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Review

What is Spoken in a Junior College Mathematics Lecture?

Ng, Y. (2001). *English in mathematics discourse.* Unpublished Master of Arts Dissertation, National University of Singapore.

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The dissertation *English in Mathematics Discourse* highlights for mathematics educators a body of practical knowledge about Junior College mathematics lecture discourse from the linguistic perspective. Although this dissertation is found among the collection of the dissertations done by postgraduate students of linguistic studies, it is of value to mathematics educators, particularly, mathematics teachers at the Junior College level.

This dissertation has its foundation in classical linguistic models and, according to the author, attempts to bring out pedagogical implications relevant to mathematics educators. As the author further noted, one of the goals of this dissertation was to "explore the features of mathematics discourse in order to understand why students find it difficult and for new mathematics teachers to understand what factors constitute effective mathematics lecture discourse". A new mathematics teacher needs to know, for example, "whether a lecture discourse is merely an oral manifestation of the corresponding textbook discourse, or a whole world of pedagogical considerations interwoven into the available textbook materials....".

As a former Junior College mathematics teacher, this dissertation is of interest in that it provides insight into the features which constitute Junior College mathematics lecture discourse from the perspective of a linguist – a non-specialist in the field of mathematics or mathematics education. One might argue that the contribution from a non-specialist may not be of use to someone in the field. However, looking at mathematics discourse from a linguistic perspective, one may be able to study the discourse from an angle not usually done by mathematics educators before, thereby giving new insight.

To make this dissertation worth reading, the author very clearly highlighted her stand that in her research she worked on the basis that mathematics is a unique discipline in its own right, rather than treating mathematics as a special field of science. She quoted references to earlier work done, all of which focused

intensively on science discourse and dismissed mathematics as a sub-field of science indicating similar results should follow.

The dissertation consists of seven chapters. In this review, I shall examine the entire work under two main headings: (1) introduction (which consists of the thesis' general introduction, literature review and research methodology found in chapters 1 to 3; and (2) main findings (chapters 4 to 7). Chapter 7 forms the conclusion of this dissertation.

Introduction

The author stated that the underlying linguistic model on which her research was based was the 3-move schema structure, known as CARS (an acronym for "Create a Research Space") model, proposed by Swales in his study of science research article discourse (Swales 1990, Bhatia 1993). According to Swales (as quoted by the author), an acceptable science research article discourse will inevitably consist of the following move structure.

Move 1 *Establishing the field*
- (A) Showing centrality
- (B) Making generalisation
- (C) Review earlier research

Move 2 *Establishing a niche*
- (A) Counter-claiming
- (B) Indicating a gap
- (C) Question-raising
- (D) Continuing a tradition

Move 3 *Occupying the niche*
- (A) Outlining purpose
- (B) Announcing present research
- (C) Announcing principal finding
- (D) Indicating structure

Figure 1. Swales' 3-move schema – or commonly known among linguists as CARS (Create a Research Space) Model

Hence her principal research question was: Is there a parallel structure behind the mind of the mathematics educator, a structure that forms an acceptable mathematics lecture discourse?

From a mathematics teacher's point of view, a model parallel to figure 1 for Junior College mathematics lecture discourse could alert Junior College mathematics teachers to the characteristic features of a typical mathematics lecture, thereby helping teachers in the preparation of lessons, especially pedagogical aspects in terms of using strategic "moves" to enhance students' understanding during lectures. This is especially important for novice teachers who will be given some useful idea on what constitutes good mathematics lectures; good lectures consist of a whole world of "moves" and strategies, not just a systematic presentation of mathematics content.

Another point worthy of note is that the author, being a non-specialist in the field of mathematics or mathematics education, made conscious effort to check her findings with the "discourse participants" (in this case, the Junior College teachers and students). Despite the difficulty in collecting data from the Junior College, she recorded all her informal feedback from students and teachers. The informal feedback – sometimes "over a cup of tea" (as she mentioned) – provided her with useful information into the model that she presented in the main chapters (chapters 3 to 6) of her work.

In chapter 3, the author described her collection of data - ten carefully recorded lecture transcripts across different lecturers from the participating Junior College. According to the author, in order to "reduce the influence of topic-dependent factors", the lecture transcripts collected were from the same section of "probability and statistics". The author's effort in collecting actual lecture transcripts is commendable. The transcripts were carefully recorded (including the non-verbal cues of the teachers and students) and presented in an appendix. This data could have been more valuable if the overhead projector material, showing actual content delivered, could have been appended in the appendix as well.

Main results of the dissertation

The main results of this dissertation can be classified into two parts: (1) lexico-grammatical structure; and (2) discourse structure, all of which span chapters 4 to 6.

Lexico-grammatical structure

The author's finding regarding the linguistic structure of the lecture transcripts can be summarized as follows:

- *Common uses of imperative sentence structure, e.g., "Consider this special case", "let us recall", "remember" etc.*
- *Absence of mathematical "jargons" nominalization*
- *Abundant use of first (singular or plural) and second person pronouns.*

According to the author, she consulted the mathematics teachers involved on the general philosophy of mathematics lectures in a Junior College in the hope of identifying a correlation between these linguistic features and the educational objectives. It is implied in chapter 4 that the role of a teacher, striking a balance between being a "controller" of the discourse and a "facilitator" of the discourse, could have affected the linguistic structure. More could be explored along this direction on exactly what the influence was. For example, The author could have conducted more interviews with the teachers involved in the recording and verified their intentions at each juncture. This could be of further interest to mathematics teachers.

One important message that can be understood from chapter 4, although not explicitly stated by the author is that not only *what*, but also *how*, the physical manifestation of what the teacher intends to achieve in lectures must be considered. The lecturers actively engage the students along the process of knowledge acquisition and help construct their knowledge of the new topic.

Discourse structure

In chapter 5, the author proposed a model for characterizing mathematics lecture discourse. A summary of her findings is presented in figure 2.

This chapter of the dissertation is particularly well written in that not only did the author propose a model to characterize Junior College mathematics lecture discourse, she also attempted to account for each "move" in her model in consultation with the Junior College teachers, capitalising on their expertise knowledge (the summary of the teachers' confirmation were recorded in the remarks column in figure 2). Further, each transcript was analyzed on a line-by-line basis to fit into the "moves" in figure 2. The final message in chapter 5 that the author noted was: there is a general "frame-work" in the mind of the (experienced) mathematics lecturers on what constitute an acceptable mathematics lecture.

A study of the lecture discourse would be incomplete without the study of the related textbooks, since the sources of lecture content are the textbooks. The author, in chapter 6, tied in a linguistic study of mathematics textbooks used by Junior College students. She conducted a short survey and found that most students found mathematics textbook difficult to read. Similar to the lecture transcripts, the author attempted to propose a model similar to figure 2 for textbook discourse and found that, in the case of textbooks, there are relatively fewer strategic "moves" to lead the students to understand the new concepts. Also, there were fewer "human elements" (as in first and second person pronouns to guide the readers along discovering and constructing new concepts) and more "rigid structures" (in the form of formal definitions, statements of theorems, word examples, and so on). The conclusion was that mathematics textbooks are difficult to read not so much as to the grammatical

Proposed Model (by the author) for mathematics lecture discourse	**Pedagogical implication (Consultation with specialist)**	**Remarks**
Move A: **Preparatory move to establish field** A1: Activating schema / background knowledge A2: Considering Specific Case A3: Showing or heightening relevance of concepts	A1: Learning is possible only when the new knowledge is anchored onto existing knowledge A2 & A3: Specific cases give students sense of relevance of the new knowledge to be acquired.	A1: Lecturers cannot expect students to have read the notes of the previous lessons before attending the current one. A2 & A3: Considerable proportion of students have instant gratification; they resist learning if they do not sense the *relevance* of the new knowledge.
Move B: **Establishing the field** B1: Introducing Concepts B2: Reinforcing concepts by exemplification or illustration	B1: New abstract concepts are introduced by illustration and drawing out its meaning rather than focusing on the technical definition B2: Actual demonstration of how concepts are applied into real numerical examples	B1: Students are not expected to be able to write out the statements of the key technical terms; they are required to know the *meaning* of the terms. B2: Students are required to *recognise* the concept in the real scenario.
Move C: **Solving actual problems** C1: Indicating a problem C2: Connecting concepts with logic and other knowledge C3: Solve the problem	This is the bulk of problem-solving in mathematics Lecture	

Figure 2. The model proposed for pre-university mathematics lecture discourse together with the pedagogical implications by specialist. (Compare with figure 1 showing Swales' CARS model)

difficulty (as it was grammatically simple), but more on the use of fewer strategies and "moves".

I would like to highlight the final remark in this chapter raised by the author, who always kept the mathematics teachers in mind when writing her dissertation: "..any new Junior College mathematics teacher should take note that lectures are not just oral versions of textbooks but that a world of pedagogical consideration is incorporated into it – more personalized and human factors are involved." Perhaps this statement could serve as an important message for practising mathematics teachers, who will be responsible for converting textbook knowledge into a form more palatable for their students.

Some remarks

This research could be considered good reading material (perhaps after removing some of the technical linguistic aspects) in any induction program for mathematics teachers newly posted to a Junior College. Some new teachers have the impression that a good mathematics lecture is one that only involves systematic presentation of content and nothing else, and a good teacher is one who is proficient in content. The finding of this dissertation tends to suggest otherwise: a teacher needs to engage the students actively in the construction of concepts during lectures to maximize students' grasping of concepts during lectures.

In fact, this dissertation suggests that linguistic study of mathematics related discourse, together with pedagogical implications for teachers, could be a new direction of research jointly undertaken by linguists and mathematics educators. Even though this dissertation is a linguistic master's degree dissertation done by a researcher who is not a specialist in mathematics or mathematics education, it does offer insight on mathematical pedagogy.

In the dissertation, as noted, a sample of ten lecture transcripts from one participating Junior College was collected and analyzed. Given the time constraints associated with a master's level study, this sample size was reasonable. Moreover, to "reduce the factor of variability across different mathematics topics", the lecture transcripts were focused on the topic on probability and statistics. Nevertheless, further research could be done along these lines by collecting more transcripts across different mathematics topics and across different Junior Colleges. Perhaps greater insight into mathematics lecture discourse could thereby be obtained.

This study – being a purely linguistic dissertation – may not have taken into account non-verbal cues. Communication is usually done beyond spoken words. Educators know the importance of non-verbal cues, such as facial expressions, hand gestures, body language and so on. Perhaps a good follow-up study could include the study of non-verbal cues.

In reality lectures are usually conducted with accompanying lecture notes prepared by the lecturers. This aspect could have been taken up in a further study and may be able to provide more interesting information of the entire lecture discourse.

This paper reflects my initial review on language in mathematics lecture discourse. Others may be interested in follow-up of this review (and the original dissertation), to consider a more thorough analysis of a complete lecture discourse (consisting of the actual spoken discourse and the lecture notes accompanying the lectures), focusing on the pedagogical implications for Junior College mathematics teachers.

References

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