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ABSTRACT

This study reports the application to classroom dialogue of the Thematic and Structural Analysis (TSA) Technique which has been used previously in the analysis of text materials. The TSA Technique identifies themes (word clusters) and their structural relationship throughout sequentially organized material. Dialogues from four Year 8 science classrooms are analyzed using the TSA Technique and the resulting structures rank-ordered on the basis of the number, quality and organization of themes. The structure of the dialogue was the most influential predictor of achievement. Implications of the findings for teaching and teacher education are discussed. An appendix includes a list of the five measuring instruments used in the study. There are 28 references cited. (Author/CW)

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CLASSROOM DIALOGUE AND SCIENCE ACHIEVEMENT

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ABSTRACT

This study reports the application to classroom dialogue of the Thematic and Structural Analysis (TSA) Technique which has been used previously in the analysis of text materials. The TSA Technique identifies themes (word clusters) and their structural relationship throughout sequentially organized material. Dialogues from four Year 8 science classrooms are analyzed using the TSA Technique and the resulting structures rank-ordered on the basis of the number, quality and organization of themes. From among an extensive list of individual and environmental characteristics, the structure of the dialogue is the most influential predictor of achievement. Implications of the findings for teaching and teacher education are discussed.

CONTENT AND STRUCTURE IN CLASSROOM DIALOGUE

The idea that the "...structure of classroom verbal communication is a fundamental variable in the understanding of the teaching process" (Anderson; 1974: 219) is supported by the proponents of inductive (e.g. Bruner; 1966), deductive (e.g. Ausubel; 1963) or eclectic approaches to teaching (e.g. Cazden, 1986). Analyses of classroom language have devoted little attention to the structure of knowledge communicated, the focus being more on the frequency and periodic occurrence of pedagogical moves (Galton; 1978; Simon and Boyer, 1975). Two significant exceptions are the work of Peel and Anderson. Peel's methodology of "describer" and "explainer" categories (Peel; 1975) although considered to have "...considerable potential (is)...only (at) a beginning and there is scope for further research" (Michell and Peel; 1977: 264). Anderson's "kinetic structure

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theory" (Anderson, 1971) although sophisticated and widely used, focusses only on teacher talk.

A technique that not only analyses the dialogue at a level of sophistication similar to kinetic structure theory but also incorporates the student contribution to the dialogue, is the Thematic and Structural Analysis (TSA) Technique (Carss; 1973). Further, since the co-occurrence of words is a fundamental aspect of the analysis, the context of the words rather than just their frequency of occurrence is accounted for.

THE THEMATIC AND STRUCTURAL ANALYSIS (TSA) TECHNIQUE

The TSA Technique was originally developed as a methodology to provide a sophisticated analysis of text material (Carss, 1973; Clarke, 1973). It has recently been modified to analyse dialogue using Bellack cycles (Clarke, 1987a, 1987b; Clarke and Carss, 1988). The procedure produces a set of themes (co-occurring word clusters), the structural relationship amongst the themes ("essential structure") and the temporal structural relationship amongst the themes across the Bellack cycles of the dialogue.

Before the original dialogue can be analysed, it is "reconstructed" using techniques devised by Loflin, Guyette, Barron and Marlin (1972) to make all of the implied language explicit.

AN EXAMPLE OF DIALOGUE ANALYSIS

The dialogue from three sequential lessons is analysed here (Note 1). The dialogue was divided into 123 Bellack cycles. From the original corpus of words, 31 words with frequency of occurrence >15 were selected for further analysis. These remaining words and their frequency of occurrence (F) are shown in Table 1.

(TABLE 1 SOMEWHERE HERE)

The principal components analysis identified 9 interpretable principal components (themes) which accounted for 73.8% of the variance. These themes are shown in Table 2.

(TABLE 2 SOMEWHERE HERE)

All themes can be named by inspection although one of them needs confirmation from the transcripts. They confirm that Theme 2 is about the warm-blooded characteristic of mammals. The overall structure of the dialogue is shown in Figure 1 and its "essential" structure is shown in Figure 2. Significant cross correlations of the themes are also shown in Figure 2.

(FIGURES 1 AND 2 SOMEWHERE HERE)

Table 2 and Figures 1 and 2 summarize the content and structure of the dialogue. The total structure is dominated by the Themes 1, 7 and 2 - teacher-student discussion on mammals. Related ideas in Themes 8, 5 and to a lesser extent, 4 emerge and recede along with the dominant structure. The major theme of teacher-student question-answer interaction, Theme 1, provides a cohering umbrella under which the content is developed. The characteristics and types of mammals (Themes 7, 2, 8 and 5) and a comparison of them with reptiles (Theme 4) is the content being dealt with. Activities (Theme 3) using equipment (Theme 6) also occur. In Lessons 1 and 2, activities involving mice sometimes in their cages occur while in Lesson 3, the emphasis is on discussion rather than student activity.

A detailed analysis of the structure is given elsewhere (Clarke; 1987a), but, in summary, Class 2 is one where there is a lot of teacher-student discussion and where the discussion is focussed strongly on science content. The normal sequence of events is that an idea is introduced, mainly by the

teacher, discussed for some time and then used to lead logically on to the next idea (e.g. cold blooded --> warm blooded) and/or a student activity. Specific aspects of the discussion are continually being related to a more general conceptual framework (characteristics of mammals) in the form of the classic Ausubelian subsumption model (Ausubel; 1963).

THE PROCEDURE USED TO COMPARE DIALOGUE STRUCTURES

If there are a number of dialogues, a comparison of their content and structures can be made by developing a number of content and structural criteria and rank ordering each of the dialogues on those criteria. The criteria developed for this study are:-

Structural:

1. The number of interpretable themes;
2. The percentage of variance explained by the themes;
3. The number of significant cross-correlations or the "coherence" among the themes compared to the total number of possible cross-correlations;
4. The number of cycles;

Content:

5. The number of themes the same as or similar to the themes identified in the corresponding text structure;
6. The number of themes explicitly related to content compared to the total number of themes.

A simple quantitative index of comparison can be obtained by finding the average overall ranking on all criteria.

A STUDY OF DIALOGUE IN SCIENCE CLASSROOMS

Conceptual Framework of the Study

The research reported here is based on a study of four Year 8 science

classrooms studying the curriculum unit, "Mice and Men" (ASEP 108; 1973) in a large metropolitan secondary school in Brisbane (Clarke; 1987a). The study is conceptualized within a Lewinian B=f(P,E) framework and involves a multivariate analysis of selected "P" variables: student personality, motivational and cognitive characteristics, and "E" variables: curriculum materials, classroom dialogue and characteristics of the learning environment. The specific "P" variables used are Conceptual Level (personality), Locus of Control (motivation) and Piagetian Level and General and Specific Scholastic Aptitudes (cognition). The specific "E" variables are the "Mice and Men" curriculum unit, teacher-student and student-student audiotaped dialogue and student perceptions of the psychosocial characteristics of their science classrooms. The particular "B" variable focussed on here as the dependent variable is achievement.

Sample

The sample consists of three teachers and 113 students in four classes distributed as in Table 3.

(TABLE 3 SOMEWHERE HERE)

The geographical location of the school is such that the student population is drawn from a cross section of socioeconomic backgrounds and the students are not significantly different from other Year 8 students in Queensland with regard to scores on compulsory standardized aptitude tests administered in the October of Year 7.

Data Collection

Dialogue was collected on audiotape. All other independent variable information was collected by questionnaire (Note 2). The dependent variable, achievement, was the student performance on the end-of-unit test

prepared by the teachers of the unit. Three sequential science lessons, each lasting for 40 minutes, were audiotaped for each class during a normal school week. All lessons occurred in a science laboratory. Allocation of students to permanent laboratory seats, identification on tape at the beginning of each lesson and the normal use of names in interaction, ensured that all students could be identified. The tapes were transcribed and used in this study to provide input into the TSA Technique.

Analysis Procedures

(a) Comparison of the Dialogue Structures

Table 4 indicates that, on the basis of the criteria outlined above, Class 2 has, theoretically, the "best" structure followed by Classes 4, 1 and 3 in that order.

(TABLE 4 SOMEWHERE HERE)

(b) Analysis of Data

Following the procedures recommended by Welch, Walberg and Fraser (1986), the analysis was done in two stages. First, a large number of independent variables were regressed on achievement. The independent variables used were age, sex, conceptual level, locus of control, Piagetian level, general scholastic aptitude, quality of the classroom dialogue and perceptions of the psychosocial characteristics of the learning environment. Appropriate conversion of non-interval variables to dummy variables was carried out (Nie, Hull, Jenkins and Steinbrenner; 1975). The structure of the dialogue (DIALSTR), locus of control (LOC), Piagetian Level (PIAGLEVEL) and general scholastic aptitude (SCHOLAPT) emerged as significant predictors of achievement. These were subjected to the second stage of the analysis and produced the results in Table 5.

(TABLE 5 SOMEWHERE HERE)

The amount of variance of achievement explained by the variables is 21.9% (Note 3). The relative contributions of the variables to the explained variance are LOC: 13.972% {(2.321÷16.611)x100}, DIALSTR: 62.278%, PIAGLEVEL: 13.630% and SCHOLAPT: 3.678%.

Of the variables having an effect on science achievement in "Mice and Men" classrooms, by far the most influential is the structure of the teacher-pupil dialogue - the better the structure, the higher the achievement. Nearly two-thirds of the explained variance in achievement can be attributed to the dialogue structure. The students acceptance of personal responsibility for academic success and their level of abstract as opposed to concrete thinking also contribute but to a far less extent. The other variable, general scholastic aptitude, in this final analysis, does not contribute significantly.

CONCLUSION

This study indicates the responsibility that rests with the teacher in an activity-oriented classroom as far as providing the structural support necessary for effective learning (Note 4). The teacher is acting as a "surrogate textbook". Using their own organization of knowledge - albiet wrong or incomplete - teachers provide the structure that is lacking. As the results indicate, some teachers can do this better than others.

A challenge for teachers and teacher educators is to devise ways of improving the structure and sequencing of classroom dialogue. The TSA Technique could help here in two ways. It allows a sophisticated analysis of dialogue, indicating specific areas of weakness which could then be

remedied by appropriate training. A similar approach has been used successfully with text material to rewrite and restructure deficient segments (Clarke; 1973). It could also be used to produce ideal "templates" of various models of teaching (e.g. Brady; 1985) for use as a guide for lesson planning.

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NOTES

Note 1. Only a brief indication of the procedure can be implied here. See Clarke and Carss (1988) for full methodological details. In the study reported later, the dialogue from four classes are compared. This dialogue comes from "Class 2".

Note 2. See Appendix 1 for details of the instruments used.

Note 3. $R^2 = 1 - (59.375 \div 75.986) = 0.219$

Note 4. In a similar analysis of dialogues in a more traditional textbook-based setting using the same classes and teachers, the structure of the dialogue did not emerge as a significant predictor of achievement (Clarke; 1987a).

APPENDIX 1

Measuring Instruments Used

1. Conceptual Level

Interpersonal Topical Inventory (Tuckman; 1964)

2. Locus of Control

Intellectual Achievement Responsibility Questionnaire (Crandall, Katkovsky and Crandall (1965)

3. Piagetian Level

Bond Logical Operations Test (Bond; 1976)

4. General Scholastic Aptitude

Test of Learning Ability (ACER; 1974)

5. Specific Cognitive Aptitudes

Reading Comprehension, Reading Vocabulary, Mathematical Aptitude and Study Skills (Byrne and Phillips; 1981).

Word	F	Word	F	Word	F
answer(n)	6;	hair	15	SR	71
answer(v)	36	human	26	student	279
blue-tongue	21	lizard	18	teacher	95
body	15	marsupial	47	temperature	95
cage	22	mean	20	TQ	94
characteristic	48	mouse(adj)	21	TR	75
container	17	mouse(n)	123	type	31
correct	50	primitive	17	up	15
dog-fight	15	put	27	way	15
go	16	question	46	warmblooded	23
				you	208

Table 1 Word Frequencies for Class 2 Dialogue

Class	Teacher	N of Students		
		Male	Female	Total
1	A	13	12	25
2	B	15	14	29
3	C	14	14	28
4	C	16	15	31

Table 3 Distribution of Teachers and Students in Classes

Theme	% Var	Words in Theme(Loadings)	
1. Teacher-student question-answer interaction	15.1	answer(n)(.84) answer(v)(.84) question(.82) correct(.77)	SR(.79) TR(.74) TQ(.65)
2. Characteristics of mammals - 1	11.3	body(.87) go(.86) temperature(.77)	human(.86) up(.72)
3. Activity: mice fighting	10.6	put(.88) mouse(n)(.77) container(.77)	fight(v)(.72) way(.65)
4. Example of a cold-blooded animal	6.8	lizard(.98) blue-tongue(.97)	
5. The meaning of warm-blooded	6.8	mean(.90) warm-blooded(.89)	
6. Apparatus for housing the mice	6.5	mouse(adj)(.90)	cage(.87)
7. Characteristics of mammals - 2	6.5	hair(.92) characteristic(.90)	
8. Type of mammal	5.5	primitive(.92) marsupial(.47)	type(.89)
9. Reference to student	5.7	you(.92)	student(.92)

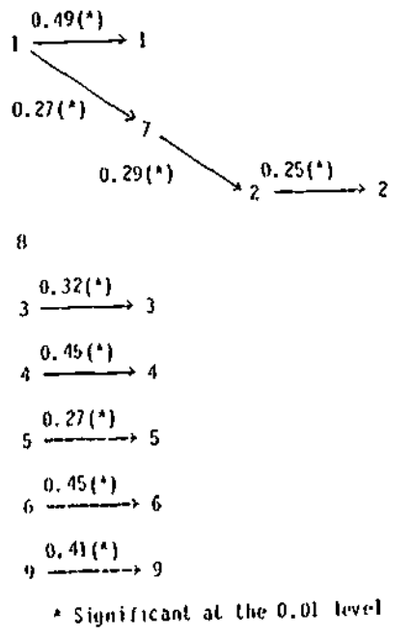
Table 2 A Summary of Themes in Class 2 Dialogue

	Class 1		Class 2		Class 3		Class 4	
Criteria	N	Rank	N	Rank	N	Rank	N	Rank
Structural:								
1. No of themes	8	2	9	1	6	4	7	3
2. Percentage of variance explained	38.7	4	73.8	2	71.8	3	79.6	1
3. Proportional coherence among and within themes	0.06	4	0.11	2	0.08	3	0.16	1
4. No of cycles	110	2	123	1	49	4	110	2
Content:								
5. No of themes the same or similar to the text	4	3	7	1	3	4	5	2
6. Ratio of content themes to total no of themes	0.38	4	0.09	1	0.5	3	0.86	2
Average of rankings		3.2		1.5		3.5		1.8
Overall Rank Order		3		1		4		2

Table 4 A Comparison of the Structures of "Mice and Men" Dialogues

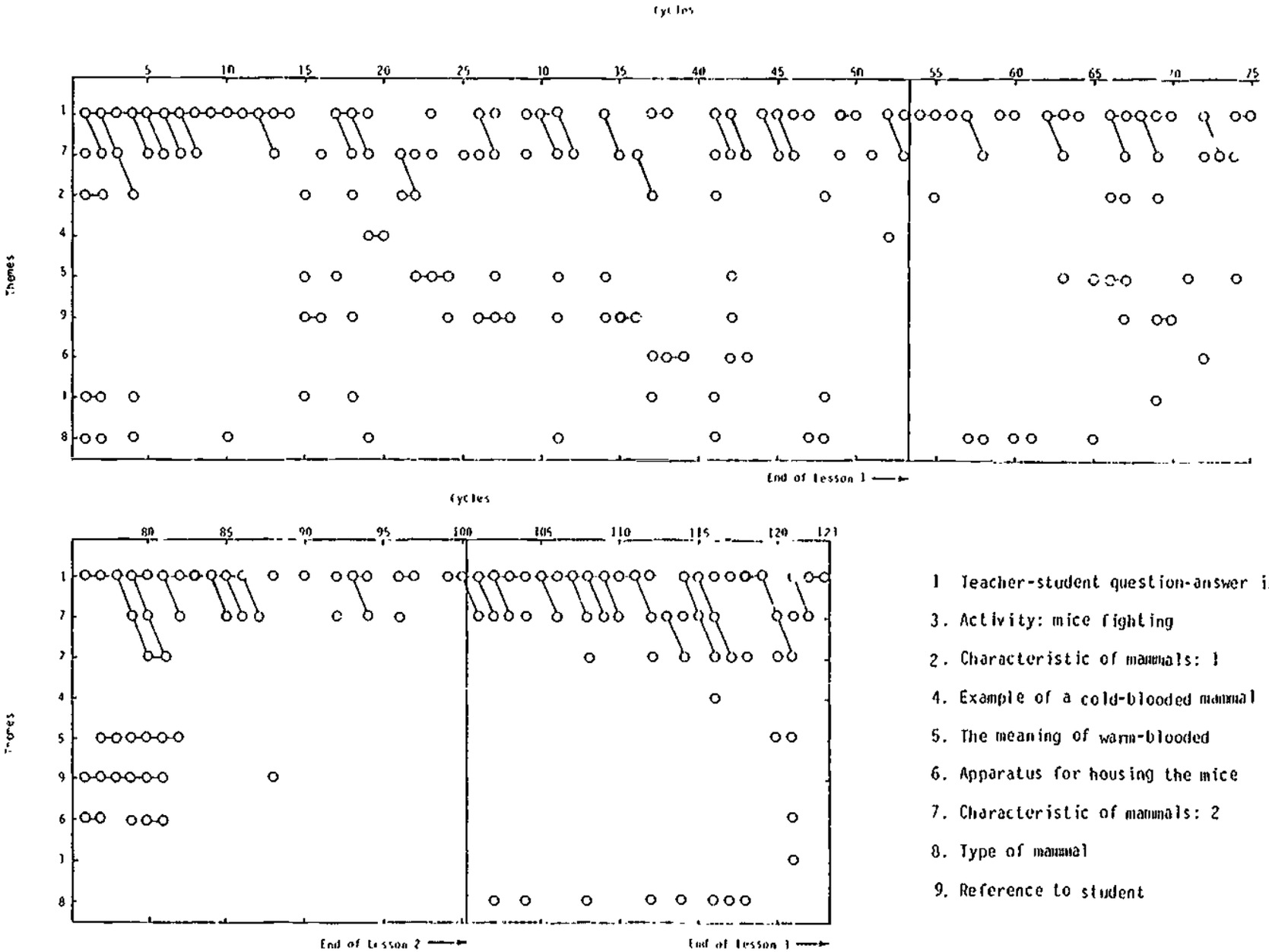
Source	df	Sum of Squares	Mean Square	F Value	Prob
LOC	1	2.321	2.321	4.220	0.042
PIAGLEVEL	1	2.264	2.264	4.116	0.045
SCHOLAPT	1	0.611	0.611	1.111	0.294
DIALSTR	3	10.345	3.448	6.269	<0.001
Residual	108	59.375	0.550		
Total	114	75.986			

Table 5 Analysis of Variance of the Significant Variables Influencing Achievement in "Mice and Men" Classrooms



* Significant at the 0.01 level

Figure 2 The "Essential" Structure of the Themes in Class 2 Dialogue



1 Teacher-student question-answer interaction

3. Activity: mice fighting

2. Characteristic of mammals: 1

4. Example of a cold-blooded mammal

5. The meaning of warm-blooded

6. Apparatus for housing the mice

7. Characteristic of mammals: 2

8. Type of mammal

9. Reference to student

Figure 1 The Structure of the Class 2 Dialogue