign Countries; Higher Education; Journal Articles; Literature Reviews; Scholarly Journals; Second Language Instruction; *Technical Writing; Writing Instruction

ABSTRACT

This study applied the Create a Research Space (CARS) model, a discourse model for research-based technical writing, to the introductory sections of 12 award-winning articles in the field of software engineering published in a major professional journal. The model analyzes the "move" structure of the writing. In the initial analysis of the articles, it became clear that the model's terminology needed clarification and the model required some modification for this purpose. Results suggest the model was generally successful in describing the overall framework of the introductions, but that problems emerged when a more detailed description of software engineering introductions is needed. The model was hampered by weak definitions of individual "steps," some of which are redundant or used infrequently. A more serious problem is the absence of an "evaluation of research" step in the original model, which is found to be crucial in the introduction. Implications for classroom use of the model to teach English for special purposes are discussed. Contains 19 references. (MSE)

Preaching to Cannibals: A Look at Academic Writing in the Field of Engineering

Laurence Anthony
Department of Information and Computer Engineering
Faculty of Engineering
Okayama University of Science (Japan)

Abstract

In this paper, Swales' 1990 Create a Research Space (CARS) model for describing the "move" structure of research article introductions is evaluated in terms of how well it can be applied to 12 article introductions in the field of software engineering. Results indicate that although the model adequately describes the main framework of the corpus introductions, a number of important features are not accounted for, in particular, a summary of previous research, an evaluation of the present research, and definitions and examples. It is shown that these areas are essential for the audience of the journal articles to not only understand the content, but also apply the results to specific problems in their own research area.

Introduction

English has not always been the dominant language used in science and technology, but since the 1960's the number of journals which require papers to be submitted in English have grown immensely. For example, Swales (1987) estimates that approximately half of the millions of journal papers now published are in English, and as early as 1981 almost 80% of all engineering journal papers were published in English (Swales, 1981). For the majority of the science community, who are non-native speakers of English, this presents somewhat of a problem; in order to get research published in the most prestigious journals, their papers have to be written in a language they will not be completely familiar with. Realizing this clear need for a specific kind of English, many ELT teachers have begun investigating English used for specific purposes (ESP) and in particular, English for science and technology (EST).

Early studies in ESP and EST identified a number of areas that prove difficult for non-native speakers. Pearson (1983), in her summary of this work, discusses five of the more prominent of these in detail: 1) technical terminology, 2) common language words used technically, 3) strength of claim, 4) contextual paraphrase, and 5) rhetorical or text structures. The fifth category of "text structures" has perhaps generated the most amount of interest. Differing explanations as to why this causes difficulties have been offered by James (1984), Mohan et al. (1985) and Pearson (1983). The most widely accepted answer, however, is that supported by Carrell et al. (1983), Hinds (1983), Kaplan (1987), Connor (1996) and others. They argue that there are profound differences in the organization of texts between different cultures and indeed different disciplines within the same culture. A non-native speaker or even a native speaker who is unaware of the particular structure of a "foreign" text, therefore, will experience comprehension difficulties.

In view of this, there have been an increasing number of studies aimed at identifying the structural patterns used in scientific writing. For example, research article abstracts have been looked at by Weissberg et al. (1990), the introduction by Hutchins (1977), Hepworth (1978), Swales (1981), and Zappen (1983) among others, and the discussion section of MA theses by Dudley-Evans (1994). There is, however, one important question that has yet to be considered: to what extent can such generalizations be made about the "writing of science and engineering"? In other words, do the general models proposed above accurately account for the writing of a specific discipline?

Here, an attempt will be made to answer this question by assessing how well Swales' 1990 model for research article introductions, the Create a Research Space (CARS) model, can be applied in engineering (see Figure 1). It should be noted that this model has been through several revisions since its conception in 1981, incorporating the findings of Cooper (1985), who applied it in engineering, and Crookes (1986), who applied it in both the 'hard' and 'social' sciences. As such, the model can be considered to be one of the stronger descriptions of text structure to date, and its acceptance in the field is reflected in the number of textbooks which directly quote it, or whose accounts have been strongly influenced by it, e.g. Weissberg (1990), Huckin and Olsen (1991) and Swales and Feak (1994).

Figure 1: Swales' (1990) Create a Research Space (CARS) Model

Move 1: Establishing a territory

Step 1: Claiming centrality
and/or
Step 2: Making topic generalization(s)
and/or
Step 3: Reviewing items of previous research

↓ Declining rhetorical effort

Move 2: Establishing a niche

Step 1A Counter claiming
or
Step 1B Indicating a gap
or
Step 1C Question raising
or
Step 1D Continuing a tradition

↓ Weakening knowledge claims

Move 3: Occupying the niche

Step 1A Outlining purpose
or
Step 1B Announcing present research
Step 2 Announcing principle findings
Step 3 Indicating RA structure

↓ Increased explicitness

Research Design

- Corpus

In Swales' (1981) study, a corpus of 48 articles was chosen from 14 journals in the fields of physics, electronics, chemical engineering, bio-medicine, and social sciences, an average of 3.4 articles per journal. The field of engineering, however, is extremely wide, with the Institute of Electrical and Electronics Engineers (IEEE) alone having 37 sub-societies. Even within a single society such as the Computer Society of the IEEE, there are many sub-disciplines such as hardware, software, robotics and communications. It was decided, therefore, to test the suitability of the CARS model not in engineering as a whole, but in only a single sub-discipline of engineering, software engineering.

As only research articles in software engineering were to be looked at, a corpus of 12 full paper articles was chosen from one of the field's most important and influential journals, the Transactions on Software Engineering (TSE), published by the IEEE with a readership of over 11 thousand engineers. As mentioned earlier, many authors in engineering are non-native speakers, and although a prestigious journal such as the TSE will review and edit their work, the possibility of "errors" and "non-standard" English remains. Cooper (1985), for example, found that at least one article in her study contained enough errors to interfere with the meaning of the text. To reduce the potential problems of non-native speaker writing, the final corpus comprised of articles which had been awarded "Best Paper of 1996" awards by the journal. To qualify for such an award, the articles had to go through two rigorous review processes where errors in English would be checked by up to six reviewers and editors.

- Validating the Analysis

In order to establish the suitability or unsuitability of the CARS model, the analysis here also required validation. In Crookes' study (1986), this was achieved using five trained raters, although problems emerged because the group, who were graduate students of English rather than engineering, were unable to identify move boundaries signaled by topic change rather than explicit signals. To avoid this problem, here, 4 specialist informants were consulted at various stages in the analysis of the data, and 7 of the original authors of the corpus articles were contacted via e-mail after the initial analysis was complete. There are, however, potential problems with using specialist informants, and so the advice given by Swales (1990, p. 130) was adopted, i.e., only specialists in the same field were consulted, and used primarily for testing formulated hypotheses and findings. In addition to using specialist informants, the results were also compared with those of other studies directly relating to writing in engineering. The main source here was the IEEE publication *Transactions on Professional Communication* (TPC), an international journal dedicated to studies on the written and oral presentation of engineering research. Surprisingly, this wealth of information has been virtually if not completely ignored in all previous studies on text analysis coming from the field of ELT. Even Cooper (1985), who looked directly at engineering writing, has seemingly passed it by.

Results

- Clarification of Terminology in the CARS Model

In the first stage of analysis, the article introductions were analyzed according to the CARS model as presented in Swales' 1990 work. It became immediately apparent, however, that the terminology used by Swales needed clarification. For example, Swales (1990, p. 146) describes Step 1-2 (making topic generalizations) as being of two types; the first expresses "the current state of the art," what is known about the field or technique in general, while the second is a statement about "phenomena" in the field. He goes on, however, to say that statements about "current requirements for further progress" would also be included in this step. If this is so, there is clearly an overlap with the purpose of Step 2-1D (continuing a tradition) which can establish a niche by expressing the "needs/desires/interests" of the field (Swales, 1990, p. 156). Based only on these definitions, the sentences below, which were taken from the corpus, could be classified into either step.

"A software requirements specification should be a comprehensive statement of a software system's intended behavior."

"Before developers of certifiably safe software can take advantage of the concurrent and real-time constructs of Ada, rigorous analysis techniques to analyze their timing properties must be developed."

To clarify the difference between the two steps, it would seem necessary to also consider the location of the statement within the text. In this study, statements appearing prior to a review of previous research (Step 1-3) were classified as Step 1-2, while those appearing directly after the review were classified as Step 2-1D. Such an interpretation has also been supported by Swales himself (personal communication). Also, improvements or requirements suggested explicitly by the author, for example, directly after a Step 2-1B (indicating a gap) or signaled by an adversative sentence-connector, were classified as a Step 2-1D rather than a Step 1-2. Other problems were found in the classification of Move 3 steps. Step 3-1B (announcing present research), for example, is defined as a description of "the main features of the research" (Swales, 1990, p. 159). Distinguishing between "main features" of the research and the Step 3-2 option "announcing principle findings,", however, was particularly difficult. For example, Swales (1990, p. 160) classifies the sentence "In this paper we give preliminary results of...." as Step 3-1B not Step 3-2. Unfortunately, he gives no examples of statements that would fall into the latter step. It was decided, therefore, to classify only general statements about how or what was done in the present research into Step 3-1B, and specific statements about research method, descriptions of tools or techniques developed in the present research, and/or specific results into Step 3-2. For example, a statement such as "This paper presents a new architectural style." would be classified into Step 3-1B while a statement such as "Our technique consists of two algorithms." would be classified into Step 3-2. Step 3-3 (indicating RA structure) was also difficult to interpret. Swales (1990, p. 161) describes this step as including "in varying degrees of detail the structure - and occasionally the content - of the remainder of the RA." To detail the content of the research article, however, would naturally include details of results, thus merging with the purpose of Step 3-2. The classification of Move 3 steps is complicated further if Swales' 1994 account is considered. In this study, while the classification of Steps 3-1A, 3-1B and 3-2 are the same, two further possible steps are mentioned, i.e., a statement of secondary findings, and statements about the value of the research. The second of these is said to mention "anything about the contribution [the] research will make" (Swales et al., 1994, p. 192). This would again appear to merge with the purpose of Step 3-1B which can include statements about how the present research extends the findings of previous work. Interestingly, the description of Step 3-3 in the

1994 account has no mention of content in the remaining RA.

To deal with these problems, first, statements about secondary findings are included in Step 3-2, and a new "Evaluation of Research" step is created, which includes statements about the value of the research, and how it extends previous results. Finally, the step indicating RA structure appears as Step 3-4 and is defined according to Swales' 1994 description. The CARS model to be used here, re-named the "Modified CARS model," is presented in Figure 2. It should be noted, however, that apart from the additional evaluation step, the model is almost identical to the original CARS model. The only other change made is the addition of the "and" condition in Move 2 and Move 3 Step 1s, as it was anticipated that more than one type of step could be used at a particular place. The issue may be raised that presenting a modified version is unnecessary and that the evaluation step can be incorporated into Step 3-2. Indeed, this is possible but I hope the analyses here will show that in software engineering at least, it is beneficial to consider it as a separate step.

Figure 2: The Modified CARS Model for Article Introductions[3]

Move 1: Establishing a territory

Step 1: Claiming centrality
and/or
Step 2: Making topic generalization(s)
and/or
Step 3: Reviewing items of previous research

Move 2: Establishing a niche

Step 1A Counter claiming
and/or
Step 1B Indicating a gap
and/or
Step 1C Question raising
and/or
Step 1D Continuing a tradition

Move 3: Occupying the niche

Step 1A Outlining purpose
and/or
Step 1B Announcing present research
Step 2 Announcing principle findings
Step 3 *Evaluation of research*
Step 4 Indicating RA structure

[3]NOTE: Italics indicate where changes to the original CARS model have been made.

Move Structure and Occurrence of Steps in the Modified CARS model

Based on the Modified CARS model above, the corpus article introductions were analyzed to identify the move and step structure. A summary of the move structure is given in Table 1, and the occurrence of steps is shown in Table 2.

Table 1: Move Structure in Article Introductions[4]

Intro.	Move Structure	Words	Sent.	Para.	Words/Sent.
1.1	1 2 1 2 1 2 1 3 1 2 3 1 2 1 2 1 2 1 2 1 2 3 1 3 2 3	1479	68	15	21.8
1.2	1 2 1 3 1 3	803	25	7	32.1
1.3	1 3 1 2 3	909	43	8	21.1
2.1	1 2 1 2 1 2 1 2 3 1 3	698	27	5	25.9
2.2	1 2 1 2 1 2 1 2 3	1190	57	10	20.9
2.3	3 1 2 1 2 1 2 1 2 1 3 2 1 3 1 3	1337	56	13	23.9
2.4	1 3 2 1 2 1 2 3	1067	42	7	25.4
3.1	1 2 1 2 1 2 1 2 3	1288	39	8	33.0
3.2	1 2 1 3 1 2 1 3 1 3 2 1 2 3	1340	59	8	22.7
3.3	1 2 1 3	642	23	6	27.9
3.4	1 2 1 2 1 2 3 1 2 1 3 1 3 1 2 3 1 3	914	43	5	21.3
3.5	1 2 1 3 1 3 1 3	591	23	5	25.7
Averages		**1022**	**42.1**	**8.1**	**25.1**

Table 2: Step Occurrence in Article Introductions[5]

Intro.	Move Classification														
Code	1.1	1.2	1.3	1	2.1A	2.1B	2.1C	2.1D	2	3.1A	3.1B	3.2	3.3	3.4	3
1.1	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
1.2	N	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y
1.3	Y	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y
2.1	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y
2.2	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y
2.3	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	N	Y
2.4	N	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y
3.1	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y
3.2	N	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y
3.3	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y
3.4	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y
3.5	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	N	Y	Y	Y
%	41.7	91.7	100	100	0	91.7	0	50.0	100	41.7	100	75.0	100	83.3	100

As can be seen from Tables 1 and 2, each introduction exhibits all the moves described in the Modified CARS model, supporting the general framework offered by Swales. The framework is also supported by research reported in the TPC and comments from the four specialist informants. From Table 2, however, we see that the occurrence of steps in the article introductions is less consistent with the proposed model. For example, although steps 1-3 (reviewing items of previous literature), 3-B (announcing present research), and 3-3 (evaluation of current research) are obligatory, steps 2-1A (counter claiming) and 2-1C (question raising) are redundant, and steps 1-1 (claiming centrality), 2-1D (continuing a tradition) and 3-1A (outlining purpose) occur in only half or less of the introductions. Swales (1981) comments that the occurrence of steps will be discipline dependent, stating that the hard sciences and engineering will show a preference for using Step 2-1B and Step 2-1D over Step 2-1A and Step 2-1C, which are more common in education, management and linguistics. Results here support this view, but suggest that variations in step occurrence among different disciplines may be greater than originally thought. They also

[4]**NOTE**: Numbers in the second column refer to the order of moves in the introduction. The numbers in the four right columns refer to the total number of words, sentences, and paragraphs in the article introductions and the average number of words per sentence, respectively.

[5]**NOTE**: Y and N indicate that the move either occurred or did not occur in the article introduction.

suggest that even within a single discipline such as engineering, there may be considerable variations between its associated sub-disciplines. For example, Swales (1990) states that engineering articles will show few examples of Step 1-3, but results here clearly reject this view.

Cyclicity, Length of Moves, and the "Preaching to Cannibals" Phenomena

Looking at Table 2, it can be seen that the introductions here show a large amount of cycling between different moves. For example, in introductions 2.1 and 2.2, there are four cycles of Move 1 and Move 2 steps before the purpose of the current research is finally stated, and in introduction 1.1, the longest in the corpus, the number of such cycles increases to twelve. This feature was predicted by Crookes (1986) to occur in longer introductions. Indeed, the introductions here are considerably longer than those in Swales' (1981) study (varying from 100 to 500 words), and even Cooper's (1985) study (varying from 154 to 1129 words, average 424 words), which were selected from equivalent engineering journals. This may suggest that articles in engineering are increasing in length, or again, that there may be significant differences depending on the particular discipline within engineering. Clearly, however, the results here in no way support Swales' (1990, p. 159) hypothesis that engineering papers will show "brevity and linearity," in fact, the precise opposite is found.

Comparing the length of individual moves and steps in the introductions, on the whole, Move 3 is the longest, followed by Move 1, and then Move 2. (See Table 3.) Looking at the table, we can see that in Move 1, a great deal of time is spent making generalizations about the field (Step 1-2) and summarizing previous research (Step 1-3). Cooper (1985, p. 46) explains that this is because article introductions in engineering contain large amounts of "unassumed knowledge." The Move 1, therefore, is to, "provide the reader with that knowledge necessary for him or her to comprehend the new information which will be given in the paper." (Cooper, 1985, p. 46)

Table 3: Length of Steps in Article Introductions[6]

	Length of Steps as Number of Words														
IC	**1.1**	**1.2**	**1.3**	**M1**	**2.1A**	**2.1B**	**2.1C**	**2.1D**	**M2**	**3.1A**	**3.1B**	**3.2**	**3.3**	**3.4**	**M3**	**Total**
1.1	0	234	468	702	0	216	0	68	284	49	109	121	103	111	493	1479
1.2	0	106	97	203	0	51	0	0	51	66	21	298	80	84	549	803
1.3	13	0	164	177	0	13	0	0	13	19	7	418	184	91	719	909
2.1	0	44	48	92	0	81	0	106	187	0	131	51	177	60	419	698
2.2	64	26	121	211	0	164	0	146	310	0	51	209	319	90	669	1190
2.3	52	106	252	410	0	231	0	0	231	0	71	469	156	0	696	1337
2.4	0	245	233	478	0	187	0	0	187	36	33	71	113	149	402	1067
3.1	0	345	478	823	0	138	0	114	252	0	41	0	172	0	213	1288
3.2	0	176	308	484	0	420	0	0	420	0	49	72	71	244	436	1340
3.3	0	70	159	229	0	0	0	20	20	0	25	111	52	205	393	642
3.4	12	40	379	431	0	128	0	17	145	0	63	0	185	90	338	914
3.5	21	19	169	209	0	72	0	0	72	54	61	0	90	105	310	591
AV	14	98	201	312	0	124	0	34	157	15	46	143	133	93	429	1022
M %	4.3	31.4	64.3	100	0.0	78.7	0.0	21.3	100	3.4	10.8	33.0	31.1	21.7	100	
T %	1.3	11.5	23.5	36.3	0.0	13.9	0.0	3.8	17.7	1.8	5.4	14.8	13.9	10.0	46.0	100.0

One reason she gives for this, is that people working in engineering often change from one specialist field to another. Although the specialist informants interviewed for this study were unable to confirm this statement, they did agree that many readers of engineering

[6]**NOTE**: IC = Introduction Code Number; AV = Average; M % = Percent of Move; T % = Percent of Total; and M1, M2, and M3 refer to the total number of words in that particular move.

articles might be unfamiliar with much of the terminology and background information necessary to understand the research. One of the main reasons for this is because engineers will often subscribe to a number of different journals not just in their own narrow areas, in order to acquire results which can be used to help solve their particular problems. For example, one of the specialist informants describes the audience of engineering articles as, "... doing research in an area that's either your same area or an area where they can use your results or build on them for their own purposes."

The audience for the TSE, therefore, will be particularly large as most engineers will be doing research in some way related to software. This profoundly affects the writing of articles which are published in it. For example, when the specialist informants were asked to describe their own writing, the following comments were made:

"I try to explain things in a simple way so that just anyone who has a bachelors degree can almost get some idea of what I'm trying to do in the paper."

"When you write a journal paper you have to be very careful that even a naive person, that means who is not very familiar about the field, will be able to read that journal paper, and understand what [you're] trying to say."

"I kind of regard [article writing] as a kind of 'preaching to the cannibals.' "

Clearly, this "preaching to the cannibals" phenomena is an important consideration for the software engineer when writing research articles. We see this in the way the author gives background information in the form of topic generalization and summaries of previous research piece by piece, commenting on its problems or gaps, and relating it to the purpose of the present research. This explains the extensive use of Move 1 - Move 2 cycles, and even cycles involving a Move 3, where the research is first presented in very general terms, but then as the introduction progresses, more specific statements are made. One more technique used by the author is to define important terms, and provide examples to illustrate difficult concepts in the introduction. These are mostly found in Move 1 steps, although two of the introductions include long examples to clarify a problem (in Intro. 3.2) and the approach being used (in Intro. 1.3). For example,

"...internally complete, i.e., closed with respect to statements ...."

"By module, we mean a single procedure...."

"For example, the software for establishing and tearing down telephone calls must...."

"...scheduling algorithms/techniques (e.g., rate monotonic scheduling)...."

Note, definitions and examples were included when calculating the length of their associated steps. This may bias the results for a particular step, but it was felt that many of the definitions and examples found, were providing additional information about the related topic or problem.

Evaluating the present research (Step 3-3)

Swales (1990) chose the labeling of the moves in the original CARS model to reflect the nature of introductions, that of "persuading" the reader to accept the research being presented. As mentioned above, in the introductions here the persuasion is achieved to some extent by cycling between statements which establish the field (Move 1) and those which indicate a gap of extension of findings in the field (Move 2). Results here, however, showed that one of the major sections of the introductions where an "appeal" to the audience is made is in Step 3-3, (evaluation of research), a possibility only hinted at by Swales (1994) when describing the original CARS model.

From Table 2, it can be seen that Step 3-3 appears in all the article introductions in the corpus, justifying the creation of a new step in the Modified CARS model. It is also one of the longest steps in Move 3, accounting for almost one third of the move and 14% of the introduction as a whole.

In this step, the present research is evaluated, almost always positively, with respect to either or both of the following criteria: 1) the applicability of the research and 2) the novelty of the research. The first criterion is central in engineering, which is primarily concerned with solving specific problems. As one of the specialist informants describes,

"Computer scientists want to know did you build it, does it work, how long, how fast is it, because they want to use it... they want to see some proof of concept."

Thus, we see its appearance in all but one of the corpus introductions, accounting for 58% of Step 3-3 as a whole. The second option, although less popular, appears in seven of the introductions, and accounts for 24% of Step 3-3 as a whole. One further possibility, accounting for the remaining instances of Step 3-3, is for the author is discuss the 'limitations' of the research. Although this is rare in the corpus, we do find three instances. Interestingly, these are always followed by a contrastive statement signaling a more positive aspect of the research. A summary of the results can be seen in Table 4 below.

Table 4: Occurrence of *Application* and *Novelty* Step 3-3 Types

Introduction	Occurances of Step 3-3 Types by Number of Words			
Code	Application	Novelty	Limitations	Total
1.1	65	38	0	103
1.2	53	27	0	80
1.3	154	0	30	184
2.1	177	0	0	177
2.2	23	99	197	319
2.3	152	4	0	156
2.4	54	59	0	113
3.1	172	0	0	172
3.2	0	71	0	71
3.3	52	0	0	52
3.4	24	79	82	185
3.5	55	35	0	90
Total	**926**	**377**	**309**	**1702**
Average	**81.8**	**34.3**	**25.8**	**141.8**
%	**57.6**	**24.2**	**18.2**	**100.0**

Conclusion

This paper opened with the question: how well does the CARS model accurately account for the writing of introductions in software engineering. From the results above, we can see that in terms of describing the overall framework, the model is very successful; only the classification of definitions and examples into an appropriate step was missing. Problems with the model emerge, however, when a more detailed description of software engineering introductions is needed. The model is first hampered by weak definitions of individual steps, and because it is designed for a wide variety of disciplines, many steps are redundant or only rarely used, namely steps 1-1, 2-1A, 2-1C, 2-1D and 3-1A. A more serious problem is the absence of an "evaluation of research" step in the original model, which is shown here to be not only obligatory, but a crucial element in the introduction, and Swales' suggestion that engineering article introductions do not include a summary of previous research, are brief, and linear.

Ultimately, the CARS model is intended to be used as a pedagogic tool in the classroom. If the limitations of the model are understood, then I feel that it can be used effectively. The danger, of course, is that many teachers of technical writing, coming from backgrounds unrelated to the discipline in which they teach, will be unable to correctly interpret the model and inevitably use it "as is." This is common in Japan, for example, where teachers with an English literature background are asked to teach technical writing courses to scientists and engineers. A related problem is how both teachers and students will deal with texts that do not fit the prescribed model. In current textbooks that use the CARS model, there is rarely an opportunity to deal with these "problem" cases, so if at some point they are encountered they are likely to be treated simple as "exceptions" to the rule. Of course, the many exceptions to the rule may in fact be standard practice in a certain field. Research articles in English, for example, rarely if ever exhibit the Step 3-3 of the CARS model, giving a summary of the rest of the paper. To suggest the CARS model is the norm to students of this discipline is clearly presenting a misleading picture. In order to effectively use the currently available general models like the CARS model, and indeed create new and more accurate descriptions of writing in science and engineering, far more research must be directed towards the writing of specific disciplines. It is hoped that the study here offers one step in this direction. In the words of Taylor et al. (1991, p. 332),

"[A] great deal more attention needs to be paid to the rhetoric of individual disciplines. Generalizing about 'scientific writing' (much less 'academic writing') is plainly insufficient."

References

Carrell, P. & J. C. Eisterhold. (1983). Schema theory and ESL reading pedagogy. *TESOL Quarterly, 17*(4): 553-573.

Connor, U. (1996). *Contrastive rhetoric: Cross-cultural aspects of second-language writing.* Cambridge: Cambridge University Press.

Cooper C. (1985). *Aspects of article introductions in IEEE publications.* Unpublished M.Sc. dissertation. University of Aston, UK.

Crookes, G. (1986). Towards a validated analysis of scientific text structure. *Applied Linguistics, 7*(1): 57-70.

Dudley-Evans, T. (1994). Genre analysis: An approach to text analysis for ESP. In M. Coulthard (Ed.) *Advances in text analysis.* Routledge.

Hepworth, G. R. (1978). *A functional description of the discourse for the English of science and technology.* Master's degree thesis. Utah State University.

Hinds, J. (1983). Contrastive rhetoric: Japanese and English. *Text, 3*(2): 183-195.

Huckin, T. N., & L. A. Olsen. (1991). *Technical writing and professional communication.* McGraw-Hill.

Hutchins, J. (1977). On the structure of scientific texts. *University of East Anglia Journal of Linguistics*, No. 5.

James, K. (1984). The writing of theses by speakers of English as a foreign language: The results of a case study. In R. Williams, J. Swales & J. Kirkman (Eds.) *ELT Documents: 117. Common ground: Shared interests in ESP and communication studies.* Pergamon.

Kaplan, R. B. (1987). Cultural thought patterns revisited. In U. Connor & R. B. Kapan (Eds.) *Writing across languages: Analysis of L2 Text.* Addison-Wesley Company.

Mohan, B. A., & W. Au-Yeung Lo. (1985). Academic writing and Chinese students: Transfer and developmental factors. *TESOL Quarterly, 19*(3): 515-534.

Pearson, S. (1983). The challenge of Mai Chung: Teaching technical writing to the foreign-born professional in industry. *TESOL Quarterly, 17*(3): 383-399.

Swales, J. (1981). *Aspects of article introductions.* Research Report No. 1. The University of Aston, Language Studies Unit.

Swales, J. (1987). Utilizing the literatures in teaching the research paper. *TESOL Quarterly, 21*(1): 41-68.

Swales, J. M., & Christine B. Feak. (1994). *Academic writing for graduate students: Essential tasks and skills.* University of Michigan Press.

Taylor, G., & C. Tingguang. (1991). Linguistic, cultural, and subcultural issues in contrastive discourse analysis: Anglo-American and Chinese scientific texts. *Applied Linguistics, 12*(3): 319-336.

Weissberg, R. & S. Baker. (1990). *Writing up research.* Prentice Hall.

Zappen, J. P. (1983). A rhetoric for research in sciences and technologies. In Anderson P. V., R. J. Brockman & C. R. Miller (Eds.) *New essays in technical and scientific communication.* Baywood.

FL025575 - FL025588

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Proceedings 1997: The Japan Conference on English for Specific Purposes

Author(s): Thomas Orr, Editor

Corporate Source: University of Aizu

Publication Date: 1/31/98

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic/optical media, and sold through the ERIC Document Reproduction Service (EDRS) or other ERIC vendors. Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following two options and sign at the bottom of the page.

[X] **Check here For Level 1 Release:** Permitting reproduction in microfiche (4" x 6" film) or other ERIC archival media (e.g., electronic or optical) *and* paper copy.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Level 1

The sample sticker shown below will be affixed to all Level 2 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Level 2

[ ] **Check here For Level 2 Release:** Permitting reproduction in microfiche (4" x 6" film) or other ERIC archival media (e.g., electronic or optical), but *not* in paper copy.

Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but neither box is checked, documents will be processed at Level 1.

"I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic/optical media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries."

Sign here→ please

Signature: Thomas Orr

Printed Name/Position/Title: Thomas Orr, Editor

Organization/Address: University of Aizu, Aizuwakamatsu, Fukushima 965-8580 JAPAN

Telephone: 81-242-37-2588

FAX: 81-242-37-2599

E-Mail Address: t-orr@u-aizu.ac.jp

Date: 8/10/98

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:	~~University of Aizu~~ Thomas Orr, Editor
Address:	University of Aizu Aizuwakamatsu, Fukushima 965-8580 JAPAN
Price:	$25.00 or 3,000 yen

(Note: We have 300 copies remaining for sale. After they are gone, ERIC may continue sales in paper-form. We expect them to run out soon.)

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:	
Address:	

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

ERIC Clearinghouse on
Languages & Linguistics
1118 22nd Street NW
Washington, D.C. 20037

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
1100 West Street, 2d Floor
Laurel, Maryland 20707-3598

Telephone: 301-497-4080
Toll Free: 800-799-3742
FAX: 301-953-0263
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com