THE GENERATION OF ACADEMIC DISCOURSE

BY ESL LEARNERS

THROUGH COMPUTER-BASED PEER TUTORING

A CASE STUDY

by

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ABSTRACT

Does peer tutoring using computer-based hypermedia resources help ESL students generate academic discourse in L2? This relates issues of SL learning and the computer in education. I observed 10 upper elementary ESL students research the topic "Earth and the Solar System", build a HyperCard stack ("Our World") to record their results, and peer tutor the stack to younger classmates. Some peer tutored the stack again to ex-ESL Grade 5 students. I recorded both peer tutoring sessions (PT(1) and PT(2)) and analyzed discourse transcripts by quantitative variables, pedagogical objectives, cognitive functions and tutoring style; linked our discourse analysis to Krashen's (1985) Input Hypothesis, Cummins (1991) concepts of conversational and academic language proficiency, and Halliday's (1985) model of language socialization distinguishing interpersonal, ideational and textual components; and followed Staab (1986), in dividing the ideational component into "Informing" and "Reasoning".

In PT(1) students spent more time talking (56%) in computer-based peer tutoring than in any other activity (10-16%). Informing was high (65%) but Reasoning was low (22%). Tutors used predominantly the traditional I-R-E knowledge-transmission teaching model, speaking 2½ times as much as tutees. In PT(2) tutors were given as aids 1) a Tutorial stack with knowledge-structure-based computer graphics to represent each topic and 2) training in moving from I-R-E to more equal dialogue exchanges with tutees. I compared a selected pair in PT(2) with a selected pair in PT(1). In PT(2), tutors produced 27% and tutees 19% more language; Reasoning increased from 22% to 39% overall and to 46% in the Tutor Explanation
tutoring mode; and I-R-E discourse dropped from 62% to 13%. These changes marked a move from traditional knowledge-transmission towards a knowledge-construction paradigm.

I conclude that 1) peer tutoring holds great promise for development of academic discourse in the L2; 2) but without training, tutors are likely to fall back on I-R-E teacher-dominated discourse with a low proportion of Reasoning; 3) interactively using the computer facilitates a shift from traditional knowledge-transmission to cooperative knowledge-construction learning; 4) the students' use of elementary multimedia technology provides a window to a future shift from print to electronic technology and towards a knowledge construction paradigm.
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INTRODUCTION

The research question

Is peer tutoring, using a computer-based hypermedia resource, an effective means of helping ESL students generate academic discourse? We explore this question through a case study of a science unit called "Our World", a study of Earth in the context of the Solar System and of Earth's physical features, conducted by the more experienced half (10) of an ungraded elementary ESL class. The students, divided into four groups, researched the subject matter (content) in the school library, organized content in the school computer lab with Macintosh HyperCard multimedia authoring software, and peer-tutored the content in the resulting HyperCard stack to the less experienced half of the class. The homeroom teacher, the librarian and the teaching computer coordinator together planned and taught the unit.

Our research question links a number of research areas: second language acquisition (SLA), academic discourse, peer tutoring, task-based learning, and technology in education, particularly the use of computers and multimedia. In Chapter 2 we selectively review the research literature for these areas as relevant to our case study. Although our study looks primarily at only 10 students, we believe that the way they work and the tools they use offer a window through which we can perceive how the new electronic technologies, as they overtake

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HyperCard is a multimedia (or hypermedia) authoring program for the Macintosh computer. Unlike a word processing program, which is restricted to text and some graphics, the HyperCard program integrates text, graphics, sound, animation and embedded computer programs in a product which on screen looks like an index card. A number of cards comprise a stack. Unlike text, which is read serially, each card contains "buttons" which, when clicked, branch directly to other cards in the stack. A stack is therefore multiply cross referenced giving users a choice in navigation: - serially, randomly (browsing), or to a predetermined plan.
the long-standing technology of print, may facilitate a change in the classroom teaching paradigm from knowledge transmission to knowledge construction.

**SLA perspectives**

Three views on second language acquisition are relevant to this study (Figure Intro.1):

1. Krashen's (1983) Input Hypothesis: The learner acquires the second language (L2) code through exposure to comprehensible input, i.e. L2 input at no more than one stage above the learner's current stage of grammar acquisition. As the learner progresses through the L2 learning stages, so the complexity range of comprehensible input increases.

2. Cummin's (1984) distinction between conversational and academic language proficiency: On a continuum from "cognitively demanding" to "cognitively undemanding", the conversational or academic language proficiency.
academic discourse is in varying degrees "demanding" and conversational discourse is in varying degrees "undemanding". The second language learner's success in mastering "content" and so progressing satisfactorily through the educational system depends upon acquiring the more difficult academic language skills rather than the more quickly acquired and less difficult conversational language skills.

3. Halliday's (1975, 1985) language-socialization model of language learning: Language, perceived as a sociosemantic system for making meanings, is both a medium of learning and an instrument of socialization within specific contexts of situation and culture. Thus second language learning is seen in terms of acquiring the L2 code not in isolation but as an integral part of learning content and the L2 culture. Halliday's model provides a system for a holistic analysis of discourse that provides insights into ways discourse contains ideational, interpersonal and textual components ("textual" relating particularly in this case study to use of the computer). It also links with the Cummin's issue of the difference between academic and conversational discourse.

**Significance of Academic Discourse**

We use "academic discourse" to mean "the language of teaching and learning" as distinct from the language of everyday social intercourse. Cummins and Halliday both make this distinction.

**Cummins**

Cummins (1991) distinguishes between conversational and academic language proficiency. He has discussed this distinction previously (1984:136-7) in terms of "cognitive academic language proficiency" (CALP) and "basic interpersonal communicative skills" (BICS):
(BICS is) defined in terms of the manifestation of language proficiency in everyday communicative contexts whereas CALP (is) conceptualized in terms of the manipulation of language in decontextualized academic situations.

He draws out the significance of this interpersonal/academic distinction:

The major points embodied in the BICS/CALP distinction are that some heretofore neglected aspects of language proficiency are considerably more relevant for students' cognitive and academic progress than are the surface manifestations of proficiency frequently focused on by educators.

In other words, coping well with social situations is not an indicator that students (and particularly L2 students) will be prepared to cope with the academic discourse of classroom and lecture hall as their education proceeds.

Mohan (1989:100) points out the negative impact of low CALP on students' performance in the "content" subjects in their education:

While the exact definition of these (BICS/CALP) is controversial, there is evidence that while immigrant students may acquire basic interpersonal communication fluency in 1-2 years in the host country, they may require as much as 4-8 years for academic language proficiency, during which time subject area achievement may be considerably depressed.

In Cummins' terms, the academic future of these ESL students -- completing high school, readiness for university -- depends on their cognitive academic language proficiency, i.e. their competence to understand and produce academic discourse in the classroom and its written counterpart, expository writing. We will adopt the term "academic discourse" as a convenient label for an important issue while noting that Cummins' use of the term does not escape completely from the criticisms raised about his previous term "cognitive academic language
proficiency" (CALP). Our prime example of academic discourse will be the language of teaching and learning as it occurs in peer tutoring.

**Halliday**

Halliday (1985:xiii) distinguishes between the two main kinds of meaning in all languages: the "ideational" and the "interpersonal":

> These components, called "metafunctions" in the terminology of the present theory, are the manifestations in the linguistic system of the two very general purposes which underlie all uses of language: (I) to understand the environment (ideational), and (ii) to act on the others in it (interpersonal).

Wherever it takes place, ideational component embraces "the whole of the transitivity system in language -- the interpretation and expression in language of the different types of process of the external world, including material, mental and abstract processes of every kind . . ." (Halliday, 1973:39). The "content" subjects in the school curriculum are primarily concerned with the world and its processes (including the social world). We may, therefore, expect the ideational component of discourse to be of special interest in the classroom where those subjects are taught.

Halliday thus offers an approach to discourse analysis which can be used to illuminate the processes of peer teaching.

**Peer Tutoring**

Peer tutoring has been widely claimed to be effective in first language content learning and developing cognitive skills (Goodlad 1979; Gerber & Kauffman 1981; Sharpley & Sharpley 1981; Topping 1988; Johnson & Johnson 1983; Bloom, 1984; Goodlad & Hirst 1990; Johnson,
Research like Flanigan (1991:141) have also claimed its value in promoting simultaneously second language discourse and content understanding. Flanigan notes:

that recent studies of interactive learning in the SL classroom have emphasized teacher-student and student-student discourse as a means of breaking the tradition of teacher-fronted one-way instruction.

Taking Cummin's perspective, it is therefore natural to ask whether peer tutoring can be valuable for developing academic language proficiency.

In our case study, student discourse resulted from cooperative work in the library and computer lab and from peer tutoring at the end of the Our World unit. We measured the amount of student talk as a percentage of total time in these activities and in teacher fronted whole class instruction to determine the effectiveness of peer tutoring in generating student talk compared with the other classroom environments. We then used discourse analysis to focus on the type and quality of language generated from the peer tutoring activity.

**Research methodology**

We used two major research methodologies:

1. **discourse analysis** for the recording, analysis and evaluation of peer tutoring discourse;
2. **work study** for the recording, analysis and evaluation of student tasks and activities.

**Discourse Analysis**

We analyze the students' peer-tutoring discourse under three separate headings:

1. **Quantitative.** A quantitative analysis of volume of talk by the variables: word count, words per minute, mean length of utterance, turns by number of utterances, utterances by number of words. For this analysis we draw on the Systematic Analysis of Language Transcripts (SALT).
system (Miller & Chapman, 1984-1991) from the University of Wisconsin-Madison Language Analysis Laboratory.

2. **Cognitive/Tutoring Mode**. A quantitative and qualitative analysis by:

   a. Halliday/Staab discourse functions:
      
      i. Interpersonal broken down by Social Needs and Controlling;
      
      ii. Ideational broken down by Informing and Reasoning;


   For **cognitive analysis** we draw on Staab (1986) who, following Halliday (1973), distinguishes between cognitive (ideational) functions and sociocultural (interpersonal) functions with further breakdowns shown above; and we draw on Mohan's (1986) Knowledge Framework for cognitive analysis of computer graphics support, recognizing that knowledge structures apply across modes of communication to graphics as well as text.

   For **tutoring mode analysis** we use our own categories, derived from inspection of the discourse transcripts. We provide detailed definitions of cognitive discourse functions and tutoring modes when describing peer tutoring results in Chapters 4, 5 and 6.

3. **Pedagogic**. A qualitative analysis by pedagogical objective for evidence of:

   a. students achieving the teachers' objectives for the unit or lesson;

   b. interpersonal dynamics between tutors and tutees.

   For this analysis we draw on general concepts of classroom discourse (Mehan 1979; Cazden 1988), and on Mehan's identification of the Initiation-Response-Evaluation (I-R-E) style of
classroom discourse, which Cazden (1988:53) calls the "default" pattern: "what happens unless deliberate action is taken to achieve some alternative".

**Functional model of language**

In our "pedagogical" and "cognitive" analyses, we follow Halliday's (1985) functional model of language which requires an examination of the discourse situation in terms of field (content or subject matter) manifested in the ideational function of discourse, tenor (participants' role relationships) manifested in the interpersonal function and mode (communication channels), represented by the textual function which shapes the other discourse structures. Mode in the peer tutoring situation includes oral discourse supported by computer graphics, recorded voice, and on-screen text (i.e. "multimedia"), as well as printed worksheets and, in a hands-on context, practical demonstration of and experimentation with physical operations. The ideational and interpersonal components are not present in the text as discrete blocks but rather as interwoven strands bound together by the textual elements and expressed through the students' words, actions and behaviour.

Taken as a whole, our discourse analysis covers a range of discourse aspects: our narrowly defined "quantitative" analysis; our more broadly defined "cognitive" analysis; and our qualitative "pedagogical" analysis which evaluates students' words and actions to provide not only an analysis by pedagogical objectives but also a qualitative framework for interpreting the other discourse aspects.
Work Study concepts and techniques

Our case study is an example of task based instruction. The students had tasks to perform that were not simply classroom exercises: they had to produce a final end product in the form of a HyperCard stack that would be a resource for teaching other students what they had learned; they had to organize and produce hard copy of their stack in order to publish a printed booklet for the school's Visitors' Day; and they had to perform necessary intermediate tasks of planning, research, note taking, organization of information, and computer/HyperCard operations in order to deliver their end products. Finally, they had the task of tutoring their less experienced classmates who knew nothing about the Our World stack. Their tasks were, in principle, the same as "real-world" tasks for producing teaching materials for an institution or business organization.

Because of this strong natural task orientation we elected to use Work Study methodology to record and analyze student activities rather than classroom observation systems such as the Flanders System of Interaction Analysis, which are more oriented to whole class teaching. Simon and Boyer (1975:92) characterize Flander's as "the most widely known and used classroom observation system" in their anthology of 99 classroom observation instruments to which we refer in our review of literature in chapter 2A.

Work Study, a British term, falls under the discipline of industrial engineering in the United States. It represents a rich research tradition developed within business and industry for the study of real-world tasks in context in order to improve products and services, and increase productivity. It has much in common with educational case study research. In particular, we draw on the following techniques:
**Activity Sampling.** We use systematic activity sampling (SyAS) based on an approximately two minute interval (Haines 1958), derived from simple random sampling (SRS) (Tippett 1935), to answer the question "What is going on in the classroom/computer lab/library"? The answer is expressed as percentages of time spent on student activities, e.g. at one level: group work, solo work, "teacher fronted" whole-class work; and at another level: speaking, reading, writing.

**Recording.** We use a variety of data gathering techniques including: the quantitative technique of activity sampling (already described); techniques to record the nature and sequence of task work such as operation flow process charting; and the qualitative techniques of participant and non-participant observation and interviewing; .

**Critical Examination.** As well as general qualitative analysis, we use informally the work study technique, Critical Examination, to identify key operations in order to develop task design enhancements for the future. We do not report on suggested enhancements in this dissertation.

Having described our purpose, basic research perspectives, and methodologies employed, we turn to an Overview of the project to briefly describe outcomes.
OVERVIEW

"Our World" unit: work flow

Outline Flow Process

Figure Over.1 shows the three broad activities in the Our World unit: library research in which the students work in groups of two or three in the library; HyperCard operations in which they work in groups of two or three in the computer lab; and peer tutoring in which they work in pairs: all pairs together in the computer lab or one pair at a time in the computer coordinator's office. We analyze the discourse from the peer tutoring operation (activity) with a focus on academic discourse.

Detailed Flow Process

Flow process analysis is typically expressed in terms of inputs and outputs. Adopting this as a convention, Figure Over.2 expands the Outline Flow-Process Chart in Figure Over.1 to show inputs and outputs in greater detail and also to show knowledge structure linkages to operations. Each operation (activity) produces simultaneously two outputs: subject matter content and student discourse. We examine in particular the student discourse from the peer tutoring activity from which we develop "pedagogic" and "quantitative" analyses for all tutor/tutee pairs, and "cognitive/tutor mode" analysis for one representative pair.
The flow process shown is the one finally put into place as described later in this Section under the heading "Second peer tutoring sessions". It includes the use of the "Tutorial" stack containing knowledge-structure-based computer graphics as a tutoring aid.

Description of process

Research. The students working in groups draw on books, software and other material in the library and produce as outputs 1) their written research notes and drawings and 2) oral discourse.
**HyperCard operations.** In the second dual operation, HyperCard and Graphics, they draw on their research notes and drawings and, working in groups on the computer, produce as outputs 1) a HyperCard stack integrating text, graphics and sound and 2) oral discourse.

**Peer tutoring.** In the third and final operation, Peer Tutoring, each tutor/tutee pair, working on the computer, draws on the Our World HyperCard stack and on the front end Tutorial stack and produces as outputs 1) their negotiated and internalized subject matter understanding and 2) their negotiated and externalized oral discourse.

**Knowledge structures.** Knowledge structures (KSs) (Mohan, 1986) are shown as a linking device. They link with operations as process -- describing, classifying etc. -- and with outputs as product -- description, classification etc. In the research operation in the library, the students are encouraged to recognize the KSs implicit in their library source material, particular the KSs of description, classification and sequence, and to use KSs as an organizing device as they prepare their notes and charts. The KSs as product in the source material accordingly tend to become embedded as product in the students' notes and charts. Then in the computer lab the students draw on their library notes and charts and again use KSs as an organizing device as they build the "Our World" HyperCard stack. The KSs as product in the students' notes and drawings accordingly tend to become embedded as product in the "Our World" stack. Finally, the students draw on 1) the "Our World" stack, where KSs are implicitly embedded, and 2) on the "Tutorial" stack where, through key visuals, KSs for each topic are made explicit, and negotiate an understanding of the subject matter. This negotiated content is the final and intangible end product of the peer tutoring operation, present as understanding in the students' minds. Because
the discourses are recorded, the KSs as product can be identified in the tangible end product of the transcripts.

The case study falls into three parts:

**Part 1** which includes: a) the construction of the Our World HyperCard stack; b) the peer tutoring sessions, PT(1), at the end of the unit and of the school year; and c) the quantitative and qualitative discourse analyses of the peer tutoring sessions.

**Part 2** which includes a) new peer tutoring sessions, PT(2), at the beginning of the new school year with new tutees and the addition of a "Tutorial" stack; and b) the quantitative and qualitative discourse analyses of the peer tutoring sessions.

**Part 3** which includes a cognitive discourse analysis by Halliday/Staab language functions and by peer tutoring modes, applied to two selected and comparable tutor/tutee pairs: one from the first peer tutoring sessions, PT(1), and the other from the second peer tutoring sessions, PT(2).

**Part 1: Construction of Our World stack and first Peer Tutoring sessions (PT1)**

We conducted a 3½ month ecological study of the more experienced half of the class (ten students) who worked in four groups to produce the "Our World" stack and, in tutor/tutee pairs to peer-tutor its content to the less experienced half of the class. The teachers had decided on peer tutoring as an experiment at one of their planning meetings after teaching the unit had started. The objective was twofold: 1) to see if peer tutoring would be an effective means for the tutors to consolidate their understanding of the unit's content; and 2) to let the tutors share the results of their work with the other half of the class. Results were as follows:
1. Peer tutoring proved effective in producing student talk (Krashen, 1985; Long & Porter, 1985) in quantity: activity sampling showed 56% of total time was student talk in peer-tutoring compared with 10-16% in other activities in homeroom, library and computer lab.

2. A quantitative analysis of peer tutoring discourses showed that the tutors benefited more than the tutees. They produced relative to the tutees:
   - two-and-a half times as many words per minute (a measure of total student talk);
   - more than three times as many multi-utterance turns;
   - more than three times as many utterances of three words or more;
   - one-and a-half times the mean length of utterance (MLU).

3. Peer tutoring appeared effective in achieving the teachers' pedagogic objectives for the Our World unit. A qualitative "pedagogical analysis" of the discourse transcripts offered evidence that:
   a. The tutees gained an appreciation for the content of the Our World stack, shown by their satisfactory completion of a written evaluation booklet after the peer tutoring sessions.
   b. The tutees learned HyperCard operations and showed by the end of the tutorial sessions that they could navigate the Our World stack with minimal assistance from the tutors.
   c. The tutors consolidated their understanding of that part of the content they had worked on and became familiar with the content they had not worked on. This was shown by their questions and discussions with each other and their teachers, as recorded in the discourse transcripts.

4. Additional qualitative analysis showed that:
a. The teaching style most commonly used by the tutors was their version of the traditional "Initiation-Response-Evaluation" (I-R-E) style (Cazden, 1988) to which they had been socialized (Halliday, 1975) in their previous classroom experience. They initiated (I) questions (thereby maintaining control) to which they expected to receive memorized responses (R) which, in turn, they evaluated (E) as right or wrong.

b. The tutors' authoritarian control of the discourse in their question-driven approach introduced some unproductive interpersonal tensions between tutors and tutees.

c. A notable exception to the use of the I-R-E teaching style in Part 1 was discourse associated with hands-on instruction in the form of learning and applying the HyperCard commands with mouse and keyboard. This all took place in Part 1. Although the tutors spoke more than the tutees in these sequences as they did in the I-R-E sequences, the dialogue between tutor and tutee was more spontaneous and varied and the tutees experienced the satisfaction of "getting it right" by direct feedback from the computer screen.

Part 1 ended with the end of the school year in June, 1992.

**Part 2: Second Peer Tutoring sessions, PT(2)**

Although Part 1 realized many benefits, the teachers were not satisfied with the quality of discourse produced by the tutors' question-driven approach. To help future tutors move away from this "default" teaching style (Cazden, 1988), the computer coordinator, in preparation for the new school year, developed a "Tutorial" stack as a front end to the "Our World" stack. The Tutorial stack was designed to provide students with contextual support in the form of computer-graphics (key visuals) to represent the knowledge structures (classification, description, sequence
etc.) inherent in each topic. The tutors were shown how to use the key visuals and practised by tutoring each other. Over a one month period at the beginning of the new school year I observed and recorded new tutoring sessions on four of the original tutors with new tutees. Results were as follows:

1. The same high level of student talk as achieved in Part 1 was maintained in Part 2.

2. The tutors moved away from one-way, question-driven "transmission" teaching towards expository discourse based on the key visuals.

3. The tutors encouraged the tutees to explain in their own words the topics which the tutors had explained and provided assistance, as required, with explanatory dialogue.

4. Control was more equally shared between tutors and tutees.

5. The tutors were more empathetic to the tutees' needs and feelings.

6. However, despite these positive qualitative changes:
   a. The tutors tended to fall back on the I-R-E teaching mode when the tutees had more than minor difficulty in emulating the tutors' explanations.
   b. The tutees showed only modest quantitative improvements relative to the tutors in Part 2 over Part 1: up 7.5% on words per minute (the tutors still spoke more than twice as much as the tutees overall); up 7% on mean length of utterance (MLU); and less than 1% up on total # utterances. The highest rate of increase was 17% on 5+word utterances.
Part 3: Comparative analysis of selected pairs in PT(1) and PT(2)

Unresolved issues in comparing PT(1) with PT(2)

At this point we recognized three problems:

1. The tutor/tutee pairings in Part 2 were not directly comparable to those in Part 1 because the tutees' profiles in Part 2 differed significantly from Part 1.

2. Our pedagogic and SALT quantitative analyses of discourse had not addressed the question of measuring academic discourse quality. Therefore we did not have objective evidence for our judgement, based on observing the tutoring sessions and reading the discourse transcripts, that the academic discourse quality was better in Part 2 than in Part 1.

3. Also, a careful reading of the discourse transcripts indicated that the tutors varied their tutoring strategies in the course of any one session. Therefore our quantitative analyses of each whole discourse could conceal potentially important differences among the different tutoring strategies used, a consideration that would also apply to the cognitive analyses that we were about to develop.

Procedure for "cognitive" and "tutoring mode" discourse analysis

We therefore took the following steps to prepare for a comparative cognitive analysis of Part 1 and Part 2 in total and by tutoring mode:

1. We based our "cognitive" analysis on Halliday/Staab language functions and our "tutoring mode" analysis on our own determination of peer tutoring modes, as shown in the following Table:
Table Over.1: Language Functions and Peer Tutoring Modes

<table>
<thead>
<tr>
<th>Language Functions</th>
<th>Peer Tutoring Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halliday</td>
<td>Staab</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Social Needs</td>
</tr>
<tr>
<td></td>
<td>Controlling</td>
</tr>
<tr>
<td>Ideational</td>
<td>Informing</td>
</tr>
<tr>
<td></td>
<td>Reasoning</td>
</tr>
<tr>
<td></td>
<td>Unstructured</td>
</tr>
<tr>
<td></td>
<td>Hands-On</td>
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<tr>
<td></td>
<td>Set Questions</td>
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<tr>
<td></td>
<td>Review</td>
</tr>
<tr>
<td></td>
<td>Tutor Explanation</td>
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<tr>
<td></td>
<td>Tutee Emulation</td>
</tr>
<tr>
<td></td>
<td>Joint Construction</td>
</tr>
<tr>
<td></td>
<td>I-R-E</td>
</tr>
</tbody>
</table>

2. We identified two tutor/tutee pairs, one from Part 1 and one from Part 2, that could reasonably be compared because the tutor was the same in both pairs and the two different tutees had similar profiles.

3. We carried out a cognitive discourse analysis in total and by tutoring mode on the two selected tutor/tutee pairs.

4. We also included in this analysis a count of a) exophoric references because they are particularly to be expected in computer based discourse, the computer screen being the point of reference; and b) I-R-E utterances because we wished to see if the tutors succeeded in moving away from this teaching style in PT(2).

Results of comparative analysis

Cognitive Analysis by Tutoring Mode (see charts in Chapter 7)

1. Peer Tutoring proved equally effective in generating Informing/Reasoning discourse in PT(1) (87%) as in PT(2) (86%).
2. However, the split of Ideational between Informing and Reasoning changed significantly between PT(1) and PT(2): Reasoning increased from 22% in PT(1) to 39% in PT(2) while Informing correspondingly decreased from 65% in PT(1) to 47% in PT(2).

a. A key factor in the Reasoning gain in PT(2) appeared to be the ability of both tutors and tutees to raise the quality of their academic discourse by replicating in it the knowledge structures embedded in the computer graphics.

3. In PT(1), the peer tutoring mode least productive of Reasoning discourse is "Unstructured" (9%), in which tutor and tutee browsed through the stack without a pre-set agenda. This compares with 27% for the Set Questions and Review modes, both of which are highly structured.

4. In Part 2, the peer tutoring mode least productive of Reasoning was Tutee Emulation (34%). This was higher than the modes most productive of Reasoning in Part 1, Set Questions and Review (both 27%).

5. Reasoning in Part 2 further increased from 34% in the Tutee Explanation mode to 38% in Joint Construction and 46% in Tutor Explanation.

**Hands-On**

The "hands-on" work in this unit was learning and applying the HyperCard commands with mouse and keyboard. All of this occurred in Part 1. Therefore, as we were not concerned with comparing Hands-On with Part 2 but rather with determining its functional profile, we could use data from all the tutor/tutee pairs in Part 1. The results were: Informing, 53%, Reasoning, 20%, Controlling, 23% and Social Needs, 4%.
1. Controlling (23%), a function shared between the tutor and tutee, was higher for Hands-On than for any other tutoring mode in either Part 1 or Part 2. Joint Construction in Part 2 was closest at 16%. Both cases were in the nature of co-operative ventures with both tutor and tutee proposing, counter-proposing and discussing how to proceed. Therefore a high score on Controlling is to be expected.

2. The score on Reasoning (20%) is perhaps surprisingly high as there is a tendency to think of hands-on instruction as essentially the tutor telling (informing) the tutee physically what to do. Reasoning becomes necessary when the tutor explains why an operation is needed or why a wrong move has produced a certain result.

**Exophoric references**

1. Exophoric references were highest in the Hands-On mode (16%) because of the frequency of pointing to screen or keyboard both in giving directions and asking questions.

2. They were present but lower (3-5%) in all other modes in both Parts 1 and 2 except Review, which was zero.

3. They were zero in Review because Review was carried out like a classroom exercise with no reference to the computer screen, an exophoric area of reference for the other modes.

**I-R-E**

1. I-R-E predominated in Part 1. A breakdown by tutoring mode showed that it was found in the Set Questions (76%) and Review (81%) modes but did not appear at all in the Hands-On mode. This may be because I-R-E is a technique for transmitting textbook knowledge (the "facts") and is irrelevant to teaching practical ("how to do") operations.
2. I-R-E appeared residually in Part 2. It did not appear in Tutor Explanation, was negligible in Joint Construction, but accounted for 34% of the Tutee Emulation discourse. This was because the tutor would resort to the I-R-E default when the tutee got beyond a certain point of difficulty in his or her explanations.

3. I-R-E is associated with teacher direction. A qualitative examination of the discourse transcripts showed that the tutor controlled the I-R-E sequences, starting from the first "I" question. This changed in Part 2. With the tutor in Tutor Explanation mode, the tutee would break in with a question or a challenge so that control was shared. In the Tutee Emulation mode, the tutee always started in control. Only beyond a certain point of difficulty would the tutee lose control -- and not regain it when the tutor reflexively reverted to I-R-E.

4. Only when control is shared does the tutee begin to benefit in L2 usage to the same extent as the tutor. Therefore the tutee will gain substantially less than the tutor in I-R-E sequences.

In the next Chapter, we describe in some detail the history, participants and progress of the Our World unit to provide an adequate context for understanding the discourse analyses and results that are described in later chapters.
CHAPTER 1: DESCRIPTION OF OUR WORLD UNIT

Introduction

The Unit divides into two parts:

1. ESL students' library research and computer lab operations to produce a HyperCard stack called "Our World" on the physical features of Earth and its place in the Solar System.

2. Peer tutoring of the stack by more experienced to less experienced students.

The peer tutoring part divides into two:

a. Peer tutoring of the Our World stack at the end of the unit by the more experienced half of the class who had built it, to the less experienced half who had worked on a different computer lab unit.

b. Peer tutoring of the Our World stack three months later by some of the students who had built it to some younger ex-ESL students from other classes. On this occasion, the tutors had the advantage of a new Tutorial front end which had been provided for them to use with the Our World stack.

Building of Our World HyperCard stack

The site was a large metropolitan elementary school with a high ESL enrolment. The home room teacher, "Karen Black", divided her ungraded ESL class of twenty students between the ages of 10 and 13 into two on the basis of L2 experience. The more experienced half of the class completed a science unit designed to introduce basic concepts about the solar system and planet Earth. The unit took the form of research in the library under the librarian, "Jim White", and building a Macintosh HyperCard stack in the computer lab under the
computer lab coordinator, "Harry Green". The ten students were divided into four groups. Each group chose one "overall topic" and at least two "physical features" from Table 1.1.

Table 1.1: Our World Topics

<table>
<thead>
<tr>
<th>Overall Topics</th>
<th>Physical Features of Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar System</td>
<td>Oceans</td>
</tr>
<tr>
<td>Day and Night</td>
<td>Mountains</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Islands</td>
</tr>
<tr>
<td>Our Earth</td>
<td>Rocks</td>
</tr>
<tr>
<td></td>
<td>Rivers</td>
</tr>
<tr>
<td></td>
<td>Caves</td>
</tr>
<tr>
<td></td>
<td>Forests</td>
</tr>
<tr>
<td></td>
<td>Volcanoes</td>
</tr>
<tr>
<td></td>
<td>Deserts</td>
</tr>
</tbody>
</table>

The students produced at least three HyperCards on each topic and prepared an Introduction and Table of Contents. The Our World stack was published in two formats, book and electronic, as exhibits for the school's Visiting Day. Three additional topics, Lakes, Jungles and Soil were added to the stack after Visiting Day. Appendices 1 and 4 show samples of the cards produced.

Peer tutoring of Our World HyperCard stack

1. Peer tutoring to students from same class

At the end of the unit, the half of the class who built the stack peer tutored its contents, with an emphasis on the Overall Topics, to the other half of the class who had been working on a different unit.

2. Peer tutoring to students from other classes

Based on the results of the first peer tutoring sessions, Harry Green (the computer coordinator) built a supplementary Tutorial stack as an aid to future tutoring. Early in the next school year, Harry arranged for four of the original tutors, now mainstreamed from ESL to
Grade 6 or 7 classes, to use the new Tutorial stack with the Our World stack in special tutoring sessions to younger Grade 5 ex-ESL students.

History

Sources

The sources for this history are my observation records, tape recorded interviews, and documentation provided by the three teachers connected with the Our World unit: Karen Black, the homeroom teacher; Jim White, the librarian; and Harry Green, the non-enrolling, teaching computer coordinator and English language support teacher. Documentation includes lesson plans, minutes of meetings, and samples of student products from the Our World unit and from previous units using a combination of homeroom, library and computer lab resources. I attended the teachers' joint planning meetings (the first was held on February 14) and regularly observed Our World periods in both library and computer lab.

Teachers' collaboration

The three teachers collaborated in producing the Our World unit in the school year 1991-92. They had previously worked cooperatively in the 1990-91 school year. Karen had discussed with Jim the idea of producing a unit whose output could be presented at the community Arts and Letters Festival in the Spring of 1991. They settled on the Weather, which Karen was planning to teach for science in her ungraded ESL class, with the idea of the students producing and publishing a book. They asked Harry to teach the class HyperCard in the Macintosh computer lab so that HyperCard could be the producing medium. The students researched their topic in the library. Jim, the Librarian, taught them how to take notes and supervised their production of sentences, paragraphs and illustrative diagrams and
pictures. The students took their written materials and illustrations to the computer lab where
Harry taught them Macintosh HyperCard basics and how to enter their materials into a
HyperCard stack (a computer file based on a card index metaphor with an emphasis on the
coordination of text, graphics and sound). The end product of the Weather unit was a booklet
Let's Find Out About the Weather, reproduced from printouts of the Weather HyperCard
stack.

The Our World Unit

The Weather unit became the model for the Our World unit in Karen's new class for
the 1991-92 school year. The ten more experienced students who worked on Our World had
been beginners the previous year and had not, except for one, worked on the Weather unit.
They became familiar with HyperCard in their first project of the new year through a unit on
Canada which Karen taught them in collaboration with Harry. Karen supervised their
production of content and Harry taught them HyperCard basics. Karen wanted to move on to
Our World because she found that even her ten more experienced students (ages 11-13) knew
very little about the earth. They knew that it was round but could not say what caused day
and night, what were the effects of the sun and moon on the earth, and what were the broad
physical features of the earth. On a scale of one to ten, Karen rated even the highest of this
group at little beyond two in this regard. Therefore, in October, 1991, she spoke to Jim about
teaching them research skills in the library with Our World as the focus and in early January,
1992, asked Harry to do a full HyperCard unit with them as he had with last year’s class on
the Weather unit. All the instruction on Our World was done by Jim in the library and Harry
in the computer lab. This left Karen free to work independently with her ten less experienced
students (seven, ages 9-11 and three, age 13). She worked with this group in the computer lab at the same time as Harry worked with the Our World group and would occasionally help out with Our World students' questions as they worked at their computers.

**Cooperative teaching**

Karen, Jim and Harry worked together in two ways, joint planning and joint teaching, building upon their previous successful collaboration in the previous year. We will look at how they did this but first describe their teaching background.

**The teachers background**

Karen. Karen had been ten years in teaching, all ESL, in several schools. This was her third year in the present school, which was the only school in her experience to offer access to collaborative team support. She identified several advantages to this approach:

1. The ESL students rotate among different teachers and therefore get varied conversational experiences.

2. They get used to the demands of English as the language of discourse where teachers are not ESL trained and do not slow down and simplify their speech as an ESL teacher does.

3. The students benefit from the expertise of other teachers.

4. When the class is ungraded, the ESL teacher can spend time more intensively with the beginners, who need more individual attention, while the more experienced students work in the library, computer lab or elsewhere with other teachers.

Karen enjoys working on a resource team and takes every opportunity to draw on the school's library and computer lab services, represented by Jim and Harry.
Jim. Jim had been teaching for just on 30 years in elementary schools, just over 20 years as a teacher-librarian, and the last 10 years in the present school. What he particularly likes about the teacher-librarian's job is the opportunity it gives to know and work with the whole school from K through 7. He also finds working with other teachers stimulating. He noted that cooperative teaching in his experience had come to the fore only in the last ten years. Before that the theory of the library being the "heart of the school" and actual practice were very different matters. However, there has now been a shift and other teachers are becoming accustomed to using the services of a librarian-teacher, at least in his present school. He collaborates with all the teachers in the school, although more intensively with some than others. He works particularly closely with Harry who provides a similar teacher-support service in the computer lab.

Harry. Harry had been teaching just over 12 years. He majored in English literature and then did his Master's in English literature and ESL methods. He joined the present school ten years ago at the same time as Jim. Harry was interested in the potential uses of computers in education right from the advent of the personal computer. In his first school he used the single PET computer extensively and learned programming. In the present school he used the early generation Commodore 64s. He was particularly interested in LOGO programming, simulation applications like Rocky's Boots and graphics applications like Koala Pad, all of which made it possible for students to play an active role in using the computer rather than the passive role dictated by traditional drill-and-practice computer-assisted instruction (CAI). In his present school, Harry pushed for the installation of a Macintosh computer lab because he could see the potential of HyperCard (bundled with the "Mac") to allow students not only
to use the computer interactively to construct and store knowledge but also to communicate
that knowledge in creative ways through the "knowledge navigation" of a computer file
integrating text, graphics, animation and voice. Students, who grow up as passive consumers
of TV, can learn how to use a TV-like medium actively as an authoring system to produce a
multi-media electronic text with a greater potential to communicate than simply printed text
on a page. Harry finds that the use of HyperCard both to author and communicate an
electronic text strongly motivates students to apply themselves and brings out their pride of
authorship. He also feels that a dynamic HyperCard stack is more inviting to a viewing
student, particularly in ESL, than paper products. Moreover, the students get a practical
introduction in an elementary way to the multi-media concept which is now a dominating
trend in the use of PCS in the workplace for producing training materials, catalogues, in-
house communications and business presentations.

Jim and Harry trained together on the Knowledge Framework (Mohan, 1986) in a
government "Funds for Excellence" program and have found the representation of knowledge
structures in key visuals a positive factor in presenting content material. They have
internalized Knowledge Framework concepts in the way they teach because they have found
them effective both in lesson planning and in helping students understand content.

Figure 1.1 presents a visual model of the cooperative teaching employed.
Joint Planning

Karen produced an outline of the unit as a basis for discussion first with Jim in the library and later with Harry in the computer lab. On January 29, Harry gave Karen a formal planning guide for setting out the overall objectives and requirements of the computer lab component of the unit. Karen completed this and on February 7 met with Harry to discuss and expand it into greater detail. Harry designed a prototype HyperCard template and some suggested language activities based on notes prepared by the students in their library sessions (obtained from Jim). On February 12 and 13, Harry spent time in the library with Jim and the students to see how much the students had completed and what they still had to do and to get their ideas on suitable questions and answers to include on the cards for the different topics.
On February 14, Harry, Jim and Karen met formally for the first time in Harry's office. I also was invited to this meeting and attended as an observer. It was agreed: to divide the students' topics into two groups, four overall topics and 9-12 topics on physical features of the earth (see Table 1.1 above); to have the students develop questions and answers only for the overall topics because of time constraints; and to have them develop brief narrations for the more numerous topics on the physical features of earth. Karen then presented a new written proposal for peer tutoring sessions at the end of the unit so that the Our World students could share what they had done with the other half of the class and, in so doing, consolidate what they had learned. The first computer lab session was scheduled for February 20. I was invited to attend this and also the two library sessions in that week in order to develop a proposal for a case study.

On February 26, I presented to Harry, Jim and Karen my proposal for making a formal case study of the Our World unit. They willingly agreed to let me attend all sessions in the library and computer lab, conduct activity sampling, make audio and video recordings of the students at work, and individually interview both teachers and students at convenient times. Karen also agreed to let me observe a series of lessons in the students' homeroom (not on Our World as this was taught only in the library and computer lab) to get a comparison between the homeroom and the library and computer lab environments.

On May 22, Harry, Jim and Karen met formally for the last time. I attended as an observer. Jim reported on the production of the printed book from the completed HyperCard stack. It was agreed that the students would continue to produce extra topic cards for Lakes, Jungles and Soil. Therefore the stack in its final form included more material than the book.
Plans for the peer tutoring sessions were discussed. Harry pointed out that this would introduce the students to a new use of HyperCard. They had to this point used HyperCard to produce and store knowledge. Now they would use it to navigate and present knowledge. Karen pointed out that another valuable result of the unit was the students' acquisition of library and research skills.

**Joint teaching**

*In the library.* Jim was responsible for work in the library. Once Harry was involved in the unit, he attended most of the library sessions, in which the students worked in groups. He and Jim circulated among the groups answering questions, making suggestions and generally facilitating the students' work. The two teachers also took turns in conducting brief whole class sessions to review what had been accomplished and to plan succeeding activities.

*In the computer lab.* Harry was responsible for work in the computer lab. He worked with the Our World students in one half of the lab while Karen worked with the rest of the class on another unit in the other half. The Our World students worked both in their groups and individually. When the Our World work became intensive, Karen would leave her half of the class (they had highly structured activities on which they could often work without extensive help) and assist the Our World groups or individuals who were asking for help.

**The Our World Unit**

**Objectives**

Karen presented a list of objectives at the joint planning meeting on February 14. The following were agreed as feasible within the time constraints of the school year, including as content knowledge the topics Jim had brainstormed with the students in the library:
1. **Content knowledge about our world.** Basic geographical and scientific facts:
   a. Earth as a globe and its position in the solar system.
   b. Physical characteristics of earth:
      i. land: the continents.
      ii. water: the oceans.
      iii. atmosphere: the various layers.
      iv. tides: caused by the moon.
      v. light and heat: from the sun as giver of life.
   c. The earth spinning on its axis, causing day and night.
   d. The earth moving around the sun, causing the four seasons.
   e. The earth's surface: rivers, lakes, oceans, rocks, soil, caves, mountains, volcanoes, islands, forests, jungles, deserts.

2. **Language and related skills.**
   b. Understanding the process of library research.
   c. Compiling and publishing a book.

3. **Computer skills.** Using a Macintosh computer and HyperCard software to organize, write, illustrate and display content.

   A fourth and important set of objectives was added by Karen at the joint meeting with Harry and Jim on February 14:

4. **Sharing and learning through peer tutoring.**
   a. Promotion of sharing and cooperative learning experiences.
   b. The tutors' development of teaching strategies.
c. The tutees' acquisition of vocabulary and knowledge about Our World.

d. The tutors' consolidation of their knowledge about Our World.

Karen developed a Key Concepts Checklist (see Appendix 2) and attached it to the list of objectives together with an outline of the following steps for the tutorial sessions:

1. Check that the tutors:
   a. have acquired sufficient background knowledge about Our World;
   b. know how to run and demonstrate the use of HyperCard stacks;
   c. know how to use the checklist for key concepts;
   d. know how to make and use evaluation booklets;
      (Karen will later provide evaluation questions to enter into a booklet which the tutors and tutees will make and complete in the homeroom).
   e. understand that they can use a mutual first language with their tutees

2. Have each tutor, working with one tutee in the tutoring sessions:
   a. tour the HyperCard stacks with the tutee in order to look and enjoy;
   b. teach the tutee the use of HyperCard features and buttons;
   c. read out vocabulary and paragraphs;
   d. read out vocabulary and paragraphs a second time, along with the tutee;
   e. use the Key Concepts Checklist to record completion of the concepts taught.

3. Have each tutor, after the tutoring sessions:
   a. make evaluation booklets jointly with his or her tutee;
   b. help the tutee to record the answers;
   c. illustrate the booklets jointly with the tutees.
Components

The Our World unit therefore has three components: the first two, the library periods and the computer lab periods, were based on the previous year's Weather unit; the third, peer tutoring, was new.

The library periods

The Our World students (the more experienced half of the class) spent one single and one double period in the library each week for the duration of the unit. The computer lab periods did not start until late February. From mid-October to mid-February, Jim worked with the students in the library on selecting topics for study, introducing them to basic concepts and teaching them research and notetaking skills.

Whole class work. At first, Jim worked with the students as a whole. He found, as Karen had said, that they did not understand the causation of basic phenomena. He took practical steps to remedy this deficiency, e.g. by demonstrating the causation of day and night with the aid of the library globe and a flashlight to model the sun. He also introduced them to concepts with the commercial HyperCard program Earthquest, which they viewed on the library computer. He taught them how to write notes, using one phrase for each main idea. He then discussed their notes with them, put on the board the results of discussions and helped them individually to write out full sentences and paragraphs in their notebooks. He went on to show them the "web" system of notetaking, diagrammatically grouping sub theme keyword nodes around a central theme node and joining the nodes with lines of relationship. This had the advantage of saving them from immediately writing out sentences. Whole class work also included brief introductions to and reviews of each session.
Group work. As soon as Jim had covered these basics, he asked the students to divide themselves into four groups, two or three to a group. One student, Hetty, wanted to work on her own but Jim insisted she join a group. She did not work out with the first pair of girls she joined. She moved to the other pair of girls where she remained for the rest of the unit. As observation was later to show, this was an early indication of Hetty's problems working cooperatively. Once the groups were formed, Jim divided the research topics amongst them on the basis of group choice with negotiation when necessary. He showed the students how to find books on different topics by using the library's computerized book catalogue, indexed by author, title and subject. The students were enthusiastic about the catalogue and were proud to know how to use it. It was a good example of "empowerment": they quickly learned how to write down the call numbers and then find the corresponding books on the shelves. The books they retrieved were left on a cart for their use for the duration of the unit. Jim also taught them how to use a book, taking advantage of the table of contents and index and "skimming" before reading in depth. As the students worked in their groups, Jim or Jim and Harry circulated among them, helping the students both in their groups and individually.

Individual work. The students jointly researched their topics and agreed on subtopics that they would develop individually. Each individual was responsible for drafting paragraphs and illustrations for his or her own subtopics. This led to additional individual research, reading and notetaking although the students were free to discuss and consult with each other. Each subtopic would eventually become the subject of a card in the HyperCard stack in the computer lab.
Sharing time. A special feature of work in the library was "sharing time". As soon as a group was ready with a topic, Jim gathered all the students into a circle, sitting on the floor, and had the students in the group share in reading out what they had got. Jim then invited questions and discussion. These sessions provided good opportunities for informal dialogue.

HyperCard orientation. In mid-February, at about the time when the groups started developing their note "webs", Harry came into the library sessions and started talking to the students about the HyperCard stacks they would shortly be producing. He used the Weather unit as an example to show them what was required. They were able to relate well to what he said because of their previous experience doing the Canada stack (see History section above).

The Computer Lab periods

Karen's students started their computer lab sessions on February 20 and continued with one double period per week until the end of the school year. The Our World students, called the Experts, worked in one half of the lab under Harry. The other half of the class, called the Beginners, worked under Karen in the other half of the lab on two programs: Pictionary, in which they matched written words to pictures, and Typing Tutor, in which they followed a graduated series of keyboard tasks and timed exercises. They clearly enjoyed these programs and were quietly engrossed in them for most of each double period. For the first few weeks, the "experts" helped the "beginners" set up their computers with the required programs.

The Our World HyperCard plan. Before the computer lab sessions started, Harry designed, in consultation with Karen, two HyperCard templates: one for Question and Answer Cards, the other for Picture and Paragraph Cards (see Appendices 1 and 4). These became the two basic formats which the students used to enter and edit their text, graphics and pictures
which they drafted in the library. The design of these templates typically required three drafts, sometimes more, with discussions and reviews before the final product was agreed. Harry planned a HyperCard stack as shown schematically in Figure 1.2.

**Figure 1.2: Schematic of Our World HyperCard Plan**

The stack is headed by a Menu which points in two directions: to the Question and Answer cards and to the Picture and Paragraph (Topic) cards. Each student group will be responsible for producing at least three cards on the themes and topics negotiated with them: one Question and Answer theme and two or three Picture and Paragraph topics per group. Harry will consolidate the productions from the four groups into a single stack of
approximately 12 Question and Answer Cards (four themes) and between 24 and 36 Picture and Paragraph Cards (8-12 topics), making up 36-48 cards in total (The finally produced stack contained 40 cards plus five for introduction and menus). All cards will be linked both sequentially with each other and with the menu. Thus viewers can go through it sequentially like a slide show or at will to and from the menu (knowledge navigation). Each group will agree on the general layout of its cards and each student will be responsible for the final preparation of individual cards.

Harry pointed out to me later that the students made suggestions of their own for modifications of the stack design as they came to understand the dynamics of the stack through using it. He helped them evaluate these suggestions and implement those that were practicable. Many of the students' ideas came from using commercial HyperCard applications in the library. As in the library, the students worked in the computer lab as a whole class, in groups and individually.

Whole class work. As in the library, whole class sessions included brief introductions to goals and periodic reviews. The introductions included instruction or review of features of HyperCard to be used in a session. Unique to the computer lab were whole class "lockstep" sessions in which Harry would call out the sequence of HyperCard instructions to be used for a given objective while the students implemented those steps on their individual computers. Harry would check that their screens corresponded to his as he also implemented the steps. These sequences therefore involved the students in practical action with immediate feedback as they watched their screens for the effect of their instructions. Alternatively, if Harry thought the students familiar enough with a particular sequence of HyperCard instructions, he
would demonstrate requirements for the next phase of work to the whole class around one computer. So prepared, the students would move on to work in their groups or individually.

**Group work: Question and Answer cards.** The students produced the Question and Answer cards (Solar System, Day and Night, Atmosphere, Our Earth) in group mode. Examples of these cards are shown in Appendix 1. Each student had his or her own computer. To work as a group the two or three students in a group gathered around one computer. Their task was to design a visual to illustrate their theme and then execute it with computer graphic tools (Macintosh Super Paint or the HyperCard painting tools). Harry had taught them basic computer graphics earlier in the year, giving them experience of combining graphics and text in the production of Halloween cards and various signs. He now introduced them to two new techniques. One was interactive naming-and-voice buttons: clicking the mouse on a part of the graphic would produce the written label for that part and clicking on the label would produce its spoken rendition (Harry had prepared digital recordings of the labels with the students on the library computer, using their own voices, and had copied these voice files into the students' computers in the lab). The other technique was animation buttons: clicking a "fast forward" button would trigger a sequence of cards in rapid succession, creating the illusion of movement. E.g. the students working on Day and Night created several cards of the earth as a globe, each one with the land masses drawn a little further forward; then when the viewer clicked the "fast forward" button, the earth would seem to turn a half revolution on its axis, simulating the movement from day to night. The groups then agreed on the final wording for their questions and answers (consulting their library notes) and entered the text in the question and answer boxes on the cards. When the cards
were complete, Harry copied them onto the lab network so that they became available to all students on their individual computers. Harry circulated among the groups helping them when they needed technical help, discussing with them design ideas and assisting them with design implementation.

Individual work: Picture and Paragraph (Topic) cards. The students produced individually the topic cards on the physical features of earth (Oceans, Islands, Rivers etc.), using the notes and drawings they had prepared in the library. Examples of these cards are shown in Appendix 4. Harry digitized the original drawings by scanning them onto the students' disks. The students then copied the scanned images onto their computer hard disks, retrieved and sized them into the left hand half of the screen, and edited them with the HyperCard painting tools, varying thicknesses of lines, creating different shading patterns and adding and deleting as they saw fit. They then entered and edited the text for the pictures in the text box on the right hand side of the screen. When complete, Harry also copied these cards onto the lab network so that they became available to all students on their individual computers. Harry circulated among the individual students, helping them as required.

"Experts" help "Beginners". At the beginning of each period the Our World students (the "Experts") helped the other half of the class (the "Beginners") start their computers and retrieve SuperPaint or Typing Tutor ready for their session with Karen. After about six sessions, the Beginners were ready and demanding to set up their own machines. At this point Harry thanked the Experts for their help and said that the Beginners would now manage on their own. The distinction between Experts and Beginners disappeared except in HyperCard applications to which the Beginners still had not been exposed.
The Peer Tutoring sessions

1. Peer tutoring to students from same class (PT(1)).

The half of the class who built the stack peer tutored its contents, with an emphasis on the Overall Topics (Question and Answer cards), to the other half of the class who had been working on a different unit. Tutors were matched with tutees one-on-one and assigned to one computer per pair in the computer lab. If both had a first language in common, they were permitted to use it. I observed, recorded and analysed the tutoring sessions of four pairs who conversed in English. The teachers were impressed with the quantity of dialogue generated by the sessions but noted from the discourse transcripts that the tutors spoke more than the tutees and that the dialogue showed a simple question and answer pattern led by the tutors, using their concepts Checklist (see Appendix 2), rather than more equal exchanges between the pairs. After discussion, Harry built for future use a HyperCard Tutoring stack as a front end to the Our world stack with key visuals to help tutors explain underlying concepts and to facilitate discussion between tutor and tutee. Appendix 5 shows samples of cards produced for the Tutorial stack.

2. Peer tutoring to students from other classes (PT(2)).

The first peer tutoring sessions took place at the end of the school year. Harry therefore planned to use the new Tutorial stack with the Our World stack early in the next school year when four of the original tutees would remain in the school, mainstreamed from ESL to Grade 6 or 7 classes. Arrangements were made for them to give special tutoring sessions to six younger Grade 5 ex-ESL students who were selected by their teachers as
particularly in need of or able to benefit from extra tuition, plus two students from Karen's new class who were also tutees in the first sessions but then using L1.

Harry first arranged three orientation sessions to show the tutors how to use the Tutorial stack. He then arranged for two tutoring sessions: the first in the computer lab with four tutor/tutee pairs simultaneously; the second in his office with four tutor/tutee pairs one-at-a-time. Each tutor had a different tutee in each session. All sessions were conducted in L2. I observed all four pairs in the computer lab and recorded three of them (one recorder failed); and observed and recorded all four pairs in the computer coordinator's office.

The Students

Both the student data and student profiles in table 1.2 which follows were supplied by the students' teachers. All the tutors and the "same-class" tutees came from Karen's 1991/92 class. I have only included the tutees whose sessions were conducted in English, which were also the sessions I observed and recorded. The tutors' profiles correspond well with my independent observations made in the early weeks of the Our World unit before I formally interviewed Karen; and agree also with independent observations made by Jim in the library and Harry in the computer lab. The "other-class" tutees, who were tutored three months later in the following school year, came from four classes, including Karen's new class for that year. The information in Table 1.2 is relevant to the qualitative observations, presented later, of both the Our World unit as a whole (Chapter 3) and the two series of tutoring sessions (Chapters 4 and 5).
<table>
<thead>
<tr>
<th>STUDENT DATA</th>
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<tr>
<td><strong>Albert</strong></td>
<td>Promoted from the School primary ESL program as soon as he was 9. His physical size made him stand out. His elementary teacher felt he had a speech problem because he spoke (and speaks) in broken English with unclear pronunciation. A speech therapist found him within acceptable range for ESL students. He goes to Chinese school Monday to Friday. Karen says his Cantonese is excellent and switching between English and Chinese is difficult. He thinks in Chinese and tends to superimpose Chinese structure on his English. He knew his printed alphabet when he came to Karen but she taught him cursive script. He has greater aptitude for math and science than language. He comes from an intact family.</td>
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<tr>
<td>Male, age 11½, from China, in Canada 3½ yrs, in three-member Group #1; First sessions: tutored same-class tutee in L1; Second sessions: matched with other-class tutee Manny, age 11¾, from Vietnam, in Canada 2 yrs, a same-class tutee with Bobby in first sessions, using L1.</td>
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<td><strong>Bobby</strong></td>
<td>Has younger sister Flo (also a tutor) in same class. Had knowledge of English, numbers and alphabet when arriving from a refugee camp with Flo and family. He is outgoing and athletic (well thought of by his PE teacher) and won &quot;all star&quot; award in School badminton team. He is developing good work habits, now completing his homework which he did not do last year. He is maturing socially and developing responsibility. Father is Vietnamese and mother Cantonese. Both he and Flo speak both languages fluently and Cantonese at home. He learned to read and write in Vietnam but had no drawing skills which he has now developed well.</td>
</tr>
<tr>
<td>Male, age 13½, from Vietnam, in Canada 2 yrs, in three-member Group #1; First sessions: tutored same-class tutee Manny in L1; Second sessions: not in second sessions because transferred to another school.</td>
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<tr>
<td><strong>Tutors</strong></td>
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**Charley**  
- male, age 13½, from China, in Canada 1½ yrs, in three-member *Group #1*;  
  **First sessions:** matched with same-class tutee *Kenny*, age 13¾ from Vietnam, in Canada 6 ms;  
  **Second sessions:** not in second sessions because transferred to another school  
- Father was a teacher of English in China. He says that Charley had behavioural problems in China where all his teachers spoke of his lack of concentration. Karen says his problems persist in Canada. He tends to interfere and seems to invite negative attention. Earlier in the year he set off the School fire alarm to "see what would happen". He sometimes does not get on well with the other students. His grandmother told Karen that in China the child is king because of the one child per family rule and the one child becomes "spoiled". Karen thinks this applies to Charley. However, he likes his Canadian school and its learning environment.

**Denis**  
- male, age 11½, from Hong Kong, in Canada 18 ms, in two-member *Group #2*;  
  **First sessions:** tutored same-class tutee *Lenny*, age 10¾, from Poland, in Canada 6 ms;  
  **Second sessions:** tutored other-class tutees *Sam*, 10 and *Vic*, 9¾, both Canadian-born Chinese.  
- Has older sister Jeannie in same class. He had four years of English, one period per day, in the Hong Kong system. He arrived with good handwriting, knowledge of alphabet and numbers and able to read and write in English within the confines of a limited vocabulary. He did not have conversational English as the Hong Kong system deals with reading and writing only. He is sociable and friendly and a good badminton player. He got a ribbon for his team, making first place in this year's badminton tournament. He is particularly adept at working with computers.
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<td><strong>Stud</strong></td>
<td><strong>Tutors</strong></td>
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<tr>
<td><strong>Eric</strong></td>
<td>Has younger brother Ollie in same class. Came to Canada from a refugee camp with his parents and Ollie. Spent six months in Calgary before coming to B.C. but this is his first school in Canada. His has a good attitude, wants to learn and is settling down well.</td>
</tr>
<tr>
<td>Male, age 13½, from Vietnam, in Canada 2 yrs, in two-member Group #2; First sessions: tutored same-class tutee in L1; Second sessions: not in second sessions because transferred to another school.</td>
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<td><strong>Flo</strong></td>
<td>Has older brother Bobby in same class and has similar background to him. She is chatty in her native Vietnamese but not communicative in English in which she has trouble expressing herself, even in structured situations. She, Jeannie and Ivy are Karen's &quot;silent ones&quot; that she feels need &quot;spoonfeeding&quot;. She is passive in class. Karen thinks Her &quot;passivity&quot; is partly cultural as oriental girls are not encouraged to express themselves actively, and partly because she lacks basic study skills.</td>
</tr>
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<td>Female, age 12½, from Vietnam, in Canada 2 yrs, in three-member Group #3; First sessions: tutored same-class tutee in L1; Second sessions: not in second sessions because transferred to another school.</td>
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<td><strong>Tutors</strong></td>
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<tr>
<td><strong>Gladys</strong></td>
<td>Shows herself academically inclined and grasps concepts quickly. She too is from a one-child family in China. Her mother is a schoolteacher. Her father does work in connection with computers. She did not do well in her previous school. Karen thinks that her previous teacher, not a Chinese speaker, did not recognize the problem of learning English against the totally different background structure of Chinese. She said that Gladys was slow. Karen finds the reverse to be true. Gladys spent four months of the previous year in another school because of her family moving away for this period. She has settled down and is progressing well.</td>
</tr>
<tr>
<td>female, age 12½, from China, in Canada 2½ yrs; in three-member Group #3; First sessions: tutored same-class tutee, Nancy, age 10½, from Vietnam, in Canada 6ms; Second sessions: tutored other-class tutees Patty, 10¼, from China, in Canada 4 yrs and Ursula, 10¼, Canadian-born Chinese.</td>
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<tr>
<td><strong>Hetty</strong></td>
<td>Also from a one-child family in China. Her father dotes on her but puts some pressure on her to do well. She is close to him and talks to him about what happens at school. She learns quickly, has a good attitude to learning and has good insight into &quot;how to learn&quot;. She had problems adjusting to rules and regulations in the school. In her first year she refused to make friends. She has an underlying defiance which she masks with apparent compliance. She is very determined to do things her own way.</td>
</tr>
<tr>
<td>female, age 11½, from China, in Canada 2½ yrs; in three-member Group #3; First sessions: tutored same-class tutee Ollie, age 8¾, from Vietnam, in Canada 2 yrs; Second sessions: tutored other-class tutees Roxy, 10¼, Canadian-born Chinese and Win, 10, from Vietnam, in Canada 2yrs.</td>
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| **Ivy**                                | *Born in the school neighbourhood, she is the only one in Karen's class born in Canada. After only a few months in kindergarten, her family returned to Taiwan for five years.*  
*Her first schooling was in Taiwan where she was immersed in Mandarin (common to mainland China, Taiwan, and Singapore while Cantonese is spoken in Hong Kong). She is a bright, diligent student but is another of Karen's three "quiet ones" and needs drawing out to speak in class. She and fellow "quiet one" Jeannie are best friends and make up the two-member Group #4.* |
<p>| female, age 13¾, from Taiwan, in Canada 1½ yrs, in two-member Group #4; First sessions: tutored same-class tutee in L1; Second sessions: not in second sessions because transferred to another school. | |
| <strong>Jeannie</strong>                            | <em>Has younger brother Denis in same class and a similar educational background to Denis. Like Ivy, her team mate, she is a diligent student but, also like Ivy, is one of Karen's three &quot;quiet ones&quot; and needs drawing out to speak in class. Seems timid and shy. Karen does not think this is a natural characteristic but rather a product of the classroom environment in Hong Kong where teachers maintain a distance from students.</em> |
| female, age 13¾, from Hong Kong, in Canada 1½ yrs, in two-member Group #4; First sessions: tutored same-class tutee in L1; Second sessions: not in second sessions as transferred to another school. | |</p>
<table>
<thead>
<tr>
<th>STUDENT DATA</th>
<th>STUDENT PROFILE</th>
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<tbody>
<tr>
<td><strong>Same-Class Tutees (first sessions)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Kenny</strong></td>
<td>Has cousin Nancy in same class and a sister in Grade 2. His father was a lawyer in Vietnam. He learns quickly and is a conscientious student. He has a speech impediment due to malformed teeth. Karen thinks that this reinforces a traditional Asian teacher-submissiveness and makes him appear less able than he is.</td>
</tr>
<tr>
<td>male, age 13½, from Vietnam, in Canada 6 yrs; tutored by Charley, male, age 13½ from China, in Canada 1½ yrs.</td>
<td></td>
</tr>
<tr>
<td><strong>Lennie</strong></td>
<td>Lives with his mother and two brothers: one younger and the other older. His mother is divorced. His language is good orally but his writing and math is below average. His mind easily wanders in class.</td>
</tr>
<tr>
<td>male, age 10½, from Poland, in Canada 6 yrs; tutored by Denis, male, age 11½ from Hong Kong, in Canada 1½ yrs.</td>
<td></td>
</tr>
<tr>
<td><strong>Nancy</strong></td>
<td>Both her parents are professionals: her father a pharmacist, her mother a teacher. She was well educated in Vietnam and has a comfortable economic background. She had no English on arrival in Canada and had to start with the alphabet. She is highly motivated and academically oriented with superior performances in written language and math.</td>
</tr>
<tr>
<td>female, age 10½ from Vietnam, in Canada 6 yrs; tutored by Gladys, female, age 12½ from China, in Canada 2½ yrs.</td>
<td></td>
</tr>
<tr>
<td><strong>Ollie</strong></td>
<td>Has older brother Eric in same class. Unlike Eric, who had basic primary education in Vietnam, Ollie had no education at all when arriving at the age of 5 in a Hong Kong refugee camp. He is illiterate in Vietnamese and is therefore learning literacy in English. He is slow recognizing words and at the moment is better at math than language.</td>
</tr>
<tr>
<td>male, age 9½ from Vietnam, in Canada 2 yrs; tutored by Hetty, female, age 11½ from China, in Canada 2½ yrs.</td>
<td></td>
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<tr>
<td>STUDENT DATA</td>
<td>STUDENT PROFILE</td>
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</tr>
<tr>
<td><strong>Patty</strong></td>
<td>female, age 10 1/4, Canadian-born; tutored by Gladys, female, age 13 from China, in Canada 3 yrs.</td>
</tr>
<tr>
<td>L1 is Mandarin. She was recommended to the English Language Centre (ELC) and the Learning Assistance Centre (LAC). She is low in confidence, has cognition problems (&quot;doesn't have it&quot;), is embarrassed and poor in talking, has difficulty expressing herself, and is weak in writing. Rated &quot;average minus&quot;.</td>
<td></td>
</tr>
<tr>
<td><strong>Ursula</strong></td>
<td>female, age 10 1/4, Canadian-born Chinese; tutored by Gladys, female, age 13 from China, in Canada 3 yrs.</td>
</tr>
<tr>
<td>L1 is Mandarin. She was recommended to the Learning Assistance Centre (LAC). She is still &quot;fairly ESL&quot;. She has an outgoing personality, likes to participate, asks questions, is bright, confident and takes risks. If she had sufficient English she would be a top student.</td>
<td></td>
</tr>
<tr>
<td><strong>Roxy</strong></td>
<td>female, age 10 1/4, Canadian-born Chinese; tutored by Hetty, female, age 12 from China, in Canada 3 yrs.</td>
</tr>
<tr>
<td>L1 is Cantonese. She was recommended to English Learning Centre (ELC) where she had a major breakthrough in mastering English. She is shy, not overly confident but will talk and take risks. Rated an average student.</td>
<td></td>
</tr>
<tr>
<td><strong>Win</strong></td>
<td>female, age 10, from Vietnam, in Canada 2 1/2 yrs; tutored by Hetty, female, age 12 from China, in Canada 3 yrs.</td>
</tr>
<tr>
<td>Was in Karen's class last year so she knew Hetty. She left Vietnam without schooling at 4 1/2, lived in refugee camps in Hong Kong for 3 years, changed camps 3 times, and learned some Vietnamese and math from a Vietnamese volunteer. She came to Canada not &quot;school ready&quot;, did not integrate into primary Grade 3 and so came to her present ESL class at age 9. She learns quickly and willingly, has good math skills, is lively and eager to please, listens well and likes to help in order to show what she can do.</td>
<td></td>
</tr>
<tr>
<td>STUDENT DATA</td>
<td>STUDENT PROFILE</td>
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</tr>
<tr>
<td><strong>Other-Class Tutees (second sessions)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sam</strong></td>
<td>L1 is Cantonese. He was recommended to the English Language Centre (ELC) and also last year to the Learning Assistance Centre (LAC) because he appeared &quot;learning disabled&quot; although with good potential. Not well motivated, poor listener, and may have processing and comprehension problems.</td>
</tr>
<tr>
<td>Male, age 10, Canadian-born Chinese; tutored by Denis, male, age 12 from Hong Kong, in Canada 2 yrs.</td>
<td></td>
</tr>
<tr>
<td><strong>Victor</strong></td>
<td>Still &quot;very ESL&quot;, lacks confidence, has low language skills, and may have a learning disability: he has difficulty processing and &quot;glazes up&quot;. Very much below Grade 5 norm.</td>
</tr>
<tr>
<td>Male, age 9¾, Canadian-born Chinese; tutored by Denis, male, age 12 from Hong Kong, in Canada 2 yrs.</td>
<td></td>
</tr>
<tr>
<td><strong>Manny</strong></td>
<td>Was in Karen's class last year so he knew Albert. He is Chinese from Vietnam, speaks Cantonese and a little Vietnamese, and had some schooling in Vietnam. He arrived in Canada with his family from a refugee camp in the Philippines.</td>
</tr>
<tr>
<td>Male, age 11¾, from Vietnam, in Canada 2 yrs; tutored by Albert, male, age 12 from China, in Canada 4 yrs.</td>
<td></td>
</tr>
</tbody>
</table>
Methodology

The purpose here is to state in outline what methodologies were used and when they were used for gathering and analyzing data throughout the case study. Their origin and rationale are discussed in greater detail in Chapters 2A & 2B, Selective Review of Literature, under the headings "The role of discourse analysis" and "Work Study". They fall under two main headings: work study methodology for recording and analyzing task activities and describing the larger context in which those activities are set; and discourse analysis methodology for recording and analyzing student discourse.

Work study techniques

Activity Sampling

Activity (or work) sampling was used in the library and the computer lab to determine what percentage of their time the students were spending on various observable activities. The particular type of activity sampling used was Fixed Interval (or Systematic Random) Sampling. During the first ten weeks of the study, I observed each student's activity approximately every two minutes over six single and five double periods in the library and over eight double periods in the computer lab. Although Our World was not taught in the homeroom, I observed four double and three single periods in the home room on units similar in content demand to Our World in order to compare the home room with the library and computer lab environments. I recorded observations under two sets of broad headings:

Students' work modes.

1. Teacher-led activity - teacher-fronted, whole-class work.
2. Solo - students working on their own.
3. Solo with teacher - students working individually with a teacher.
4. Group work - students working in their groups of two or three.
5. Group work with teacher - students working in their groups with a teacher.
6. Working with peers - students working out of their groups with peers.
7. Pause - time out of the room, waiting for a teacher or not on assigned task.
8. Other - time spent at library shelves, the board, or the computer lab printer.

Students' communication modes.

2. Reading - time spent reading notes or printed material (not computer screen).
3. Writing - time spent writing on paper (not computer screen).
4. Other - time spent on everything else, e.g. listening to teacher and "pause" time.

I also used activity sampling to record communication mode activities in the peer tutoring sessions, using video recordings of four tutor/tutee pairs.

Interviews

Teachers. Early in the study, I formally and separately interviewed, with their consent, the three teachers, Karen Black, the homeroom teacher, Jim White, the librarian, and Harry Green, the computer lab coordinator, to get their individual perspectives on the Our World unit, a description of their roles and an account of their previous working relationships. I also informally interacted with all three teachers throughout the unit and spoke with Karen several more times to get her profiles of the students and their previous experience in her class.
Students. Karen invited me to talk as much as I liked with the students in the homeroom during any of their free weekly periods. I therefore spoke with them on several occasions throughout the study, individually and in small groups, to get their perspectives on the unit, their experiences in working together in groups and in peer tutoring sessions, and their reactions to the three environments in which they were working: the library, the computer lab and their homeroom.

Observation

I observed all sessions of the Our World unit except one period in the computer lab and two in the library. During the periods that I activity-sampled (the first nine weeks of the unit) I jotted down brief qualitative notes to help in the later interpretation of the quantitative sampling data. During the remaining eight weeks of the unit (including the first of the peer tutoring sessions) I made extensive qualitative notes as I circulated among the student groups. During the peer tutoring sessions held in the computer coordinator's office (two pair-periods from the first sessions and all eight pair-periods from the second sessions) I was able to continuously observe the tutor's and tutee's interactions with each other and the computer because only one pair was working in the office at a time. In addition, I had a complete video recording of two periods of peer tutoring to supplement my personal observations.

Participant observation

The students quickly accepted me as just another teacher doing special things in their unit like recording, writing notes and occasionally asking questions. Both Jim in the library and Harry in the computer lab encouraged me to help out with students' questions during group work. So I observed the groups as I interacted with them from time-to-time in the role
of "TA". I also took the opportunity to occasionally sit with each group and watch it work for more extended periods of time and at the same time answer questions as they arose.

**Discourse analysis techniques**

**Audio and video tape recording**

*The Our World unit.* I recorded all the Our World library and computer lab sessions that I attended with four audio tape recorders, one for each of the four groups. These recordings were useful as an audio record of the progress of the unit and the content of the lesson periods. However, although they clearly recorded the teachers' discourse, they caught very little of the students' discourse because the students spoke on-the-whole softly against considerable background noise. I also recorded the sessions (not on Our World) that I observed in the home room with one audio recorder.

*The peer tutoring sessions.*

It was imperative to get clear recordings of student discourse in the peer tutoring sessions so that accurate transcripts could be made for discourse analysis. I tried a number of alternative configurations of equipment and eventually found the answer in small, highly sensitive Shure unidirectional microphones attached to headsets (as used by recording vocalists) so that the microphone came to within about one inch of the wearer's mouth. We fitted the tutors and tutees with these headsets and connected the microphones either to a regular desk-model tape recorder through a Shure mixer or directly to a stereo tape recorder. The results were good. Relatively little background noise was picked up and it was possible to decipher even whispers and below breath utterances.
The first peer tutoring sessions, PT(1), extended over two periods. Two tutor/tutee pairs were audio-recorded in the first of these periods in the computer lab. Two pairs were audio-recorded in the second period in the computer lab. One of these pairs was additionally video-recorded. A third pair was audio- and video-recorded in a special second period in the computer coordinator's office (the tutor had been absent from the second regular period). In addition two pairs were audio- and video-recorded in a supplementary session in the computer coordinator's office.

The second peer tutoring sessions, PT(2), extended over three periods. Three tutor/tutee pairs were recorded in the first of these periods, held in the computer lab. The second and third sessions were held in the computer coordinator's office. Four pairs followed each other on one day and four pairs (same tutors, different tutees) followed each other on another day in the succeeding week.

Quantitative analysis of discourse transcripts

All peer tutoring pair-periods recorded were transcribed, using the Systematic Analysis of Language Transcripts (SALT) software (J. F. Miller and R. S. Chapman, 1984-1991) from the Language Analysis Laboratory of the University of Wisconsin-Madison. This software has the advantage, once discourse has been key-entered using the required conventions, of analyzing discourse over a great number of variables of which the following were used:

1. Total utterances per speaker, broken down inter alia by complete, incomplete, interrupted and questioning utterances, and utterances containing mazes and overlaps.

2. Speaker turns by number of utterances.
3. Timing of total utterances and total words per minute for each speaker (excluding words in 1 mazes).

4. Number of utterances per speaker by utterance length in words.

5. Standard word lists per speaker broken down by grammatical categories of direct questions, negatives, conjunctions, auxiliary verbs and pronouns.

6. Word frequency lists per speaker.

The SALT data thus provides the basis for a quantitative analysis of the discourse transcripts.

Pedagogical analysis of discourse transcripts

The discourse transcripts were also analyzed qualitatively to assess the students' success in realizing the pedagogical objectives of the tutorial sessions. These objectives changed from PT(1) to PT(2) and are stated in detail in the context of Chapters 4 and 5.

Cognitive analysis of discourse transcripts

A cognitive analysis of the discourse transcripts was required to determine the amount and quality of the ideational as distinct from the interpersonal component generated. The role of discourse analysis is discussed in the selective review of literature in Chapter 2A. The method of its application for cognitive analysis is discussed in detail in Chapter 7 dealing with the cognitive analysis of the transcripts from PT(1) and PT(2). In brief, a method for both quantitative and qualitative cognitive analysis was developed for this study, drawing on:

1 Mazes are defined as false starts, repetitions, and reformulations and are coded within parentheses (like this). Words found in mazes are excluded from calculations of Number of Different Word Roots, Total Number of Words and Mean Length of Utterance (MLU).
1. The concept of Ventures, i.e. units of instruction categorized by their "overarching objectives", any one or number of which make up a "strategy" of teaching (Smith, Meux et al., 1967, "Strategies of Teaching).

2. Knowledge Structures (KSs), as developed in Mohan's (1986) Knowledge Framework, a high level cognitive analytical framework of six KSs that may be applied to both verbal and non verbal (e.g. graphical) presentations of knowledge.


5. Our own determination of different tutoring modes or styles.

We now turn to a selective review of the literature relevant to the activities observed in this case study and to the methodologies used for their investigation.
CHAPTER 2A: SELECTIVE REVIEW OF LITERATURE (1)

INTRODUCTION

Our Research Question is: "Is peer tutoring, using a computer-based hypermedia resource, an effective means of helping ESL students generate academic discourse?" This touches on four main themes which are inseparably interlinked in our enquiry:

1. Second language acquisition;
2. Academic discourse;
3. Peer tutoring
4. The computer in education.

Because the peer tutoring in our case study comprised a series of tutor tasks built around the computer, we review task-based language teaching and computer-assisted language learning in conjunction with peer tutoring.

Each theme contains a number of historical, conceptual and methodological issues contained in the literature. Our scheme of review is therefore as follows:

1. Second language acquisition

   Conceptually, we review the following perspectives on second language acquisition which bear upon our study: Krashen's (1986) input hypothesis; Cummins' (1991) distinction between academic and conversational proficiency; Halliday's (1975) functional model of language, which provides a conceptual framework for the practical analysis of discourse in a sociocultural setting from a linguistic position; and Schieffelin and Ochs' (1986) presentation of language socialization from an anthropological position.
2. Academic discourse

Academic discourse is a convenient label for the "language of teaching and learning". It contains, in Halliday's terminology, both ideational and interpersonal components with emphasis on the ideational. We review historical, conceptual and methodological aspects of this theme:

**Historical**

A review of observational studies of classroom discourse and interaction in which there is a striking neglect of cognitive as distinct from linguistic and behavioural analysis.

**Conceptual:**

a) A rationality model of teaching vs a behavioural, linguistic or other type of model;

b) Two schemes for the cognitive analysis of discourse:
   
   i) From the Smith, Meux Logic and Strategies of Teaching studies:

   Logical Operations, Ventures and Moves;

   ii) From Mohan's Language and Content studies: the Knowledge Framework.

**Methodological**

Discourse analysis:

a) its development for linguistic and interpersonal analysis;

b) its identification of the Initiation-Response-Evaluation (I-R-E) teaching model;

c) its development for cognitive analysis using the above conceptual schemes.
3. Peer tutoring

Peer tutoring was a task assigned to the students with the object of generating language use while absorbing content. Specifically it was a computer-based task. We therefore review:

Peer tutoring

The concept of peer tutoring, its historical development and assessments of its effectiveness as a method of teaching.

Task-based language teaching

a) The concept of task-based teaching;
b) Concepts of psycholinguistic and sociocultural tasks;
c) Computer-assisted language learning (CALL);

Methodological

a) Task design;
b) Work Study, a discipline for task recording, measurement and analysis.

4. The computer in education

This theme is broader based than the methodological review of CALL. It looks at the issue of technology in the classroom, including the technology of print. Students of media claim that print was the origin of the traditional knowledge-transmission model of teaching while the computer and other electronic technologies have a natural affinity with a knowledge-construction model of learning.

The unit we studied was an example both of computer use and of knowledge-construction learning. We therefore regard it as a window through which we can discern the
problems and potential of the rapidly maturing electronic technologies for both language and content learning in the classroom. We therefore review:

a) The links between technology in the classroom and teaching style;

b) The technologies of communication (media): Writing, Printing, Computers;

c) Underlying factors in the school system inimical to technological change;

d) Computers and new patterns of thinking;

e) The future.

Although our case study is a second language learning unit, many of the concepts and methods we review are equally applicable to content learning by L1 students.

**PERSPECTIVES ON SECOND LANGUAGE ACQUISITION**

In this Division we review the perspectives on second language acquisition relevant to our study. We begin with Krashen’s (1985) Input Hypothesis and notion of comprehensible input; move to Cummins (1984, 1991) who provides the distinction between conversational and academic discourse; then to Halliday (1975, 1985) whose functional theory of language provides a firm basis for identifying and analysing the ideational and interpersonal components of discourse; and conclude with Ochs/Schieffelin (1986) and Ochs (1988) who provide for analysis in depth beyond the contours of the language to the ways in which language users (our students) are socialized into the culture (including that of the classroom), culture both defining and being defined by language use.
Krashen's (1985) Input Hypothesis

Krashen's five hypotheses

The Input Hypothesis is the central one of five hypotheses that restate Krashen's (1976) comprehensive theory of second language acquisition. The theory, known as Krashen's Monitor Theory (MT), was "one of the best known and most influential theories of SLA in the 1970s and early 1980s . . . MT began life not as a theory of SL acquisition, but as a model of SL performance" (Larsen-Freeman & Long 1991). Krashen's five hypotheses can be summarized as follows (Krashen 1985:1-4):

1. **The Acquisition-Learning Hypothesis** distinguishes acquisition, a subconscious process as used by children in acquiring their first language (which can be likened to Chomsky's "Language Acquisition Device" or LAD), from learning, a conscious process used by adults in traditional language learning, which is based on the L2 grammar system. The subconscious process is by far the most powerful.

2. **The Natural Order Hypothesis** states that rules of language are acquired in a generally predictable staged order independent of the order in which they are taught in class.

3. **The Monitor Hypothesis** states that conscious learning has only a limited function in adult SL performance and that is as a monitor or editor of language produced from acquired subconscious knowledge.

4. **The Input Hypothesis** states that language (whether L1 or L2) is acquired only by the process of receiving comprehensible input. "We progress along the natural order (hypothesis 2) by understanding input that contains structures at our next 'stage' -- structures that are a bit beyond our current level of competence" (4). Input at stages
beyond this represents uncomprehended noise. The received input is processed through the Chomskyan LAD, the "mental organ" for language, which generates rules for perceived new constructions and works equally for adults as for children. The Input Hypothesis has two corollaries:

1. Acquisition, the subconscious process, not learning causes speaking. Speaking does not cause acquisition.

2. Given sufficient comprehensible input, the LAD will automatically generate the required grammar without need of teaching.

5. The Affective Filter Hypothesis: Negative affective factors, particularly lack of motivation, lack of self-confidence, and anxiety prevent various amounts of comprehensible input from reaching the LAD. This works in adults from puberty onwards, not in children, and is the reason language acquisition declines sharply after childhood is passed.

Language acquisition for adults, very simply, depends on sufficient comprehensible input getting through the Affective Filter. For the argument that output is important, see Swain, 1985)

Claimed evidence for the Input Hypothesis

Krashen & Terrell (1983) claim extensive evidence for the Input Hypothesis:

1. Caretaker speech, teacher talk and foreigner talk (Krashen, 1981) make concessions to the interlocutor's lack of language experience by negotiating meaning through various means (e.g. simplification, expansion of utterances, repetition) to assist the decoding process. This ensures a steady flow of comprehensible input which is not more than (I + 1)
structures beyond the acquirer's level of competence. **Interlanguage talk** (speech of peers) is also important for the same reason.

2. The *silent period* in children's L2 acquisition (Krashen 1983, Newmark 1966, Rodriguez 1981, Fourcin, 1975) can be explained by the Input Hypothesis. Large amounts of comprehensible input are assimilated during this period so that speech, when it begins, is at a level comparable to that reached by children who have not remained silent.

3. When there are age differences, e.g. between adults and children or between older and younger children, those who are older acquire L2 at a faster rate (Krashen, Long & Scarcella 1982). This can be explained by the greater amount of comprehensible input to which they have been exposed because of their greater life-experience. Younger acquirers overtake adults in the long run because of their lower affective filters.

4. Research findings that greater L2 acquisition sometimes results from instruction within an informal environment compared with a formal one (Krashen 1982) can be explained by the larger amounts of comprehensible input often provided in informal environments.

5. Comprehensible input may be the vital difference in the results of different teaching methods. The low efficacy of grammar-based and drill-based methods can be explained by paucity of comprehensible input. Success of some unconventional methods like Natural Approach (Krashen & Terrell, 1983) and Suggestopedia (Dhority, 1984) may be explained by plentiful comprehensible input. Findings that delaying oral production has no negative effects (Gary 1975, Postovsky 1974) may also be explained by the Input Hypothesis -- the LAD silently processes the comprehensible input with or without speech.
6. The success of Canadian immersion programs (Swain & Lapkin, 1982) can be attributed to an abundance of comprehensible input. In particular, this experience shows that the subject-matter classroom can be a superb language classroom with natural, not artificially contrived, input. Similar benefits have been achieved in "sheltered" content classes taught to university students in L2. (Edwards, Wesche, Krashen et al. 1985).

7. Successful bilingual programs provide content instruction in L1 together with comprehensible input in L2 (Cummins, 1981, 1983). The L1 instruction increases learners' "cognitive academic language proficiency" (Cummins, 1979) which, in turn, makes the L2 input more comprehensible, i.e. increases comprehensible input.

8. The Reading Hypothesis states that a relationship exists between writing competence and reading for interest and pleasure (Krashen, 1984; Smith, 1983). This may be explained by extensive reading placing added comprehensible input at the service of writing.

Criticisms of the Input Hypothesis

Krashen's theory attracted considerable criticism in the SLA literature and perhaps "more than its fair share (because) it was one of the first 'theories' developed specifically to explain SLA, and so was for a time a, and for many the major position to be subjected to empirical test" (Larsen-Freeman & Long 1991:245). Legitimate criticisms included, inter alia, challenges to the learning/acquisition, conscious/subconscious distinctions and the use of subjective, anecdotal evidence to support them (McLaughlin 1978); and Krashen's idiosyncratic use of the term hypothesis: the Natural Order Hypothesis is a generalization based on empirical studies; the Acquisition-Learning, Monitor and Input hypotheses are claims about SLA processes; and the Affective Filter Hypothesis is a metaphor. None of these
is a hypothesis in the usually accepted sense of the term, i.e. being empirically testable (Larsen-Freeman & Long 1991:291). Gregg (1988) presents a rigorous critique of what he considers vague linguistic notions in Krashen's theory and some of the defences of it and concludes: "It may be the case that second language acquisition is simply too hard, too complex a field to be susceptible of coverage by a unified theory" (Gregg 1988:95). Larsen-Freeman & Long (1991:249) give a balanced summing up:

In conclusion, the Monitor Model and its successor, MT, served SLA researchers well by offering an early attempt to make sense of a wide array of disparate research findings. In addition, Krashen's ideas themselves stimulated a good deal of data-based research, and forced some fresh thinking in language teaching circles. While some of the original claims no longer excite much interest among researchers and/or have been superseded by other developments, they served a valuable purpose by identifying some of the relevant issues and, where apparently wrong, by obliging critics to seek out and substantiate alternatives.

Cummins (1991) and academic language proficiency

Cummins' research has focused on first and second language (L1 and L2) academic development in bilingual contexts. Over a number of years he has developed three theoretical constructs: 1) a distinction between conversational and academic language proficiency; 2) the interdependence hypothesis which posits a relationship between L1 and L2 proficiency; and 3) the threshold hypothesis which states that bilingual children must first attain threshold levels of linguistic competence to enjoy the cognitive benefits of bilingualism (Cummins 1991).
Conversational and academic language proficiency

Conversational and academic language proficiency were originally termed "basic interpersonal communicative skills" (BICS) and "cognitive academic language proficiency" (CALP) (Cummins 1979). The problems Cummins addressed in making this distinction were:

1. The unwarranted conclusion that poor performance on an L2 verbal IQ test indicates deficient cognitive abilities: testers have assumed that the language proficiency needed for face-to-face communication is no different from that needed to perform academic tasks.

2. The premature transfer of minority language students to L2 only classrooms on the basis of their "fluency" in superficial interpersonal communication: the result is that such students fall behind academically and then get "tagged" as cognitively or culturally "deficient" (Cummins 1984:131).

Cummins points out that while data suggests that "many minority students can develop a relatively high degree of English communicative skills within about two years of exposure to English-speaking peers, television and schooling", analysis of results from language tests administered in the Toronto Board of Education shows "that it took immigrant students who arrived in Canada at age 6-7 or later, between 5 and 7 years, on the average, to approach grade norms in English verbal-academic skills" (Cummins 1984:133). For empirical evidence, see Collier (1987). This general conclusion is supported by comparison with successful bilingual programs for minority students in the United States (San Diego City Schools 1982) and French immersion programs in Canada (Swain & Lapkin 1982). Similar results were reported by Skutnabb-Kangas & Toukomaa (1976) who, in their study of Finnish immigrant students in Sweden, drew a distinction between "surface fluency" and "conceptual-linguistic
knowledge". Cummins formalized this distinction in terms of "basic interpersonal communicative skills" (BICS) and "cognitive academic language proficiency" (CALP). BICS was "defined in terms of the manifestation of language proficiency in everyday communicative contexts whereas CALP was conceptualized in terms of the manipulation of language in decontextualized academic situations" (Cummins 1984:137). Cummins (1991) now refers to BICS and CALP as simply "conversational language proficiency" and "academic language proficiency" in bilingual contexts.

The interdependence hypothesis

The relationship between L1 and L2 proficiency is expressed in the "interdependence hypothesis" (Cummins 1978, 1991) which states formally:

To the extent that instruction in Lx is effective in promoting efficiency in Lx, transfer of this proficiency to Ly will occur provided there is adequate exposure to Ly (either in school or environment) and adequate motivation to learn Ly.

In other words, "the development of literacy-related skills in L2 is partly a function of prior development of literacy-related skills in L1". What is transferred from L1 to L2 is primarily common underlying conceptual knowledge rather than specific linguistic elements. This hypothesis is advanced to explain the research data that consistently indicate that instruction in a minority language has no adverse effect on development in the majority language, a factor of obvious concern to the parents and teachers of children entering a bilingual program. Cummins (1991:77-78) notes the relevance of the interdependence hypothesis to Krashen's notion of "comprehensible input":

L1 literacy and conceptual knowledge constitute central attributes of the individual that help to make academic input in the L2 comprehensible. If a second language learner
already understands concept x in her L1 then L2 input containing that concept will be considerably more comprehensible than if she does not understand concept x in her L1.

The threshold hypothesis

The threshold hypothesis was developed to account for the findings of some empirical studies of cognitive deficits resulting from bilingualism. Cummins 1991:76) states:

there may be threshold levels of linguistic competence that bilingual children must attain both in order to avoid cognitive disadvantages and allow the potentially beneficial aspects of becoming bilingual to influence their cognitive functioning.

Cummins claims a "valuable heuristic impact" for this hypothesis but agrees that it cannot be empirically validated because of the difficulty in specifying and operationalizing the nature of language proficiency.

Operationalizing the concept of academic discourse

In the Our World case study we needed, in Cummins' terms, to differentiate between "conversational language" and "academic language" in order to assess the extent to which the students were successful in generating academic discourse. Cummins does not offer a procedure for operationalizing this distinction but claims "solid linguistic evidence for distinguishing between conversational and academic aspects of language proficiency" and in particular refers to Biber's (1986) "psychometric analysis of an extremely large corpus of spoken and written material" along three dimensions:

1. high personal involvement and real-time constraints vs conditions permitting considerable editing and high explicitness of lexical content but little personal interaction.

2. a detached formal style vs a concrete colloquial one based on analysis of linguistic features such as nominalizations, prepositions, and passives;
3. a primary narrative emphasis, marked by considerable reference to a removed situation vs
non-narrative emphases marked by little reference to a removed situation but a high
occurrence of present tense forms.

While these linguistic criteria may in general distinguish between conversational and
academic discourse, they are not satisfactory as a basis for specific analyses. For instance, a
colloquial style may indeed characterize conversational discourse. This does not, however,
preclude the use of a colloquial style in an academic dialogue, e.g. an excited discussion,
replete with exophoric references to data presented on a computer screen. Conversely, some
conversational discourses may be clothed in great formality at high levels of abstraction, e.g.
a disciplinary interview. We felt that we needed direct criteria that we could apply to each
utterance to determine whether it was "conversational" or "academic". We therefore turned to
Halliday's (1973, 75, 85) functional model of language which allows for a multi-dimensional
analysis of discourse to include not only linguistic but also sociosemantic dimensions.

**Halliday's functional model of language**

Halliday's model of language embraces not only meanings expressed through
grammatical patterns but also meanings which are themselves "the expression, or realization,
of options in behaviour" realized in socially significant contexts. Halliday (1973:5) has, in his
model building, taken into account Bernstein's theories of social order and social change,
"theories in which language plays an essential part":

Language is the primary means for the transmission of culture from one generation to
the next; and Bernstein's work has shown that there are certain types of social context,
especially forms of interaction between parent and child, which are critical for this
socialization process. By taking a functional viewpoint we can gain some idea of how
it is that ordinary language, in its everyday uses, can so effectively transmit to the child the deepest patterns of culture.

Halliday further points out that a functional model of language was advanced by Malinowski from an anthropological viewpoint with the perception that the functional origins of the language system could be seen most clearly in the language of young children. At the child level, language is what language does. The child uses it to realize his/her intentions. Halliday identifies eight child-talk functions which the child uses one at a time according to the end in view: The instrumental model, the "I want" function, is a way of manipulating and controlling the child's environment; the regulatory model, the "do as I tell you" function is a way of regulating the behaviour of others; the interactional model expresses "me and you", the self interacting with others; the personal model expresses the self as speaker and aware of individuality; the heuristic model with the "tell me why" function uses language to investigate reality, to learn; the imaginative model with the "let's pretend" function, creates private worlds; finally, developing later, the representational model with the "I've got something to tell you" function communicates and expresses propositions. Halliday (1973:36) links the micro functions of child talk to the macro functions of adult language:

What happens in the course of maturation is a process that we might from one point of view call 'functional reduction', where the original functional range of the child's language - a set of fairly discrete functional components each with its own meaning potential - is gradually replaced by a more highly coded and more abstract, but also simpler, functional system . . . These 'macro-functions' are the highly abstract linguistic reflection of the multiplicity of social uses of language.

Halliday identifies the macro functions as three in number: the ideational, the interpersonal and the textual:
1. The **ideational** is concerned with the content of language; its function is to express "our experience, both of the external world and of the inner world of our own consciousness -- together with what is perhaps a separate sub-component expressing certain basic logical relationships" (66). It represents the meaning potential of the language system in its vastness and complexity: "for example, the whole of the transitivity system in language -- the interpretation and expression in language of the different types of process of the external world, including material, mental and abstract processes of every kind" (39).

2. The **interpersonal** refers to the non-ideational elements in the adult language system: it is "language as the mediator of role, including all that may be understood by the expression of our own personalities and personal feelings on the one hand, and forms of interaction and social interplay with other participants in the communication situation on the other hand" (66). Grammatically, the interpersonal function is represented by mood and modality: "the selection of the speaker of a particular role in the speech situation, and his determination of the choice of roles for the addressee (mood), and the expressions of his judgements and predictions (modality)" (41).

3. The third component, the **textual**, "has an enabling function, that of creating text, which is language in operation as distinct from strings of words or isolated sentences and clauses. It is this component that enables speakers to organize what they are saying in such a way that it makes sense in the context and fulfils its function as message" (66), thus distinguishing "a living message from a mere entry in a grammar or a dictionary" (42).

The "living message" is contained in discourse which is embodied in text and generated within the context of specific sociocultural situations. Halliday offers a conceptual
framework for the practical analysis of discourse that systematically relates the "context of situation" to the "functions of language". The functions of the semantic system of language we have briefly examined above: (a) the ideational, subdivided into logical and experiential, (b) interpersonal, and © textual. The context of situation is expressed in terms of field of discourse, tenor of discourse and mode of discourse. The two, context of situation and functions of language, are then brought together into:

a correlation between the categories of the situation and those of the semantic system, such that, in general terms, the field is reflected in the experiential meanings of the text, the tenor in the interpersonal meanings, and the mode in the textual meanings. We could express this the other way round by using a complementary metaphor and saying that experiential meanings are activated by features of the field, interpersonal meanings by features of the tenor, and textual meanings by features of the mode" (Halliday 1985:29).

Halliday's system firmly sets language with recognizable functions in a sociocultural context. This marks a departure from the psycho-linguistic movement of the 1960s, which was concerned primarily with the mechanism of language rather than its meaning and function. Above all, language is a system for making meanings which becomes the "primary mode of transmission of the culture". The semantic system of language is therefore parallel with and pointing to the social system, itself a system of meaning. This gives point to Halliday's notion of language development as a semiotic process (Halliday 1975:iv).

**Schieffelin & Ochs and language socialization**

Schieffelin & Ochs (1986) describe the process of language socialization (LS) from an anthropological position in a way that is entirely consonant with Halliday's functional approach to language. They note the same intimate linking between the semantic and social
systems as Halliday, which they express as two interlocking processes: "socialization through the use of language and socialization to use language". Importantly, they add that language socialization "is not limited to the role of language in integrating children into society, but is open to investigating language socialization throughout the human lifespan across a range of social experiences and contexts" (163). This makes the LS approach to classroom discourse analysis particularly relevant.

They note that the notion of LS "draws on sociological, anthropological, and psychological approaches to the study of social and linguistic competence within a social group". Like Halliday, they acknowledge the work of Bernstein (1975) and his associates, e.g. in showing the link between school children's styles of communication and local concepts of social identity and social roles. They also note the relevance of Hymes' (1967, 1972) notion of communicative competence, e.g. in Fischer's (1970) study of linguistic socialization in Japanese and American family communication in which varying degrees of communicative competence maintain and progressively change the subject's social position as member of society (164). In summation, they state: "the contribution of linguistic anthropology to developmental psychology is to make explicit that Anglo white middle-class verbal interactions with infants and young children are also culturally organized and to outline the nature of that cultural organization" (165).

A key theme in LS literature is that language socialization is an interactive process meaning that "the child or novice is not a passive recipient of sociocultural knowledge but rather an active contributor to the meaning and outcome of interactions . . . (an idea) compatible with the Piagetian (1952) concept of the child as an active constructor of his or
her own development" (165). This perspective draws on the early symbolic interactionist approach taken by Mead (1934) and on the phenomenological notions "that reality, including concepts of self and social roles, is constructed through social interaction" (e.g. Berger & Luckmann 1967; Schutz 1967; Ricoeuer 1974); and "that members' perceptions and conceptions of entities are grounded in their subjective experiences and that members bring somewhat different realities to interpersonal encounters" (Mehan & Wood 1975). Interactivity is also a dominant research theme within Vygotsky's (1962, 1978) framework, e.g. Bruner (1966), Cole & Bruner (1971), Leontyev (1981), Cazden (1981), with the notion that "novices are able to carry out particular tasks through 'guided interactions' (and) develop skills in a 'zone of proximal development' as they move from guided or collaborative to independent action" (166).

Ochs (1988) emphasises the role of activity in the whole process of language socialization and points out that activity is both a behavioural unit associated with particular motivations and goals (Leontyev 1981) "and a process, in the sense of praxis (Marx 1959; Vygotsky 1962) "drawing on "the psychological approaches of Piaget (1952) and Vygotsky (1962, 1978) and the sociological approaches of Bourdieu (1977) and Giddens (1979, 1984) . . . What is common to all these approaches is the view that knowledge and praxis create each other" (14-15). Ochs represents this in a simple model:

Linguistic knowledge <--------> Activity <--------> Sociocultural knowledge

The relevance of the sociohistorical approach to this model is "that sociocultural and linguistic knowledge structure activity, and activity creates (in the case of the novice/acquirer) and recreates (in the case of the member/competent language user) knowledge in
both of these domains" (16). This model is directly relevant to task-based content and
language learning in the classroom for both L1 and L2 learners, and more particularly if the
tasks are "real" rather than pedagogical activities. The sociocultural knowledge imparted is
both that of the host culture in general and of the classroom sub-culture in particular.

ACADEMIC DISCOURSE

In this Division we review the history of cognitively oriented observational studies of
the classroom and consider the reasons for their neglect after the ground-breaking work of
Smith, Meux et al. in the 1960s. Conceptually, we examine reasons for the importance of
cognitive observational studies, particularly in L2 learning; review the two Smith, Meux
studies, Logic of Teaching and Strategies of Teaching, and their concepts of Logical
Operations, Ventures and Moves; review Mohan's Knowledge Framework; note the links
between the conceptual units of the Knowledge Framework (knowledge structures) and a) the
conceptual units of the Smith, Meux studies (logical operations, ventures and moves), and b)
formal schemata in reading and writing research, which, together with the Knowledge
Framework, marked a return in the mid-1980s to an emphasis on the cognitive aspects of
classroom teaching. Methodologically, we look at the origins of discourse analysis; how it
has concentrated on the interpersonal and procedural rather than the cognitive aspects the
classroom discourse; and how it identified the I-R-E (Initiation, Response, Evaluation) model
of classroom teaching. We end with a summarization and some conclusions.
History of research neglect of cognitive observational studies

Neglect of the Smith, Meux studies

Two classroom observation studies by Smith, Meux, Coombs et al: *A study in the logic of teaching* (1962) and *A study in the strategies of teaching* (1967) are amongst the earliest and, perhaps, the most extensive in the literature. We will refer to them from this point on as Logic and Strategies. Although frequently cited, they have received little detailed attention. For example, Miller (1976) refers to the hundreds of observation schedules developed in the 1960s and 1970s and, although he includes the Smith, Meux studies in his references, he omits them from his list of significant examples:

- Withall's Social-Emotional Climate Index (1949)
- Medley & Mitzel's Observational Schedule and Record - OSCAR (1958)
- Flanders' Interaction Category System (1960 and 1970)
- Bellack and colleagues' Pedagogical Moves (1966)
- Taba's Teaching Strategies and Cognitive Functioning (1965)

This neglect may be because the Smith, Meux studies focused exclusively on the cognitive aspects of teaching:

Teacher behavior is many-sided. For this reason, we have been forced to select some aspect of it for study rather than attempt to analyse the behavior in its entirety. We have, therefore, concentrated upon the cognitive aspects of teaching behavior and have ignored those behaviors that have to do with the affective domain and with such elements as reinforcement and discipline (Smith, Meux, Coombs et al. 1967:3).

Subsequent research neglected the cognitive content of teaching in favour of two other streams: the behavioural aspects of teaching from the mid-1960s on; and additionally, the linguistic analysis of classroom discourse starting in the mid 70s.
The Behavioral research stream

Nuthall, who was on the Smith, Meux, Coombs Strategies of teaching team, and Alton-Lee (1990:549) suggest that classroom-interaction researchers were influenced to move towards a study of teacher behaviour in the classroom by the challenge mounted in the 1960s by the application of behavioral psychology to education:

Teaching machines, programmed instruction, and behavioral objectives were the products of that application. The behaviorists claimed that, compared with their own scientifically based achievements, classroom interaction research was a case of the blind leading the blind...Teaching needed reforming, not studying.

Accordingly, classroom-interaction researchers felt the need to show that such variables as teacher questions, lesson structuring, and patterns of teacher-student interaction had a causal relationship to student learning. Process-product research became the order of the day with the assumptions that 1) teacher behaviour (the process) causes student learning, and 2) the amount of student learning (the product) measures teacher effectiveness. The researcher's task was to observe various teacher behaviors and correlate them to student scores on achievement tests. As in behavioral studies, the focus was on stimulus and response -- the teacher's stimulus and the student's response -- with no interest in the "black box" of cognition in between. The findings of Smith, Meux et al. were irrelevant to this research.

Tom (1984) notes that this line of research eventually ran its course. The initial claims of researchers that the process-product approach had isolated the key teacher variables that cause student learning (Rosenshine and Furst 1971) were sharply reduced in the face of critical challenges (Rosenshine 1979). Critics particularly called into question the top-down approach of this research with its emphasis on the teacher rather than student and its reliance on aggregated data and average scores, which concealed individual student differences. By the
mid-1980s, despite a number of experimental studies which attempted to hold constant the teacher variable (Nuthall and Church 1973; Gage 1985), researchers were unable to reach a consensus about the value of this research paradigm. Some (Tom 1984, 1985; Shulman 1986) expressed doubt that it had any positive value at all.

Nuthall and Alton-Lee (1990) speak of these doubts and differences as a crisis of confidence in research on teaching. They suggest a new direction for research that, in response to earlier criticisms, will focus on learning rather than teaching and on individual students rather than aggregated data. Research in this new direction may indeed yield valuable results. The focus, however, is still on the relation of behaviours to learning under various contextual conditions and not on the cognitive processes employed.

The Linguistic research stream

Sinclair and Coulthard (1975), who pioneered the use of classroom discourse for linguistic analysis, were not educationists but linguists. Their interest was "not to throw light on strategies of teaching and learning, but to provide linguistics with an impetus and a preliminary model for the systematic study of discourse" (Edwards & Westgate 1987:139). They chose the classroom as a setting because classroom discourse has a clear, overt structure, topics of discourse are well defined and one person (the teacher) has acknowledged responsibility for directing the discourse (Sinclair & Coulthard 1975:6). Their work stimulated a stream of research, taking as its focus the role of language in structuring classroom interactions. Edwards and Westgate (1987:5) review this line of research into classroom talk and summarize its focus as "a concern with the communicative consequences of transmitting knowledge, and a concern for the often limited and limiting quality of language experience
which schools offer children". They criticize earlier classroom interaction studies, taking Flanders (1970:135) as representative, for omitting an analysis of language:

Each focuses upon behaviour involving or giving rise to language rather than upon language itself, on control of the topic or setting rather than on the structure of the discourse. There is no linguistic analysis of the behaviour at all.

They make only the briefest of references to classroom interaction studies with a cognitive focus. They dismiss the Smith, Meux studies in one short sentence (146): "Early studies drew more on logic than linguistics (for example, Smith and Meux, 1970)." Bellack (1966) also receives a one-line mention with credit for being one of the first to use verbatim transcripts of classroom talk (overlooking that Smith Meux (1962) had used verbatim transcripts some years earlier). The cognitive aspects of teaching were considered no more relevant in the linguistic than in the behaviorist research stream.

Research studies citing Smith, Meux

The two studies -- Logic and Strategies -- address a deficiency of Process-Product research -- that it examines teaching strategies but does not look at the logical acts of teaching. Smith, Meux introduced the notion of teaching as a manipulation of content for achieving stated objectives, using rational dialogue. Above all, they provided a rich descriptive natural history as a basis for future experimental research. No other studies of this depth followed on the cognitive aspects of teaching in the classroom; nor has there been any major follow-up of the issues raised. However, a number of studies have cited Logic and/or Strategies, sometimes in simply a historical sense and sometimes indicating being influenced by them.
Early linking of teacher behaviour and student achievement

Wright & Nutgall (1970) -- Nutgall was one of the researchers on the Strategies study -- sought to identify significant relationships between student performance on an achievement test and the sorts of teacher behaviours identified in Bailiwick, et al (1967), Smith, Meux, et al (1962), Tab., Levine and Elsey (1964), and Nutgall and Lawrence (1965). Despite the citing of Smith, Meux, the results were expressed in terms of teachers' operational, not cognitive, strategies: the teachers producing greater pupil subject knowledge were those who used direct closed questions, provided informative summaries after each episode of discussion, involved more pupils by redirecting questions, frequently thanked pupil responses, and provided revision at the end of lessons.

This study is an example of process-product research which sought links between teacher behaviour and student outcomes. It came under criticism for the inability of correlational studies to hold variables constant (e.g. characteristics of teacher and students, physical environment etc.) in natural settings as distinct from controlled laboratory conditions (Tom 1984; McKeachie 1984). Nutgall himself in Nutgall and Lee (1990) recognizes and documents these criticisms in a review of teaching and learning research over the preceding thirty years.

Part of "a proliferation of instruments"

A number of researchers have referred to the proliferation of observation systems in the late 1960s and the 1970s (Rosenshine & Furst 1973; Dunkin & Biddle 1974; Miller 1976; Galton, 1979). Most of these systems have an affective, work process or behavioural but not cognitive orientation. Some of the more significant observation systems were brought together
by Simon and Boyer (Eds., 1967, 1970, 1975) in an anthology called **Mirrors for Behaviour**. Over half of the 79 systems in the 1970 edition of **Mirrors** were derived from Flanders' Interaction Analysis System (Flanders, 1964) which has an affective and behavioural orientation and has proved to be the most popular of all observation systems (Galton 1979).

**Mirrors** classifies the systems it lists under four headings: Affective Domain, Cognitive Domain, Work Process (Control), and Behavior. The Affective Domain refers to the affective climate of the classroom as indicated by teachers' reaction along a continuum from rejecting to accepting students' ideas (cognitive output), feelings (emotional output), attempts to manage classroom procedure, and non-verbal behaviours. Few systems deal only with the cognitive domain and they tend to be more complex. Those listed include both **Logic** and **Strategies**. However, as Nutgall and Church (1972) note, the "cognitive domain" in **Mirrors** can be subdivided to distinguish between instruments with "special theoretical concerns" and those directed towards "linguistic analysis". **Logic** and **Strategies** are concerned with the theoretical concerns (the cognitive in the sense of logical operations applied to lesson content), not with linguistic analysis.

Miller (1976) observes that most observational systems concentrate on the recording and coding of teachers' rather than students' talk and behaviour. He advocates a return to a relatively unstructured yet careful observation of students' activities. He recognizes, however, the need for some system of classification of teacher and student behaviours to facilitate the formulation of working hypotheses that, in turn, may lead to further observations under experimental conditions. The **Logic** and **Strategies** studies had made precisely that point. He also advocates the use of audio and video recording to supplement the human observer and
contribute towards as complete a record as possible of both teacher and student talk. Logic and Strategies had also pioneered the use of recording methodology. He cites both Logic and Strategies but not in connection with the points we have just noted but for their use of episodes of classroom speech as units of reporting.

Dunkin (1976) speaks of "the arduous task of reviewing a large body of systematic observational research" which he had completed in Dunkin and Biddle (1974). More than a third of the 200 studies reviewed use a classification of classroom behaviour based on Flanders' (1964) Interaction Analysis. The many other approaches are each represented by only a handful of studies, which makes it difficult to assess their contributions to a cumulative understanding of the effects of teaching. Dunkin speaks of "a tremendous development in the realization and representation of the patterns and complexities of classroom behaviour," and acknowledges advances in the sophistication of research design and data gathering techniques. On the other hand, he deplores the conceptual confusion resulting from the lack of uniform terminology and the use of the same terminology for variables that are conceptually different. He compares the cognitive systems used by Smith and Meux (1962) (Logic) and Bailiwick et al. (1966), and analyses the meanings of the terms "defining", "explaining", "evaluating" and "opining". He concludes that only "opining" has approximately the same meaning in both studies and that "it would, therefore, be invalid to conclude that either study had provided evidence additional to the other's concerning the remaining three terms" (179). It would seem more appropriate to say that Bailiwick's study had not provided evidence additional to Smith and Meux's as Logic was the first study of the two by several years. Dunkin deplores the lack of compatibility in the large number of
observation systems used. Galton (1979) echoes his frustration because lack of consistency and compatibility has made this large body of work of much less accumulative value than might otherwise have been the case.

A task analysis analog

Moore (1981) makes an interesting connection between task analysis and the analysis of language interactions in schemes like Logic. He led a three-year research project at the School for External Learning (SEL), an experience-based high school program in a large city. He and his team were seeking some form of organizing principle for the analysis of cognitive data in the performance of tasks. They rejected various psychological schemes generated from laboratory studies because they were not generalizable to natural settings. In reviewing the literature on teaching and learning, they came upon the body of work on the structure of language interaction in classrooms, including Smith, Meux et al. 1962 (Logic), Bailiwick et al. 1966, Tab. 1966, Sinclair & Coulthard 1975, and Mehan 1979. Moore (291) comments:

"Several of the studies suggest categories for classifying 'moves' made respectively by teachers and students in the stream of classroom discourse".

Of the studies cited, only Smith, Meux deals exclusively with cognitive discourse while Bailiwick and Tab. deal with cognitive along with affective and procedural discourse. However, Moore went in a different direction, of interest to our case study because of our tutors' emulation of the traditional I-R-E classroom discourse pattern. He and his team were intrigued with the frequency with which the I-R-E sequence (Mehan, 1979) -- initiation by the teacher, response by the student and evaluation by the teacher -- appears in the classroom discourse transcripts they were examining and were puzzled by their inability to
find the same sequence in the discourse transcripts from their resource sites. Moore comments: "We found . . . this form does not appear often in natural speech -- there is something peculiarly 'teacherly' about it." What they did discover, however, was a structural analog of the I-R-E sequence in a sequence, not on the level of speech alone, that they called a "task episode":

The task is established for the student. The task is accomplished (or not) by the student. The student's performance on the task is monitored or processed. . . . Task, therefore, took the logical place of "cognition" in our original problem, as it had the advantage of being an observable phenomenon (Moore 1981:291-2).

Moore proceeds to develop a "rational pedagogy of experience" in which the dimensions of tasks and social means together form pedagogical strategies. He offers this as a way of better understanding the process of education in non-classroom settings. We will suggest in reviewing task-based language teaching later in this Section that Moore's notion is also applicable as a pedagogical structuring device in classrooms and that, often, the closer classroom tasks are to the workplace setting, the more meaningful and hence more effective they are.

**Relevance in math and science education**

Bishop (1982), whose orientation is towards constructive alternativism (Kelly, 1955), looks to educational research not for "results" which should be "applied" but for helpful constructs that will sensitizethe student teachers towards problems and help them generate experiences that will broaden horizons both for them and their students. He distinguishes between the classroom of teaching-methods research, which tends to be an extension of the learning laboratory with a focus on individualized learning, and the real life mathematics
classroom which is, above all, a social arena. He cites Smith, Meux (1970) (*Logic*) as an example of researchers who have chosen the classroom as their research site and have recognized the centrality of discourse for understanding what is going on:

Language has traditionally been of interest and researchers have studied aspects from the level of questions being used (Friedman, 1976) to the whole logic of classroom discourse (Smith and Meux, 1970), an area which could have tremendous value for mathematics education but which has not yet been exploited systematically (125).

Bishop advocates moving much of the work in teacher training in mathematics from the general educational theory context to the mathematics-education context because of the unique character of much of the discourse in the mathematics classroom. Hirst's theory of forms of knowledge and the findings in *Strategies* of predominating patterns of moves in different subject areas lends support to this view.

Gordon (1984) modified the methodology of *Logic* for a special purpose. He wanted to identify the image of science as part of the "hidden curriculum": that which is transmitted unintentionally by teachers and picked up unconsciously by students over a very long period. Direct evidence to support this thesis could be established only over a period of many years. Gordon therefore decided to gather indirect evidence in the form of highly redundant messages transmitted in the hidden curriculum and to take redundancy as *prima facie* evidence that these messages had been transmitted successfully. He used the same sort of category system as developed by the *Logic* study but modified to suit his special needs:

The category system was used to analyze all teacher verbal behaviour excluding class management and discipline issues. For most of the categories the unit of analysis was the lesson's *logical episodes*, although the notion of an episode used resulted in far
shorter sections of discourse being defined as episodes than in Smith's (1960 [sic]) pioneering work in this field (Gordon 1984:394).

Later linking of teacher behaviour and student achievement

We started this review of research studies citing Smith, Meux with an early process-product study (1970) by Wright and Nutgall linking teacher behaviours and student achievement in science lessons. Needels (1988), nearly twenty years later, recognizes the many criticisms of the traditional process-product approach, e.g. Macmillan & Garrison (1984), Erickson (1986), but believes that many of these criticisms can be addressed so that valid relationships between teacher actions and student outcomes can be established by building safeguards against inappropriate generalizations into a study design. Of particular interest to us is her attention to an additional issue, the quality of instruction. In particular, she finds research on logic in education lacking in its assessment of quality of discourse.

For the most part, research on logic in education has been conducted on the following three areas: (a) the kind of instructional treatment that best increases students' performance on a post-test of formal logic, (b) the development of logical reasoning in the child... and (c) the kinds of logical operations used during classroom instruction (e.g. Bailiwick et al. 1966; Smith & Meux 1962 (Logic); Wright & Nutgall 1970).

Only the last of these kinds of research was concerned with the kinds of logical moves used by teachers in a particular subject area... These studies, however, failed to assess the quality of discourse. This failure is a major weakness because to understand the logic of the discourse, the quality of the segment must be assessed (Needels, 1988, p. 505).

In other words, if teachers waffles or uses poor syntax when attempting to clarify a statement or give an explanation, they are more likely to confuse than to enlighten the student.
Needels therefore uses *communicative* logic in her study as distinct from formal logic, following Grice (1975) and his *Cooperative Principle* with its four categories: Quantity, Quality, Relevant, and Manner. She established six variables: 1) confused syntax; 2) omitting necessary definitions; 3) omitting causal factors; 4) irrelevant use of words; 5) Incorrect use of words; 6) incorrect causal relation. Based on this analysis, she found a positive relationship between the quality of teacher discourse and student achievement, especially for lesson content at a high level of cognitive complexity.

This adaptation of the methodology of *Logic* (she does not refer to *Strategies*) to establish communicative logic categories is constructive and addresses the issue of quality of teacher discourse which neither *Logic* nor *Strategies* does. However, Needel's notion of quality seems applicable more to one way teacher discourse in an I-R-E mode than to interactive discourse from which the participants construct meaning.

**Link with natural language interfaces for expert systems**

Kellerman et al. (1989) found the concept of "venture" in *Strategies* valuable in providing conceptual support for the notion of "scenes" as a higher level unit than "scripts" as used in natural language programming for expert systems and intelligent tutoring systems. They use Schank's (1982) concept, Memory Organization Packet (MOP), as an addition to the concepts "scripts" and "scenes". "MOPs are knowledge structures that organize scenes so that some higher level goal(s) can be accomplished" (30) and replace scripts as an organizing principle of memory. Scripts are redefined as short and containing only those actions that detail general actions specified by the scene: e.g. in an introduction scene, one script will involve the specific actions for shaking hands, another the actions for revealing the
relationship with the conversation partner ("we've met before" or "I'm your student") etc. The scene, therefore, is the independent memory unit of a MOP and represents a grouping of scripts for cross-situational and situation-specific actions. Whatever becomes a scene must have a discourse topic and an associated instrumental goal. Scripts will be brought into play to realise that goal. Kellermann et al. comment on the similarity between their concept of "scene" and the concept of "venture" in Strategies:

Smith, Meux, Coombs, Nutgall, and Precians (1967) have identified what they term a "venture" as a segment of discourse consisting of a set of utterances dealing with a single topic and having a single overarching content objective. The venture is believed to be the equivalent of the scene in the informal initial conversation MOP. Greetings serve the goal of recognizing each other, introductions serve the content objective of exchanging identifying information, and each topic serves as an instrumental goal of locating commonalities, extracting information, and the like. (33).

If "ventures" are the equivalent of "scenes", it would seem reasonable to suppose that "moves" are the equivalent of "scripts" or, at least, closely resemble them. Moves, like scripts, specify a number of limited, detailed alternatives at the disposal of the conversation partners in the venture. Kellermann et al. find that Strategies does what discourse analysis in general does not do -- provides a hierarchical as well as a linear structure to the discourse: "Thus, the seeming profusion of discourse units and their resultant implications for discourse structures is more a function of a linear model of discourse, without as consistent a concern for its corresponding hierarchical nature" (28). Just as the MOP is made up of scenes which contain scripts so the Strategy is made up of ventures which contain moves.
Summary

The Smith, Meux methodologies in Logic and Strategies were noted in reviews of the "proliferation of instruments" for classroom observation in the 1960s and early 1970s. They were also included in successive editions of Simon & Boyer's Mirrors for Behaviour anthology (1967-75). These, however, catalogued methodologies as distinct from using them. There was no full scale follow-up on the cognitive aspects of classroom discourse to explore the questions that Smith, Meux raised: in particular, the effect that explicit understanding of logical operations in classroom discourse may have on the quality of students' thinking and acquisition of knowledge, and of teachers' performance and their command of subject matter.

The Smith, Meux studies did, however, establish units of analysis and logical categories that proved useful to some subsequent research: Wright & Nutgall (1970) used the "logical operations" of the Logic study, together with other units, to study links between teacher behaviour and student achievement. This was, however, behaviourally rather than cognitively oriented. Moore (1981) found the concept of "move", used by Smith, Meux and others as an organizing principle for analysing classroom discourse, a helpful analog for organizing task work in experienced-based instruction in non-classroom settings. Gordon (1984) modified the Smith, Meux unit of "logical episode", although more to analyze science teachers' verbal behaviour in communicating "hidden" science curriculum than in analyzing cognitive exchanges with students. Needels (1988) used an imaginative adaptation of "logical operations" in devising a system of communicative logic to measure the quality of teachers' discourse. This was a valuable complementary study to Smith, Meux but was not a direct follow-up. Kellerman et al. (1989) found the concept of "venture" in Strategies valuable in
providing conceptual support for the notion of "scenes" as a higher level unit than "scripts" as used in natural language programming. This work, although highly cognitive, lies in a different field than the cognitive aspects of classroom discourse.

Therefore we may say that although the constructs devised in the Smith, Meux studies provided conceptual support and/or leads to various researchers, there was no effective follow-up on the line of cognitive classroom research they pioneered.

**Concepts for approaching the cognitive aspects of teaching**

**The importance of the cognitive aspects of teaching**

A major weakness in the process-product research paradigm and in the behaviourism from which it sprang is an implicit denial of the autonomy of students (and, for that matter, of teachers too). As Smith, Meux (1962:5) point out: Thorndike, in his studies of animal intelligence, reduces thinking and learning to a stimulus-response model. From this it is concluded that classroom teaching is simply a matter of the teacher supplying correct stimuli to students and reinforcing correct responses. All that matters is observable behaviour. Because mental processes are not observable, laws of logic and modes and procedures of cognition are irrelevant. Dewey, at the same time, was developing a totally different non-behaviourist notion that learning resulted from reflective thought and logical enquiry elicited (i.e. motivated) by the need to resolve perplexing situations. "Between the perplexing situation and its resolution, Dewey put reflective thought. Thorndike on the other hand, filled the gap between stimulus and response with neuron connections" (6). For Dewey, the rules of logic are the rules of successful inquiry and therefore normative for the resolution of perplexing situations. The psychologists, however, ignored these normative aspects of Dewey's theory of
learning and, emphasizing his psychological elements, developed a psychologized version of his theory of logic which drew upon motivation rather than cognition theory. The way they had it, students do not think their way but behave their way out of troubling situations by trial and error, motivated to act by discomfort and guided and reinforced by the teacher. From this was born the notion of learning by the problem (discovery) method: "In this version of inquiry and teaching, there is no distinction between valid and invalid thinking, for such distinction cannot be made within this kind of psychological analysis of problem solving" (7).

Smith, Meux seek to redress the balance. They hold that learning results from the exercise of autonomous thought, not from automatic behavioural responses. They believe that learners will benefit in terms of increased knowledge and understanding if they can be made aware of these cognitive processes operating in various situations. Because their study is descriptive and not experimental, they express these potential benefits in the form of questions to be addressed by subsequent experimental research:

... is the student better able to monitor his own thinking as well as that of others if he has knowledge of the logical structure and rules governing the performance of these (logical) operations? Does an explicit understanding of these operations increase the student's knowledge of the subject he is studying? Does the more rigorous performance of these operations require that the teacher have command of his subject matter in ways different from that which he ordinarily possesses? Would the ability of a teacher to explore subject matter logically free him from overdependence upon the textbook? Should answers to these questions be affirmative, would not knowledge about these logical operations and how to perform them constitute a new content for courses in pedagogy? (Smith, Meux, 1962:10-11)

Mohan (1986, 1989) also is concerned with increasing the learner's knowledge and understanding through awareness of cognitive processes, in particular those underlying
academic discourse and expository texts. He is concerned particularly (but not exclusively) with students learning in a second language (L2). He points out the significance of Cummins' (1991) distinction between conversational and academic language proficiency, particularly in the length of time indicated for mastery: 1-2 years for conversational, 4-8 years for academic discourse. Immigrant students are "mainstreamed" after two years (or less) of second language study into the native speakers' content classes on the strength of coping satisfactorily with interpersonal communication only to find themselves unable to understand the far more cognitively demanding academic discourse and expository texts with which they are confronted. As a result, they do poorly academically. Because, supposedly, they are competent in the language of instruction, their poor academic performance is attributed either to deficient cognitive abilities or poor motivation. Cummins (1984:143) makes the point that L2 students bring with them "an underlying cognitive/academic proficiency which is common across languages". Working in their own language, they already have a store of conceptual knowledge and experience in the cognitively demanding tasks of analysis, synthesis and evaluation. Mohan's goal is to enable them to draw on this native proficiency by making them aware of the Knowledge Structures (KSs) underlying the academic discourse and expository texts presented to them in L2. This is made easier because KSs can be represented nonverbally:

• KSs appear across modes of communication and understanding, being expressed verbally or non-verbally. For instance, classification can be expressed not only through writing and reading, and monologue or dialogue, but also across nonverbal modes of communication, such as graphics and database programs (Mohan 1989:104).

Heightening cognitive awareness in this way should not only help L2 students come to terms with cognitive discourse and academic texts but also help L1 students who have
problems in these areas. Heightened cognitive awareness through teaching text structure has also been shown to benefit reading comprehension of expository texts for L1 as well as L2 students (Carrell 1985; Meyer 1985). Clearly, from the points of view both of teaching methods and student performance, there appear to be good reasons to repair the neglect of research into the cognitive aspects of teaching.

A rationality model of teaching

We have referred to the Smith, Meux studies as early examples of cognitive classroom studies. We will describe them more fully and show their relationship to Mohan's (1986) Knowledge Framework. Before doing this, we should first examine the theoretical base for cognitive research in the classroom. This lies in a rationality model of teaching.

A rationality model defined

Common to the analyses of teaching and education by Bantock (1965), Peters (1966), Scheffler (1966) and Green (1971) is an emphasis on cognitive transactions conducted in a morally acceptable manner. We may call this a rationality model of teaching. Green allows explicitly for those activities that shape behaviour (knowing how) as well as those that shape knowledge and beliefs (knowing that). However, as in "knowing that" he distinguishes teaching-instructing from indoctrination, so in "knowing how" he distinguishes teaching-training from conditioning. In both cases the distinction depends upon the cognitive element of students' intelligent response. That response must occur to consummate the act of teaching.

Some critics, e.g. Cooper (1966) against Scheffler (1960), have charged that conceptions of teaching that fall under a rationality model fail to address the more affective areas of teaching, such as music, the visual and performing arts, and aesthetic appreciation.
Even in these areas, however, cognitive elements are important: students learn performing "know how" through first following procedures and understanding the reasons for them (as we shall see later when we analyze students' "hands-on" discourse); and they learn to make aesthetic judgments through first understanding what to look (or listen) for in a work of art. Moreover, a false dichotomy is often drawn between rationality and affect. One does not exclude the other. Many of our beliefs we hold with affective intensity. Some we may even be prepared to die for. And no belief is without its affective element: the very act of believing is a move away from affective neutrality. We therefore take a rationality model of teaching as a point of departure as expressed in essence by Scheffler (1966:131):

Teaching may be characterised as an activity aimed at the achievement of learning, and practised in such a manner as to respect the student's intellectual integrity and capacity for independent judgment.

Scheffler puts equal weight on two key aspects of teaching, both focused on the learner. First is presenting the students with what is to be learned. This is more than the simple transmission of information from the teacher to the students. It is also the presentation to them of rules of evidence and criteria of judgment for assessing the validity of what they read and hear. Second is obtaining the students' acceptance of what is presented to them. This means helping them to develop their capacities to use rules of evidence and apply criteria so that they exercise their independent judgment in accepting (or not accepting) what is presented to them. The rationality model of teaching therefore implies epistemological understanding and moral commitment.

Scheffler warns against equating the concept of rationality with some innate structure of the human mind. A universal demand for formal consistency is expressed concretely in
uniquely different ways in the different domains of knowledge, e.g. rationality in science is expressed in different ways than rationality in history. He therefore advances a concept of rationality that is one of rules and principles embodied in **multiple evolving traditions** in different domains rather than an abstract and general ideal. He concludes (114):

> Teaching, from this point of view, is not, as the behaviorists would have it, a matter of the teacher's shaping the student's behavior or of controlling his mind. It is a matter of passing on those traditions of principled thought and action which define the rational life for the teacher as well as the student.

**Hirst and epistemological structure**

Scheffler does not elaborate on the nature of the traditions of thought and action for the different educational domains. Hirst (1965) examines this issue from the point of view of the epistemological structure of what is taught in the classroom. He revisits the subject again in collaboration with R. S. Peters (Hirst & Peters, 1970); and answers critical comments and elaborates on a number of points in a later paper (Hirst, 1973). The essence of his position is that within the domain of knowledge there are a number of different **forms of knowledge** that have distinct logical characteristics. These, according to his 1973 classification, are:

<table>
<thead>
<tr>
<th>mathematics</th>
<th>knowledge of minds</th>
<th>religious knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>physical science</td>
<td>moral knowledge</td>
<td>aesthetic knowledge</td>
</tr>
<tr>
<td>philosophy knowledge</td>
<td></td>
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</tr>
</tbody>
</table>

He includes history and the social sciences under "knowledge of minds" because they are uniquely concerned "with explanations of human behaviour in terms of intentions, wills, hopes, beliefs, etc." (Hirst 1973:86). They may share with the physical sciences a concern for empirical investigation and experimentation but this is not where their uniqueness lies. Hirst recognizes that each form of knowledge holds concepts common to others. What he looks for
as a basis for classification is that set of concepts that uniquely predominates in a particular area. Each form of knowledge, while sharing basic concepts with the other forms, has its own unique conceptual structure, unique tests for determining truth claims and unique standards of good evidence for assessing truth claims.

He refutes the idea that "the relations between concepts and propositions in all forms of knowledge must conform to those of mathematical or scientific knowledge". This, he states, "is a matter of pure dogmatism" (90). Forms of knowledge are constructs of the human mind and are constantly changing. The present forms represent today's objective judgment. Tomorrow's objectivity may be different. He also denies the existence of an area of common sense distinct from the particular forms of knowledge: "Common sense knowledge is to my mind simply that collection of elementary knowledge . . . from the different forms, which is largely taken for granted in a given society" (90).

Hirst's analysis of the cognitive content of teaching by forms of knowledge contributes towards understanding what is going on or what should be going on in the classroom. He sees no necessity for structuring the curriculum in terms of his forms of knowledge although he suggests that from a logical point of view there may be advantages in so doing. He does not claim to have said the last word on how many forms or sub-forms of knowledge there should be: e.g. we could say that the category "physical sciences" is too broad as it includes physics, chemistry and biology, which all have different intellectual traditions. He also recognizes that large areas of moral, religious and aesthetic teaching lie outside of propositional knowledge and therefore outside of the forms of knowledge bearing those names (88).
Smith, Meux and the Logic of Teaching

Hirst discussed the epistemological structure of the knowledge that should be taught in the classroom but said nothing about the process of teaching it. Smith, Meux (1962) in Logic set out to fill this gap in educational research. They state at the outset: "It is just as necessary to understand the phenomenon of teaching as a condition of applying ideas and principles to it as it is to understand the ideas and principles themselves" (1). As we saw at the beginning of this Section, researchers had made many observational studies of classrooms and developed various observation schedules. However, these had looked primarily at affective elements in teacher-student interactions and at various aspects of classroom management. No study had made a thoroughgoing record and analysis of the rational, cognitive content of teaching. Logic was the first. It was also one of the earliest, if not the earliest, major study to make extensive use of tape recordings of classroom discourse to obtain an exact record of classroom verbal interactions which could be analysed and reanalyzed as many times as required.

Logic captured teacher-student discourse in 17 classes from grades 9-12 in English, Math, Science, and History-Social Studies. It was neither an evaluative nor an experimental investigation of teaching but rather "an analytic and descriptive one in the natural history sense" (8). Its purpose was to observe, describe and classify logical behaviour (governed by epistemic rules) in the classroom in terms of logical operations in teacher-student interactions.

By "logical operations", which are the focus of our study, we mean the forms which verbal behavior takes as the teacher shapes the subject matter in the course of instruction. For example, the teacher reduces concepts to linguistic patterns called definitions; he fills in gaps between the student's experience and some new phenomenon by facts and generalizations related in a verbal pattern referred to as explanation; he rates objects, events etc., by reference to facts and criteria related in a
pattern called evaluation. If he does not engage in such operations himself, the teacher
either requires his students to do so, or more typically, the teacher and his students
jointly carry on these operations through verbal exchanges (3).

These logical operations take place in units of discourse called episodes, which begin
with an expression that triggers a verbal exchange about a topic and end with completing
discussion of that topic. The logical operations identified from these opening expressions and
used in the study are shown in Table 2.1.

<table>
<thead>
<tr>
<th>Logical Operation</th>
<th>Smith, Meux Logical Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining</td>
<td>Defining</td>
</tr>
<tr>
<td>exemplary, proper name</td>
<td>mechanical, causal</td>
</tr>
<tr>
<td>verbal equivalence,</td>
<td>sequent, procedural,</td>
</tr>
<tr>
<td>classificatory</td>
<td>teleological</td>
</tr>
<tr>
<td>relational definition</td>
<td>normative explanation</td>
</tr>
<tr>
<td>Designating</td>
<td>Designating</td>
</tr>
<tr>
<td>identifying, specifying.</td>
<td>Opining</td>
</tr>
<tr>
<td>Classifying</td>
<td>Classifying</td>
</tr>
<tr>
<td>Conditional inferring</td>
<td>Conditional inferring</td>
</tr>
<tr>
<td>Evaluating</td>
<td>Evaluating</td>
</tr>
<tr>
<td>Comparing and contrasting</td>
<td>Comparing and contrasting</td>
</tr>
</tbody>
</table>

"Describing" was also identified but found too complex with too many sub categories
to include in the analysis. "Stating" and "reporting" were identified but excluded from
analysis because they were found to be of little pedagogic significance. "Substituting” was
identified but excluded from analysis because it occurred in very few episodes. Describing,
Designating and Explaining were the three most frequently recurring operations, in that order.
Substituting, Reporting and Classifying were the three least frequently occurring operations.

The logical operations occur in different patterns in the different subject areas: physiology is more concerned with Defining and Designating; physics with the use of symbols and
Conditional Inferring; biology and chemistry with Evaluating. Samples were too small for
drawing firm conclusions. Results, however, suggest that differences may exist in the use of logical operations among teachers and subject areas for examination in future studies.

A number of interesting questions are raised, going beyond the purpose of the study because they are experimental in import. Among these are:

Is the student better able to monitor his own thinking as well as that of others if he has knowledge of the logical structure and rules governing the performance of these operations? Does an explicit understanding of these operations increase the student's knowledge of the subject he is studying? Does the more rigorous performance of these operations require that the teacher have command of his subject matter in ways different from that which he ordinarily possesses? (10)

These questions were not followed up by researchers in the following two decades. They anticipate the work of Carrell (1985) and Meyer (1985), working with text structures and Mohan (1986), working with knowledge structures (KSs). These researchers use logical analysis of content in different ways to enable students to increase their comprehension of expository and narrative texts and academic discourse. In addition, Christie (1989) has used genre analysis and Mohan has used KS analysis to facilitate the writing process.

Logic notes at the outset that theories of teaching are based on conceptions of logic or psychology or both. Although the study sought to establish each logical category based upon the kind of rule a person would follow in an ideal response, it concludes with the observation that some categories are more clearly rule-governed than others. Particularly troublesome are "opining" and "describing". There are no well formulated rules for "opining":

it seems to make more sense to speak of defining well than it does of opining well. A similar point can be made . . . with describing or reporting one's feelings. What rules does one follow in answering questions such as "How do you feel about snakes?" and "Do you have a headache? . . . On the other hand, even in responding to Opining
entries the student is guided by some rules, though they are quite general" (194).

The study concludes by suggesting that the categories used could be arranged on a logical-psychological continuum according to the extent to which an ideal response is governable by rules. This concession recognizes the inherent untidiness of real-life discourse, which resists neat categorical analysis.

The study also deplores the then narrowness of the fields of logic and psychology of thinking. It suggests ways of broadening them, particularly through a study of logical patterns in ordinary language and in the languages of the different domains; and through an investigation of different kinds of logical vs non-logical behaviour. The suggestions were prescient, preceding as they did the stream of linguistic research that sprang from Austin's (1962) work on Speech Act Theory, including, notably, Sinclair and Coulthard's (1975) work on Discourse Analysis; and the stream of research in cognitive psychology that flowed from the new interdisciplinary field of Cognitive Science, lying more than a decade into the future.

Smith, Meux, Coombs and the Strategies of Teaching

Smith, Meux, Coombs et al. (1967) conducted Strategies as a follow up to Logic. Strategies reanalyzed the recorded data from Logic with a focus on the larger maneuvers controlling the subject matter of instruction, called Strategies. The term "strategies" was introduced in Logic as a pattern of actions concerned with attaining certain outcomes and, hence, directly related to objectives. It was not, however, the focus of analysis as it is in the new study. Strategies are made up of units of instruction, called Ventures, which are categorized according to overarching objectives. Ventures are further subdivided into verbal Moves, logical (mostly) and psychological, which constitute the basic elements of the
strategies of instruction. Moves can be viewed statically as units of content (i.e. as products) or dynamically as units of manipulation (i.e. as processes). They reflect the basic discourse schemas that embody the essential features of each venture's objective.

Strategies, like the previous Logic study, is descriptive and focuses on the cognitive aspects of teaching as distinct from the affective domain and such aspects of teaching as reinforcement and discipline. The eight types of venture identified, with their overarching objectives and typical moves are shown in Table 2.2:

As with all classification schemes, there are problems with boundaries and overlaps. The Causal and Reason categories are not customarily distinguished in the language and so can be easily confused: "Reason ventures are concerned with considerations a person takes into account in deciding to take some action. These considerations do not count as causes" (100). The Conceptual and Particular categories strongly resemble each other: "The major difference between the two is that conceptual ventures discuss the characteristics of a class of things whereas particular ventures discuss an individual object, event, person or place" (243). Although some 105 different types of move are identified, with criteria developed for each one, characteristically only one or two moves predominate within each venture.
Table 2.2: Smith, Meux Strategies of Teaching Ventures, Objectives and Moves

<table>
<thead>
<tr>
<th>Classification</th>
<th>Overarching Objective</th>
<th>Macro Level Moves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causal</td>
<td>A cause-effect relationship between particular events or classes of event</td>
<td>Cause describing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Effect describing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relational</td>
</tr>
<tr>
<td>Reason</td>
<td>Reasons for an action, decision, policy or practice.</td>
<td>Action elaboration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purpose elaboration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rule centred</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual consideration</td>
</tr>
<tr>
<td>Conceptual</td>
<td>A set of conditions governing or implied by use of a term and constituting criteria</td>
<td>Descriptive</td>
</tr>
<tr>
<td></td>
<td>for determining membership in the class of things referred to by the term</td>
<td>Comparative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instantial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Usage</td>
</tr>
<tr>
<td>Particular</td>
<td>A body of information which clarifies or amplifies a specific topic or group of</td>
<td>Descriptive</td>
</tr>
<tr>
<td></td>
<td>related topics</td>
<td>Explanatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appraisal</td>
</tr>
<tr>
<td>Evaluative</td>
<td>A rating of an action, object, event, policy, or practice</td>
<td>Identification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Criterial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relational</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tangential</td>
</tr>
<tr>
<td>Interpretive</td>
<td>The meaning or significance of a set of words or symbols</td>
<td>Meaning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extrapolation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual elucidation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Citation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Representation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evidential</td>
</tr>
<tr>
<td>Procedural</td>
<td>A sequence of actions by which an end may be achieved</td>
<td>Problem centred</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance centred</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Procedure centred</td>
</tr>
<tr>
<td>Rule</td>
<td>A rule or several related rules for conventional ways of doing things or for analytic</td>
<td>Rule formulation</td>
</tr>
<tr>
<td></td>
<td>relations to guide actions</td>
<td>Rule justification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rule application</td>
</tr>
</tbody>
</table>

* Macro-level moves are broken down into 105 detailed moves as indicated by the figures in parentheses
Strategies is a deeper analysis of the classroom discourse than Logic. The logical operations identified in Logic, governed by epistemic rules, are embedded in the Moves which are part of the larger objective-oriented Ventures. The Ventures are governed by instrumental rules. This analysis foreshadows Green's (1971) analysis of the logical acts and the strategic acts of teaching.

In a similar way as Hirst identifies unique conceptual structures for his forms of knowledge, so Strategies identifies certain Ventures which, although not unique, are more common in certain subject domains. Conceptual and Causal Ventures occurred most frequently in the sciences. Reason Ventures, being more closely associated with human actions, occurred predominantly in History. Particular Ventures also predominated in History. Interpretive Ventures occurred predominantly in English, mostly in connection with discussions about literature. Rule Ventures predominated in English and Mathematics. Evaluative Ventures predominated in English and History. The samples used are not large enough for drawing firm conclusions but do indicate interesting trends.

We turn now to a comparison of the Smith, Meux studies with Mohan's work.

Mohan's Knowledge Framework

Mohan's (1986) Knowledge Framework (Figure 2.1) is a research instrument and pedagogic device for the cognitive analysis of texts across the curriculum. Mohan argues that the six Knowledge Structures (KSs), Description, Sequence, Choice, Classification, Principles, Evaluation, contained in the Knowledge Framework are logical forms represented within Halliday's ideational discourse and, equally, are logical forms represented within the classroom discourse contained in the Smith, Meux Ventures as defined in their 1967
Strategies study (Mohan, personal communication). A distinction is drawn between the three KSs of action within specific situations and the three KSs of background knowledge which represent the theoretical principles employed by the KSs of action.

**Figure 2.1: The Knowledge Framework**

<table>
<thead>
<tr>
<th>Background Knowledge (Theoretical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
</tr>
<tr>
<td>Description</td>
</tr>
</tbody>
</table>

Mohan's KSs can also be described as high level schemas, a term Smith, Meux applied to the concept Moves, which they describe as reflecting the basic schemas underlying discourse. Schema has become a somewhat general and variously used term. The OED dates its usage in English to 1839 from Kant and defines it as "any one of certain forms or rules of the 'productive imagination' through which the understanding is able to apply its 'categories' to the manifold of sense perception in the process or realizing knowledge or experience". From philosophy the term migrated to psychology and was used by Piaget to stand for the infant's stored patterns of perceptual-motor coordinations, i.e. schemata of action ("schemata" being Piaget's preferred plural form). Cognitive psychology uses the term to stand for organized chunks or packages into which knowledge is schematized to facilitate comprehension, memory and application (Abelson & Black 1986). Cognitive psychology also uses knowledge structures as an alternative term to schemas. These structures are flexible, not fixed, constantly changing with inputs of new experience. Mohan (1990:16-17) focuses on a few, broadly defined, high-level realizations:
Because the notion of schema is so general and bland, it is necessary to focus on certain classes of knowledge structures [see Figure 2.1]. There are three pairs of related structures: a description of a particular object or person often involves a classification or set of general concepts; a particular temporal sequence of states, events or actions often involves general principles (social rules or cause-effect relations) which relate one state to another; a particular choice or decision often involves general values. These Knowledge Structures (KSs) are broad and general patterns of the organization of information, at a fairly high level of abstraction.

Mohan (1987:507) has also been influenced by the anthropological research tradition and by Halliday's systemic linguistics with the accompanying notions of text and situation:

Halliday's view of language as social semiotic (Halliday 1978, 1985), in the tradition of Malinowski and Firth, has two key terms: text and situation. Every text, spoken or written, unfolds in some situation, or context of use.

He cites Malinowski's (1935) description of Trobriand coral gardening, based upon texts of oral discourse. A large part of these texts is concerned not only with the pragmatic language of action: description, sequence and choice; but also with the more complex language of theory: classificatory distinctions (taxonomies) among various aspects of land, gardens, crops and agricultural techniques; social, legal, economic and magical principles; and evaluations.

Malinowski (1960) went on to claim that traditional cultural knowledge systems are similar in structure to the knowledge systems of modern science. This leads to the important claim that these knowledge structures are cross-cultural – a significant factor in second language teaching, which has to provide for students coming from a wide variety of cultural groups.

The universality of basic knowledge structures has been well explored in cognitive anthropology. Figure 2.2 shows Mohan's mapping onto the Knowledge Framework of the
main types of multi-cultural ethnographic cognitive structures, drawing on Werner &
Schoeple 1987.

**Figure 2.2: Main types of cognitive structure in ethnographic semantic analysis**

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>PRINCIPLES</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxonomy (classification) Part-whole relation</td>
<td>Causal chains</td>
<td>Values and evaluation</td>
</tr>
<tr>
<td></td>
<td>Plans (sequence in time)</td>
<td>Decisions</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>SEQUENCE</td>
<td>CHOICE</td>
</tr>
</tbody>
</table>

Mohan's KSs therefore represent cross-cultural universals expressed at a high level of abstraction. Their purpose is to facilitate the cognitive analysis of text, written or spoken, in specific situations and particularly in classroom situations. They can be used for this purpose because they underlie and give shape to text and discourse although, as Mohan (1990:17) points out, they do not necessarily exhaust the analysis of a typical situation, activity or task. Unlike the Smith, Meux Logical Operations and Ventures, which are expressly defined in terms of verbal behaviour, KSs can be represented in both verbal and nonverbal form.

Of particular value is the ability to represent KSs through graphic conventions, e.g. description by maps and diagrams, classification by classification trees, sequence by flowcharts, principles by line graphs, choice by decision tables, evaluation by rating scales, etc. As Cummins (1984) points out, L2 students can relate to information so presented in terms of language-independent cognitive structures they have mastered in their L1 environment. These serve as a bridge to verbal expression in L2.
Knowledge Framework compared with Smith, Meux structures

A comparison of the Knowledge Framework with the Smith, Meux studies shows that the two systems have both similarities and differences and complement each other.

1. Mohan's KSs closely parallel as process Smith, Meux (1962) logical operations, the main unit of analysis in the 1962 Logical study.

2. Mohan's KSs closely parallel as product Smith, Meux (1967) ventures, the main unit of analysis in the 1967 Strategies study.

3. KSs as process can be used for a logical analysis of classroom discourse, as contained in Smith, Meux Ventures, but at a higher level than the Smith, Meux logical operations.

We will support these claims by mapping logical operations and ventures onto KSs to show the links between them; and will also look at relationships between the Knowledge Framework and other cognitive structures in reading, writing and computer processing.

Logical Operations and KSs

* Figure 2.3: Mapping of Logical Operations onto KSs

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>PRINCIPLES</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining</td>
<td>Explaining</td>
<td>Evaluating</td>
</tr>
<tr>
<td>Classifying</td>
<td>Condit'n Inferring</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Substituting</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>Total:</td>
<td>Total:</td>
</tr>
<tr>
<td></td>
<td>7.8%</td>
<td>5.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describing</td>
<td>28.0%</td>
</tr>
<tr>
<td>Designating</td>
<td>16.3%</td>
</tr>
<tr>
<td>Comparing/Contrasting</td>
<td>3.6%</td>
</tr>
<tr>
<td>Reporting</td>
<td>3.2%</td>
</tr>
<tr>
<td>Total:</td>
<td>51.1%</td>
</tr>
</tbody>
</table>

* The percentages represent the frequency of occurrence of each Logical Operation in the Smith, Meux samples.
A commonality between Logical Operations and KSs is indicated by the similarity of the questions asked in order to determine the various categories used within each construct. This is translated into the mapping of logical operations onto KSs as shown in Figure 2.3.

The mapping in Figure 2.3 is not exact. Boundaries are not hard and fast and categories potentially overlap in both constructs. This is not surprising. Smith, Meux (1962:27-28) report coefficients of agreement between two teams of two trained judges ranging from .62 to .73, with a median of .70, for categorizing utterances by Logical Operations. Disagreements stem from vagueness or ambiguity of utterances and from subtle shadings and nuances in behaviour which create uncertainty in applying criteria. The same problems are experienced in assigning KS categories to discourse segments. Similar differences arise in matching Logical Operations to KSs.

**Ventures and KSs**

Ventures are units of instruction categorized according to their overarching objectives. Those objectives are cognitive in nature and taxonomically derived:

As an aid to understanding the nature of an overarching objective the judges were referred to the taxonomy of educational objectives in the cognitive domain constructed by Bloom, et al. (Smith, Meux, Coombs et al., 1967:16-17).

The judges were told to use but not restrict themselves to objectives listed in Bloom's taxonomy. Bloom (1956) divides knowledge into three distinct types: cognitive, affective and psychomotor. Bloom's taxonomy has dominated the field of curriculum development over the past four decades. Although it provided a valuable service in providing building blocks for critical thinking and curriculum development, it has had a negative influence in splitting the cognitive from the affective (Coombs, personal communication, May 1990). We have already
noted that Smith, Meux regard the logical and psychological, the cognitive and the affective, as on a single continuum. Coombs (1987) also points out that the meaning of categories derive not only from their reference conditions, i.e. how their terms are used in relation to the concrete world, but also from their relational meanings, the much more complex element of meanings derived from how their terms relate to other terms, which define "what it is for something to be an X, i.e. the significance of regarding something as an X" (46). The meaning of Ventures, therefore, (and also of Logical Operations) is not restricted to the single dimension of Bloom's taxonomy. Bloom was simply a point of departure.

KSs also are cognitive in nature and taxonomically derived but based on the taxonomy of ethnographic semantics. Mohan also emphasises a KS's multidimensional meaning. Taking his point of departure from the situation type or frame as used in anthropology for the study of language and culture, Mohan (1987:516) comments:

There is a distinguished tradition in the philosophy of education which takes this holistic approach, using the term "activity" for situation (Dewey 1916; Peters 1966) . . . Much more prominent has been the separatist approach taken by scholars such as Bloom (1956) . . . (whose) separation of knowledge, action and value . . . overlooks situation as a coherent unit of meaning and learning

Ventures and KSs, therefore, closely parallel each other. Figure 2.4 shows a mapping of Ventures onto KSs by relating the overarching objectives for Ventures (Table 2.2) to the questions asked to determine KSs (Mohan 1986:36-37). As in the case of mapping Logical Operations onto KSs, matches are not exact and are subject to differences of perspective. Overall, however, the two structures show a similar approach to classification by cognitive categories.
It might be asked: how can KSs be compared with Logical Operations at one level and with Ventures at another, as we have in fact compared them in our mappings in Figures 2.4 and 2.3? The answer lies in the process/product distinction. Smith, Meux 1967:53 found the same distinction in Moves:

Moves are verbal in character and they may be thought of as units of content as well as manipulations, depending upon whether one considers them as static or dynamic elements.

A Classification Move in a Conceptual Venture is described as follows: "In this type of move a class of things is named or described and it is stated that the referent falls within this class" (Smith, Meux 1967:65). This can be thought of as a discussion that classifies a referent in a group to which it belongs (a dynamic process), or as a classification brought about by the discussion (a static product). In the same way a Defining Logical Operation can be thought of as the process of defining or as the product of having been defined, i.e. a definition.
When we map Logical Operations onto KSs we are thinking of both constructs in terms of process. We could, of course, consider them in terms of product but as they are being applied to small units of discourse (Smith, Meux Episodes) it is more natural to think of them in terms of the processes (operations) that will contribute to a greater whole.

One of the reasons for the Smith, Meux Strategies study was to provide a unit of analysis large enough to represent this greater whole, a unit which could be analyzed in terms of teaching strategies. This unit is the Venture, a product of many Logical Operations and of even more Moves. Therefore, when we map Ventures onto KSs we think of both constructs in terms of a larger whole or product, which is made up of many Logical Operations or Moves or KSs at the process level.

Smith, Meux can think of Moves (and by extension, Logical Operations) as static units of content or as dynamic manipulations, because they are inherently verbal and defined by the text, which can be thought of as either a process or product of words. Mohan, on the other hand points out that knowledge structures are mental schemas that the thinker calls upon while processing. They are manifested in the text as process or product but are not one with the text. Rather they underlie it and can also be manifested in nonverbal forms like graphics.

Differences of purpose

We have seen that there are close parallels between Logical Operations and KSs and between Ventures and KSs, although in each of these pairs the cognitive pie is sliced somewhat differently. The main differences, however, are those of purpose rather than of structure.
Purpose of the Smith, Meux studies

Both of the Smith, Meux studies are avowedly descriptive:

Like our earlier study of the logic of teaching, the purpose of the present investigation is to give a descriptive account of teaching behaviour. This study is in no way an experimental inquiry. Rather it is a natural history of the behaviour of teachers as it occurs under classroom conditions. (Smith, Meux, Coombs 1967: 3).

Smith, Meux point out that, at the time of their studies, very little was known about what actually goes on in the classroom. There had been investigations into teachers, their knowledge, attitudes, styles and personality traits, but very little investigation into teaching, and in particular the cognitive aspects of teaching. They hoped that their studies would provide an empirical base for future experimental studies.

They were also hoping to reveal some "readily observable pattern of development" in the variety of teaching behaviour. In the earlier Logic study they talk about strategies and tactics of teaching, the means by which the end-in-view of teaching is achieved. The tactical elements, the Logical Operations, are the focus of the Logic study. The "large-scale maneuvers which we call strategies" become the focus of the Strategies study.

In the analysis of Ventures in the Strategies study, the Move unit is introduced, broken down into finer detail than the Logical Operations, in order to identify more completely "the major kinds of cognitive information in (classroom) discourse" (56). Also, another unit is introduced called the Play: a consecutive sequence of one or more moves of the same type. A large part of the analysis of Ventures is concerned with drawing out discernible patterns of moves and plays. The objective is to find out whether certain sequences of moves and plays are common to different subjects or different teachers. A
number of such characteristic patterns were discerned and are discussed in the analysis of each type of Venture in the Strategies documentation.

Thus the thrust of the Smith, Meux studies was a strategic one. How do teachers accomplish the cognitive objectives of their classroom periods? Are there recognizable patterns? Can further research check, refine and elaborate on these patterns? Can successful patterns be distinguished from unsuccessful ones? Will this data be useful in teacher training? Will it bridge the gap between teaching theory and teaching practice? Will students and teachers improve their performance through a greater awareness of the cognitive objectives of teaching and the patterns of plays through which those objectives are realized? These questions remain largely unanswered because, for the reasons we have reviewed, the Smith, Meux studies and the cognitive aspects of teaching were neglected by subsequent research.

Purpose of the Knowledge Framework

Mohan comes to an analysis of the cognitive, not from the viewpoint of the strategies of teaching (although these are, in fact, affected by a teacher's use of KSs as an organizing basis for instruction) but from the viewpoint of language learning, and particularly from the viewpoint of the millions in the world who receive their education in a language other than their mother tongue. The problem that these millions face is a failure to reach their potential in academic achievement "because their language learning is poorly coordinated with their learning of content or subject matter" (Mohan, 1986:1). In life, language is a means that links content (what is talked about) with expression (the talking). All too often in the language classroom, language is treated as an end in itself, divorced from content, while all
too often in the content classroom, content is treated as though it had nothing to do with language through which, in fact, it is both expressed and learned.

What is needed is an integrative approach which relates language learning and content learning, considers language as a medium of learning, and acknowledges the role of context in communication. Such an approach will not only be of value for students learning through a second language, it will have implications for education in general" (Mohan 1986:1-2).

Mohan's Knowledge Framework offers such an integrative approach, representing as it does not only the structure of knowledge (a cognitive category relating to content) but also a means of analyzing text (the language in which the content is expressed). Note, however, that KSs are not text in themselves but are an abstract means of analyzing text. Because they are abstract they can be expressed in other ways than by text and in particular by graphic structures. These represent powerful ways of making explicit to the learner the KSs embedded in the text.

Therefore KSs can be used for analyzing Ventures. The Venture with its multiple Moves makes explicit the strategy for teaching a lesson. KSs (rather like high level Logical Operations) make explicit the cognitive structures upon which the language of the lesson is shaped. KSs also bear a similar relation to other cognitive structures such as the text structures of reading, the genres of writing, and programs and graphics of computers.

Knowledge Framework compared with other cognitive structures

What follows summarises Mohan's (1990) review of the relationship of KSs to other cognitive structures.
Reading text structures

Research in reading has shown that skilled readers use their awareness of different types of text structure to rapidly comprehend and remember what they read (Meyer 1985). Two types of schema are recognized: a content schema relating to the type of content in the text and a formal schema relating to the cognitive organization of different types of text (Carrell 1987). Carrell (1984) has shown that the interaction of content and formal schemas determines comprehension of second language readers. Mohan (1990) equates the formal schemas of reading to knowledge structures; and sees the content schemas as facilitating devices for content teachers to use in teaching both L2 and L1 learners. The formal schemas are "an area of common ground for joint action by content teachers and language teachers" (23). He shows the relation of Meyer's top-level text structure types to KSs as follows:

Figure 2.5: Mapping of Meyer's (1985) text structures onto KSs

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>PRINCIPLES</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection</td>
<td>Causation</td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>Collection (sequence)</td>
<td>Response</td>
</tr>
<tr>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>SEQUENCE</td>
<td>CHOICE</td>
</tr>
</tbody>
</table>

Reading/writing text structures

Langer and Applebee (1987) present interesting examples of text analysis which illustrate the low-level process and high-level product perspectives. They divided students into groups using different study methods and assigned them texts to read to form the basis of subsequent tests, including writing. Our concern here is to note their text-structure analysis of the reading passages as illustrated by the following classification tree for one passage:
At the product level, this passage expresses a Classification KS. At the process level, we find expressed KSs for Description, Sequence and Principles as shown in Figure 2.7.

Figure 2.7: Mapping of Langer & Appletree content nodes onto KSs

<table>
<thead>
<tr>
<th>Langer &amp; Applebee Nodes</th>
<th>KSs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desc (Description)</td>
<td>Description</td>
</tr>
<tr>
<td>Adver (Adversative)</td>
<td></td>
</tr>
<tr>
<td>Ev (Event)</td>
<td></td>
</tr>
<tr>
<td>Seq (Sequence)</td>
<td>Sequence</td>
</tr>
<tr>
<td>Explan (Explanation)</td>
<td>Principles</td>
</tr>
<tr>
<td>Caus (Causal)</td>
<td></td>
</tr>
<tr>
<td>Ante (Antecedent)</td>
<td></td>
</tr>
<tr>
<td>Cons (Consequent)</td>
<td></td>
</tr>
</tbody>
</table>

Langer & Applebee (1987:162) comment on one of the texts they had selected: "The passage is loosely organized, with many specific but undeveloped examples to support its main points". It is loose organization that makes real-life analysis difficult, as the Smith, Meux observers had occasion to observe when classifying Ventures. Loose organization is, unfortunately, characteristic of some text book writing. The authors in this case would have
done well to articulate their cognitive objective(s) and to have crafted the written equivalent of, say, a Conceptual and one or two Particular Ventures and then to consider the best Plays/Moves to execute them; or, in KS terms, to recognize that they were producing a classification product by means of description, sequence, and certain principles.

**Writing genres**

A parallel situation to text structures in reading is found in research on writing in both first and second languages. A knowledge of the content domain facilitates more cohesive writing in L1 (McCutchen 1986). Of even greater significance, a knowledge of the formal schemas of writing or "Genres" facilitates better organized writing (Hasan 1984; Martin 1985; Ventola 1987). Just as Smith, Meux found that concept description, not concept attainment is customarily taught in schools so researchers have found that teachers have little awareness of genres: they use almost exclusively the easier descriptive or narrative genres and neglect the more complex expository genres (Hammond 1987). Mohan shows the relation of genres from Martin (1985) and Rothery (1990) in the mapping in Figure 2.8.

**Figure 2.8: Mapping of Martin & Rothery's genres onto KSs**

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>PRINCIPLES</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report</td>
<td>Explanation</td>
<td>Judgement</td>
</tr>
<tr>
<td>Description</td>
<td>Recount</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>SEQUENCE</td>
<td>CHOICE</td>
</tr>
</tbody>
</table>

**Structures made accessible by computers**

Finally, we can relate KSs to cognitive structures made accessible by the computer in the classroom, such as computer graphics, databases and programs. A database, e.g. a video-
ape library, represents classification as product: a Classification KS underlies it. Assigning new videotape programs to the library represents Classification as process. A computer

**program** is by definition a sequential product, executing each command in strict order. A Sequence KS underlies it. However, analysis of the program as process discloses IF...THEN choice structures, descriptive report generations and the application of numerous principles, e.g. reference to decision table rules, which points to underlying Choice, Description and Principles KSs. **Graphics** can be used independently of computers but only to a limited extent in classrooms because they are difficult to produce. Computers make quality graphics easily available. Mohan (1990) shows the relation of graphic conventions to KSs:

**Figure 2.9: Mapping of graphic conventions onto KSs**

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>PRINCIPLES</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td>Function/line graphs</td>
<td>Rank ordering</td>
</tr>
<tr>
<td>Venn diagram</td>
<td>Crossbreak table</td>
<td>Rating scale</td>
</tr>
<tr>
<td>Table headings</td>
<td>Ordered pair table</td>
<td>Value labelling</td>
</tr>
<tr>
<td><strong>Pictures</strong></td>
<td><strong>Action strip</strong></td>
<td><strong>Flowchart decision</strong></td>
</tr>
<tr>
<td><strong>Diagrams</strong></td>
<td><strong>Time chart</strong></td>
<td><strong>Decision tree</strong></td>
</tr>
<tr>
<td><strong>Maps</strong></td>
<td><strong>Flowchart</strong></td>
<td><strong>Decision Table</strong></td>
</tr>
</tbody>
</table>

**Summary and conclusions**

The two Smith, Meux, Coombs et al. studies on the Logic and the Strategies of teaching opened up a promising area of research into the cognitive aspects of teaching. Jerry Coombs of UBC, Vancouver, and Graham Nuthall of the University of Canterbury, NZ, were researchers on the Strategies team and so can be said to have been a part of classroom
observational research at its beginning. Nuthall in Nuthall & Lee (1990: 549) evokes the novelty and excitement of the research approach used at that time:

To be involved in the first systematic observational studies of classroom interaction was like being involved in a mission of discovery . . . Nothing they (the teachers) had learned during teacher training or read in books about teaching methods prepared them for the reality of systematic audio recordings of their own teaching. As researchers, we were excited because we discovered, beneath the apparent confusion, the "um's" and "ah's," and the disjointed nature of the recorded discussions, systematic patterns and logical structures that had never been identified before. It was like discovering a new language or social ritual with its own syntax and vocabulary.

This area was neglected because of the predominating behaviourist research paradigm of the 1960s and 1970s and the linguistic/classroom-interaction research stream from the mid-1970s on. Process-product correlational studies became the order of the day. A great many instruments for the observation of classroom discourse proliferated during this period but very few focused on the cognitive domain. By the end of the 1970s the Process-Product approach had come under severe criticism mainly because 1) teacher, student and environmental variables could not be held constant in natural education settings; and 2) aggregated data and averages were unreliable without reference to individual students. Classroom research needed new directions. Nuthall & Lee (1990) suggest that these should include focusing on learning rather than teaching and on individual student results rather than aggregated data; and should take account of students' personal perceptions and the way they affect learning processes.

There remains the need to focus on the cognitive aspects of teaching and learning, particularly in the case of second language acquisition. L2 students achieve functioning social
communicative competence in a period as short as two years. Content teachers in general do not distinguish this everyday ability to function in L2 from the competence required to handle academic discourse and expository texts. L2 learners do poorly in content classrooms not because they are cognitively deficient (as is sometimes believed) but because they cannot function in L2 at the more sophisticated level that academic content demands. This problem is not confined to L2 learners. Many L1 students also do poorly in academic subjects.

Mohan (1986) developed the Knowledge Framework as an approach to this problem, building on foundations laid by cognitive psychology and cognitive anthropology. The Knowledge Framework contains six high-level knowledge structures (KSs) which represent mental schemas for the broad, most common cognitive operations observed by anthropologists across cultures. They do not exhaust all the structures to be found in texts but can account for most of the content of academic discourse and expository texts.

Mohan picked up the cognitive trail as it had been left by the pioneering studies of Smith, Meux et al. in the 1960s and mostly neglected since. There are similarities between Mohan's Knowledge Framework and the Smith, Meux constructs. They both draw on the concepts of philosophical logic and cognitive psychology and share a common grounding in taxonomy, educational or anthropological. The questions which define the criteria for both constructs are similar so that, at the process level, KSs identify what are, in effect, high-level Logical Operations; and at the product level KSs closely parallel Ventures. The main differences are that the six KSs are defined at a higher level than the 24 Logical Operations; and both Logical Operations and Ventures are defined as textual entities while KSs are
defined as abstract schemas that underlie such entities. KSs also underlie alternative forms of expression like computer data bases and programs and graphical depictions.

The Knowledge Framework also differs from the Smith, Meux constructs in purpose: The thrust of both Logical Operations and Ventures is strategic, to disclose the strategies of teaching in accomplishing cognitive objectives. This strategic thrust is emphasised by the breakdown of Ventures into Moves and Plays, which are essentially strategic terms. The thrust of the Knowledge Framework is to link language learning and content learning in an integrative approach by making transparent the cognitive structures that underlie language and particularly the academic language of the content classroom. These structures are equally available to the L2 learner as the L1 and thus form a bridge for L2 learners from L1 to L2.

The Knowledge Framework can be used for the analysis of Ventures by disclosing the cognitive schemas underlying the Venture text to give a different cognitive perspective than an analysis by Moves and Plays. In the same way, KSs can be used for the cognitive analysis of text structures in reading, genres in writing, and computer structures, particularly computer graphics. There is advantage in having a common approach in all these areas as the same students are having to learn from the academic discourse they hear, the expository texts they read, the genres they write and the computer graphics that they see as aids to a cognitive understanding of the other structures.
The methodology of Discourse Analysis

Definitions

Discourse analysis can be defined broadly as "any study of 'discourse'" or narrowly as "a system of analysis pioneered by Sinclair and Coulthard (1975) and others" (Edwards & Westgate 1987:x). With Edwards and Westgate (22), we follow Brown & Yule (1983) who define "text" as the verbal record, and keep "discourse" to mean "language in use". This distinction is also made by Halliday (1978) who speaks of language being "actualized" or "realized" in text. Thus a transcript of classroom discourse is the realization of that discourse in text which, being permanent, is available for "discourse analysis". We are concerned broadly with an interactional and affective analysis of our peer tutoring discourses and narrowly with a cognitive analysis.

Sinclair & Coulthard's linguistic discourse analysis

Linguistic analysis of discourse can be traced back to the work of J. L. Austin (1962). Edwards and Westgate (1987:19) comment on this link and its connection with developments within linguistics which were at first philosophical in nature, and can be traced back to the seminal suggestions made by J. L. Austin (1962) for clarifying "what can be done with words". His threefold distinction between the locutionary and illocutionary force of an utterance, and its perlocutionary effect, brought a new clarity to analysis of the kinds of work which language can perform . . . The concept of illocutionary force in particular opened the way for two highly relevant further lines of thought. The first led, by way of Grice and his theory of "implicature", to pragmatics; the second, to the allied field of discourse analysis. Both have their origins in speech act theory, and both have much to contribute to the analysis of classroom talk.
Sinclair and Coulthard (1975), pioneers in the linguistic use of discourse analysis, were not educationists but linguists and interested "not to throw light on strategies of teaching and learning, but to provide linguistics with an impetus and a preliminary model for the systematic study of discourse" (Edwards & Westgate 1987:139). They chose the classroom as a setting because classroom discourse has a clear, overt structure, topics of discourse are well defined and one person (the teacher) has acknowledged responsibility for directing the discourse (Sinclair & Coulthard 1975:6). As linguists, they were interested in the structure of language and how language is used in communicative situations.

**Systematic classroom observation**

The method of classroom study that preceded Sinclair and Coulthard's work in the mid-1970s was known as Systematic Classroom Observation. It was characterised by the use of schedules, category systems and observation instruments which, as we have already noted under the heading "The Behaviorist research stream", proliferated during this period. Coulthard (1977) contrasts "systematic observation" with "discourse analysis". "Systematic observation" sought to protect itself from an "overwhelming stream of talk and action" by coming to the observation with a predetermined list of categories of behaviour and interaction and working from observation samples rather than the whole data. In contrast, "discourse analysis" developed categories from retrospective analysis and worked with the whole data. Above all, systematic observation worked primarily with quantitative rather than linguistic data, with counts of categories of interaction rather than analysis of language.

Now none of these actions is specifically linguistic. Each relates to a type of interaction, and each can be realized in a variety of linguistic forms. Each focuses upon behaviour involving or giving rise to language rather than upon language itself,
on control of the topic or setting rather than the structure of the discourse. There is no linguistic analysis of the behaviour at all (Edwards & Westgate, 1987: 135).

Cognitive and pragmatic discourse analysis

We should note at this point that more than a decade before Sinclair and Coulthard's work, Smith, Meux were using "discourse analysis" not for linguistic but for cognitive analysis of classroom discourse, i.e. not to study the structure of language *per se* but to study the forms which verbal behaviour takes as the subject matter of instruction is shaped by logical operations between teachers and students. We are particularly concerned with this type of analysis of our peer tutoring discourses.

We also are concerned on occasions with a pragmatic analysis of the same discourses. Pragmatics is concerned with a study of discourse in relation to contextual, including non-linguistic factors. Particularly important is the term "conversational implicature" which Grice uses in contrast to logical implications "to refer precisely to those inferences which the speaker intends to be recognized, and to be recognized as intentional", e.g. when a teacher observes to a student, "The door is open", and means "Shut that door!" (Edwards & Westgate 1987:19). In contrast to linguistic and cognitive analysis, pragmatic analysis is concerned with the underlying as well as the surface meaning of utterances in relation to contextual factors.

The typical I-R-E structure of lessons

Edwards & Westgate (1987:144) comment; "The most enduring legacy of the work of Sinclair and Coulthard (and of Mehan) has perhaps been the light thrown on that three-move exchange of initiation-reply-evaluation (or I-R-E) which seems such an exceptionally prevalent feature of classroom discourse". Cazden (1988) also speaks of this phenomenon at length and with authority as it was nine videotaped lessons in her elementary classroom that
Mehan analyzed in the mid-1970s. From this analysis he reported that I-R-E was the basic sequence in classroom discourse (Mehan 1979). Cazden (1988: 53), with the benefit of corroborative research in the intervening years, states:

The three-part IRE sequence is the most common sequence in teacher-led speech events. In linguistic terms, it is the "unmarked pattern". A more informative label comes from computer terminology: IRE is the "default" pattern -- what happens unless deliberate action is taken to achieve some alternative.

The teacher by initiating a sequence with a question establishes control. This was not a problem to Sinclair and Coulthard: they welcomed the traditional classroom environment because of its stability deriving from teacher control. Control, however, has its cost. Edwards & Westgate (1987:144) cite Dillon (1983) as producing "perhaps the most devastating critique of teacher-dominated questioning as a pedagogic strategy". Dillon argues that it encourages children to be passive and dependent and points out that professionals like social-survey interviewers, counsellors, and lawyers in courtrooms "all tend to use questions when they want their respondents to be brief and non-thoughtful (and) other tactics (for example, silence, or declarative comment) when they wish to consider longer or more considered responses".

These criticisms may be well founded. One does wonder, however, how many of the critics of I-R-E have faced 30 or 40 restive children, many of whom may not want to be where they are, some of whom may come from broken or abusing homes or homes in the course of breaking up, and some of whom may simply have missed their breakfasts that morning. Certainly not social-survey interviewers, counsellors or lawyers in courtrooms, all of whom enjoy the luxury (to a teacher) of a one-on-one communication ratio. There is a reason and a
place for an I-R-E strategy. If, however, it is the only classroom strategy then there is good reason for believing that the quality of the children's education is less than it should be.

**Discourse language functions**

Cazden (1988:3) calls the study of classroom discourse "a kind of applied linguistics - the study of situated language in one social setting" and suggests that those familiar with linguistics will recognize "the tripartite core of all categorizations of language functions":

- The communication of propositional information (also termed the referential, cognitive, or ideational function).
- The establishment and maintenance of social relationships.
- The expression of the speaker's identity and attitudes.

We can call these the propositional, social, and expressive functions, for short . . . Any one utterance can be, and usually is, multi functional. In each and every utterance, speech truly unites the cognitive and the social.

We can recognize in the first two categories Halliday's ideational and interpersonal macro functions of language. The third can be regarded as a subset of the interpersonal function. Stab (1986), for the purposes of her study, identifies it as the subfunction "Asserting and maintaining social needs".

Brown and Yule (1983:1), in common with Halliday and others, also identify only the first two functions, adopting two terms as an "analytic convenience" with the same warning as Cazden's, that a natural language utterance is unlikely to fulfil only one function to the total exclusion of the other:

That function which language serves in the expression of "content" we will describe as **transactive**, and that function involved in expressing social relations we will describe as **interactional**. Our distinction "transactive/interactional", stands in
general correspondence to the functional dichotomies - "representative/expressive",
found in Buhler (1934), "referential/emotive" (Jakobson, 1960), "ideational/
interpersonal" (Halliday, 1970) and "descriptive/social-expressive" (Lyons, 1977).

It is interesting to note that Smith, Meux, some ten years before Sinclair and
Coulthard's work, were conducting a linguistic analysis of tape-recorded discourse to
deliberately exclude the interpersonal because their express focus was the cognitive aspect of
teaching, i.e. Brown and Yule's "transactional" or Halliday's "ideational". A review of the
"proliferation of instruments" discussed in the preceding Section indicates a disproportionate
emphasis of research on the "interactional" or "interpersonal". The cognitive (ideational)
territory opened up by Logic and Strategies has been largely bypassed in favour of the
social (interpersonal) territory of the affective, work process (control) and behavioural
domains (to use the terminology of Simon & Boyer's Mirrors). Transactional (ideational)
discourse, therefore, remains an area in need of further research, to which Mohan's (1986)
Knowledge Framework is one contribution.
CHAPTER 2B: SELECTIVE REVIEW OF LITERATURE (2)

How can L2 learners function best in the "content" classroom? What lesson structure or teaching methods are most effective in enabling them to learn both the content of the lesson and the language with which to express it? For both L1 and L2 content learning, strong cases have been made for the use in of 1) peer tutoring, 2) task-based teaching, and 3) computer-based language learning (CALL). This Section reviews these cases, looks at issues in task design and examines the relevance of "work study" methodology, as used in business and industry, for the analysis and improvement of task-based work in education.

PEER TUTORING

We have, in this peer tutoring review, drawn particularly on Topping (1988) and Goodlad & Hirst (Eds), 1990.

History

Peer tutoring is not a new idea. It was first systematically used in 1789 in Madras by Andrew Bell, superintendent of a charity school for orphaned sons of soldiers. He was remarkably farsighted in his approach and anticipated both benefits and problems disclosed by research and experience today. He designated tutor/tutee pairs in every class in the school and assigned an assistant teacher to each class to supervise and instruct tutors — a practical step often omitted in peer tutoring projects today. Topping quotes from Bell’s 1797 report:

For months together it has not been found necessary to inflict a single punishment. The moment you nominate a boy a tutor [Bell's was an all boys school], you have exalted him in his own eyes, and given him a character to support, the effect of which is well known. The tutors enable their pupils to keep pace with their classes. Another advantage is that the tutor far more effectually learns his lesson than if he had not to teach it to another. By teaching he is best taught.
Joseph Lancaster in London in 1801 opened the Borough Road School for boys. He built on the base of Bell's system and took it further by grouping pupils by curriculum area and using highly structured materials. In 1817, Bell reported that about 100,000 children were being taught by the Bell-Lancaster system in England and Wales. Unhappily, the system did not long survive the departure from the scene of Bell and Lancaster. Topping (15) associates the decline with the beginning of state funding for public education and the professionalisation of teachers. He adds that, as with most innovations:

it may well be that subsequent imitators lacked the attention to detail of its original proponents, and weaknesses were introduced into the system which made it less effective. It seems that the tutors themselves were given little specific training, acquiring their skills on an apprenticeship basis, and this may have proved inadequate in the long run.

**Components for successful peer tutoring**

The peer tutoring components that Topping (1988:1) lists are, significantly, all present in the original Bell/Lancaster system and most often absent from poorly thought out implementations today. They are:

1. Careful matching of tutor and tutee.
2. Specification of frequent and regular contact times.
3. Training in tutorial techniques, including correction procedures.
5. A system for monitoring and supervision.

Another component, inherent in the very nature of peer tutoring is cooperation between tutor and tutee. This compares with inter-student competition in the traditional
classroom: prizes in real terms or in status for the winners and nothing for the rest who are, by default, losers. Johnson, Johnson & Holubek (1991:1.2) state:

In every classroom, no matter what the subject area or age of the students, teachers may structure lessons so that the students: 1) Work collaboratively in small groups, ensuring that all members master the assigned material; (or) 2) Engage in a win-lose struggle to see who is best; (or) 3) Work independently on their own learning goals at their own pace and in their own space to achieve a preset criterion of excellence.

Topping (2) summarizes: "In cooperation, one achieves and all achieve; in competition, one achieves and others do not achieve; in individualistic work, one achieves and others are unaffected".

**Evaluation of peer tutoring**

**Benefits**

Both tutors and tutees benefit from peer tutoring. The main benefit for the tutor was expressed by Bell in 1797: "By teaching he is best taught"; or, as expressed by Briggs (1975): "To teach is to learn twice". Benefits to the tutee (Topping 1988: 4) include:

1. The tutee receives one-to-one attention which individualises learning.
2. Tasks can be selected (ideally) to suit the tutee.
3. Speed of presentation can be adjusted for optimum learning.
4. Opportunities can be taken for demonstration ("a pleasant change from the verbal harangue which is often all the harassed teacher can find time for")
5. The tutee receives regular and responsive feedback and is subject to close monitoring which maximises on-task time.
6. Verbal and social reinforcement is readily available "of a particularly personal and powerful kind if the relationship is working well".

Topping concludes this summary of benefits by noting that "the quality of teaching provided by tutors may not quite match that of professional teachers, but there is a great deal more of it, suffused with the rosy glow of companionship". We could add from our experience of peer tutoring in this case study that at least in some cases the experience is "suffused" with the red glow of resentment when tutors are heavy handed with their assertion of what they perceives as their teaching authority. All of the above benefits are, therefore possible, but depend upon a well thought out program with adequate training of tutors, adequate preparation of teachers and adequate backing by administration. However, effectiveness research points on the whole to positive results.

**Effectiveness research**

Feldman, Devin-Sheehan & Allen (1976) produced the first critical review of research to conform to generally accepted academic standards. These authors note that reports of effectiveness in peer tutoring programs are often based on no more than anecdotal reports. However, the later controlled experimental studies tended to corroborate this weaker evidence. While the evidence indicates improved attainment for tutees and a broad range of benefits to tutors, evidence for benefits to tutors socially or in personality terms is variable. They found there was little empirical support for the belief that same-sex pairs are best for tutoring simply because most studies had used same-sex pairs. The few that had not did not produce evidence of any variability although most subjects preferred to tutor a same-sex partner. Most studies used white, middle class subjects but a number of studies showed increased academic
improvement in other racial and social class pairings. Little systematic evidence was found for the optimum age difference between tutor and tutee but what evidence was available suggests that a greater age difference results in rather better tutee performance. Most programs matched one-to-one tutor/tutee pairs. A few matched one tutor to three tutees. The evidence tends to support the greater effectiveness of one-to-one tutoring. Feldman et al. note many problems of research methodology, e.g. lack of control groups, lack of control of instructional time, and lack of control for the effects of novelty and special attention from adults. They conclude, critically, that there is a need to draw more upon mainstream psychological and educational theory for research to be other than "fragmented, inconclusive and non-cumulative".

Goodlad (1979) produced the first major British work to review peer tutoring. Like Feldman et al. he notes the great amount of anecdotal evidence and adds that "it is remarkable how unsuccessful 'hard nosed' research has been in supporting this". He cites nine studies demonstrating cognitive gains for tutors but agrees with Feldman et al. on the mixed results on affective outcomes. The evidence for cognitive gain for tutees he finds "overwhelming", particularly for reading skills. The most consistent gains came from structured tutoring involving programmed instructional materials. His review of effectiveness factors largely agrees with Feldman et al. with the addition that a greater age/experience gap of up to three years is likely to be necessary for more complex materials; that more rather than less frequent tutoring sessions are most effective; and that structured tutoring with programmed instructional materials allowing the tutor/tutee pairs to focus on specific tasks
appears to be most beneficial to the tutees with no loss of gains in satisfaction and self-concept to either participant.

Sharpley & Sharples (1981) produced the most thorough academic review of the period. They examined reports on 82 peer tutoring programs, many of them doctoral dissertations and not readily available. They conclude that a broad range of students could benefit academically or socially from peer tutoring participation as either tutor or tutee. However the relative competence between tutor and tutee is significant independently of age norms: high achieving tutors in some projects had shown no gains for themselves while low achieving tutors in some projects had failed to produce gains for their tutees. They conclude that same-age tutors are as effective as disparate-age tutors in producing tutee cognitive gains but that same-age tutors are more likely to benefit from the tutoring experience. There are no conclusive results on the optimum length of a tutoring program; only that studies with less than four hours per week reported minimal gains while all studies with more than four hours per week reported significant gains. Reading was by far the most frequently reported task although various degrees of success were reported for other tasks including mathematics, foreign languages, writing assignments, creative thinking and problem solving. The impact of training is hard to assess because of variable definitions of "training". Any coherent training may raise the confidence level of tutors but no evidence was found to support one method of training over another. Sharpley & Sharples also note limitations in research designs of many studies and note with interest the absence of reporting deleterious effects on tutors or tutees. These effects had been either not present or present and not reported. Also, many of the 82
studies failed to show significant effects from peer tutoring. This bids caution to those mounting peer tutoring projects not to take favourable results for granted.

Gerber & Kauffman (1981), in a book from a behaviorist viewpoint edited by Phillip Strain, find in general that peer tutoring is at least as effective as teacher-led instruction under certain conditions and that peer tutoring as a supplement to teaching is likely to be better than teaching alone. Peer tutors are not, however, free resources. Many studies do not report the instructional resources (and costs) required for training and supporting peer tutors. These authors, working within the tradition of behavioural psychology, emphasise programmed instructional material and reward structures and claim that the tutors are effective in helping the tutee to transfer learned behaviour to new settings once they "are established as the source of reinforcement for certain target behaviours". Topping (1988:82) questions their belief that "control of contingency arrangements should be given precedence in future research" because past research indicates that "for many tutor-tutee pairs tutoring proves to be intrinsically self-reinforcing". Interesting, however, is Gerber & Kauffman's finding that tutors respond positively to tutees that they originally did not want to partner when the tutee's performance improves as a result of the tutor's efforts.

Meta-analysis procedures were used by Cohen, Kulik & Kulik (1982) and Cook et al. (1986). These studies indicate that the performance level of tutors and tutees is higher than that of the controls; that tutees in general achieve more academic gains than tutors; that changes in self-concept and sociometric measures are negligible but both tutors and tutees show improved attitudes to school and/or subject area; and that behaviour ratings change more for tutors than tutees.
The sharp acceleration of interest in peer tutoring in the 1970s levelled off in the 1980s but work continued at a steady pace. Structured tutoring systems became increasingly popular and are reported in von Harrison & Reay (1983). Particularly interesting are findings by Trovato & Bucher (1980) who assigned 69 children over a 15-week program in seven public schools to three groups: peer tutoring only; peer tutoring with home-based reinforcement; and control. The subject was reading. They report that both reading accuracy and comprehension increased significantly in the peer tutoring group compared with the control group and that the addition of home-based reinforcement doubled this increase.

"Reciprocal tutoring" was reported on by Pigott et al. (1986) and Palincsar & Brown (1986), with positive results. This is a combination of one-to-one peer tutoring and small group work. The members of the group accept different roles and all take turns in assuming each role. In Pigott's study: the roles were different aspects of peer tutoring: peer instruction ("coach"), observation ("score-keeper"), evaluation ("referee") and reinforcement ("manager"); the tutees were 12 under-achieving primary pupils; and the focus was arithmetic performance. This increased during the intervention to the same level as the tutee's classmates and was maintained at a 12-week follow-up. The members of each group increased their peer affiliation with each other. Palincsar & Brown report positive results in reading in groups which included the teacher with students rotating the roles of predicting, question generating, summarising, and clarifying. Before long the students were able to assume the role of "reciprocal teacher".

Of particular interest is the work of Benjamin Bloom (1984) and his students at the University of Chicago over a period of years, searching for a solution to the "two sigma
problem". The object over a series of studies was to compare differences in achievement measures for groups of children under different educational systems. They found that the average student in one-to-one tutoring was about two standard deviations above the average of the control group class, i.e. the average tutee out-performed 98% of the pupils in the control group class. The "two sigma problem" was to find other educational systems which could approach this level of effectiveness. Certain forms of "mastery learning" in combination with other measures reached a 1.7 sigma effect size. Only tutoring broke the two sigma "barrier". Put in other terms, about 90% of tutored students and 70% of mastery learning students achieved a performance level reached by only the highest 20% of students under traditional instruction conditions.

Topping (88) concludes his review of effectiveness research with the observation that Bloom's claims for peer tutoring appear to be largely substantiated but adds:

Nevertheless, because peer tutoring is effective in general, that does not mean it is bound to be effective right where you are. A number of studies have not produced significant results, and these tend to be rarely discussed or reported. When establishing a peer tutoring project, particularly for the first time, it is essential that it is most carefully organised and that evaluation research is built in.

Goodlad & Hirst (Eds. 1990) speak of the cost effectiveness of peer tutoring and see it as a way of relieving pressure on overburdened teachers. Their own experience with peer tutoring practice and research is extensive. In 1987 they received a two-year grant (UK) to disseminate results of a scheme called "The Pimlico Connection", operating since 1975, involving some 800 students from Imperial College in helping teachers in local schools by tutoring 9,000 students. Goodlad & Hirst (1989) was the pre-conference book for an international conference on peer tutoring held at Imperial College in 1989.
Goodlad & Hirst (1990) report finding over 1,000 more research papers on peer tutoring since Wilkes (1975) reported 268 papers. They note (5) that this research lacks cohesion because of the great flexibility of peer tutoring but add: "research evidence is clear: peer tutoring can improve the attainment of both tutor and tutee in the content area being tutored; in addition many studies report affective gains". Additional costs incurred through peer tutoring are more than repaid. They cite a cost effectiveness study on elementary school children by Levin, Glass & Meisters (1987) who find that peer tutoring is more cost effective than computer based instruction (CAI) and both of these are more cost effective than reducing class size or increasing the length of the school day. Goodlad & Hirst (1990:19-23) see much of this cost effectiveness represented by gains to teachers: enhancing their professional role; freeing time for counselling, innovating and guiding; solving some discipline problems (bad behaviour often improves in and after tutoring); coping with mixed abilities in their classes. They warn however that peer tutoring is not a panacea and should be regarded as an addition to the teacher's repertoire along with field trips, project work, library research etc. They conclude their review (24):

In summary, the range of applications of peer tutoring included in this volume [reported by various contributors] indicates the potential of the strategy as a teaching aid at all educational levels. Without doubt, many questions regarding tutoring remain unanswered, and there is a need for careful evaluation to enable researchers to identify the mechanism by which effects are seen to occur. However, research which has already been carried out shows tutoring to be effective at producing both cognitive and affective gains for tutors and tutees in very many contexts.
Peer tutoring and second language (SL) acquisition

Flanigan (1991:141) notes "that recent studies of interactive learning in the SL classroom have emphasized teacher-student and student-student discourse as a means of breaking the tradition of teacher-fronted one-way instruction". The great advantage of interactivity is the greater amount of student talk and negotiation of meaning that takes place, resulting in increased comprehensible input. Flanigan recognises this but raises two issues regarding elementary school classrooms with a mix of native speakers (NS) and non-native speakers (NNS) and ESL classrooms with a mix of more and less proficient NNSs:

1. Can peer interaction be useful, productive and less than frustrating in these situations?
2. What kind of language do the tutors use analogous to "foreigner talk" (FT) used by adults when conversing with NNSs not yet fluent in L2, or teacher talk used by teachers in one-to-one conversation with such NNSs?

The subjects of Flannigan's study were NNS children working in six pairs. The settings called for little tutee verbal response as they were working on "real world" practical learning tasks on how to use computers set up as graded reading and listening stations. This was deliberate because the tutees were very new to the school with low English proficiency. Much of their interaction could be limited to nods and other physical responses.

It was found that the tutors' discourse resembled teacher talk more than FT because the sessions were one-way instructional. The tutors employed the same strategies and tactics as adult interlocutors: e.g. frequent deictics in demonstrating tasks, direct imperatives, clarification of meanings, repetition; and less frequent direct explanations and direct questions,
the latter mostly used as comprehension checks. Flanigan (145) comments: "The tutors imitate their regular teachers very well, using oral spelling and punctuating their commands with acknowledgements of success". I found this observation true in the peer tutoring discourses in my own case study, the tutors embracing the whole I-R-E mode of teaching that they had learned from their classroom teachers. Flanigan (147) also observes that "approval of correct responses and rejection of incorrect responses are overtly expressed very little, and never with the exaggerated congratulatory tone that adult teachers use". Our tutors were more ready with correct or incorrect replies and some certainly did emulate the teacher's congratulatory tone, in one case to the point of parody.

Flanigan concludes that her study supports research which shows the value for second language learners of linguistic input from proficient NNSs even when that input is not really "negotiated", i.e. worked out in a two-way verbal exchange. Moreover, the fact that even young children employ the same kinds of strategies and tactics that adult interlocutors have been found to use (Long 1983; Gass & Varonis 1985) would suggest that they be encouraged more extensively and deliberately in the schools to do what they apparently do spontaneously anyway (Chesterfield & Chesterfield 1985).

**Peer tutoring issues**

The advantages and potential benefits of peer tutoring seem so great and well supported by research that one must ask why peer tutoring is such a rare phenomenon in the educational system. Goodlad & Hirst (1990) consider the issues and action required under three headings: political, psychological and administrative.

**Political**

Political obstacles can vary from outright opposition to preoccupation with other programs. In North America, peer tutoring may be seen as conflicting with the "back to
basics" movement and therefore opposed on that account. In B.C. the recent focus on the "Project 2000" initiative would leave little energy to spare for other projects for classroom change. For success, a program for implementing peer tutoring would require at least a) absence of active opposition at the Ministry level; b) active support and follow through at the District level. Political issues overlap with psychological issues.

Psychological

Goodlad & Hirst (1990:226-229) quote from Francis Macdonald Cornford's "slim but immortal volume 'Microcosmographica Academia'":

Every public action which is not customary either is wrong or, if it is right, is a dangerous precedent. It follows that nothing should be done for the first time.

At the school level, teachers may fear loss of authority, negative reaction from parents, disapproval of colleagues or superiors, selling students short, and "above all, the prospects of administrative hassle (that) can put people off attempting an innovation".

Administrative

The 1989 conference convened by Goodlad and Hirst confirmed research findings: "namely that the three principal obstacles to running peer tutoring schemes are: the need for an initiator, timetabling, and resources". A prime necessity, easy to define but hard to implement, is appointing one person with enthusiasm and "belief" in the program to have overall responsibility for organisation and for liaison and communication with participating teachers. The greatest obstacle is the restraint imposed by existing rigid timetabling: "In a survey of 82 peer tutoring projects, Fitz-Gibbon (1987:29) found that scheduling problems occurred in 52% of them". Resource demands that must be met are teachers' time
commitments, particularly at the beginning of implementation, and space arrangements to facilitate tutor/tutee interaction without disturbance to neighbouring pairs.

It is axiomatic with systems managers in industry that one of the greatest obstacles to the implementation of innovative programs is the inertia of the existing way of doing things. It is not unreasonable to believe that this hold true in education also. Peer tutoring is different from the norm and does not fit neatly into existing curricula and timetables.

**TASK-BASED LANGUAGE TEACHING**

**Constructing a task syllabus**

**Vacuum between syllabus and method**

Long (1985) deplores a vacuum in SLA classroom practice caused by 1) a lack of coordination between syllabus and method, between the *what* and the *how* of SLA instruction, and 2) by a lack of relatedness of syllabus and method to SLA research. The most common syllabus types such as structural, notional-functional, topical and situational are characterised by units of analysis that are overtly or covertly linguistic. They say nothing of what, concretely, will be taught nor of the sequence in which material will be presented. Selection (what is to be taught) and grading (sequencing), if handled systematically at all, take place at some other stage of program planning if time permits and requisite expertise is available.

Method in practice is still predominantly grammar translation or audiolingual, the two most widely used approaches, "or worse, in some parts of the world, a ghoulish hybrid, often known locally as 'the eclectic method'" (78). This vacuum has been filled by a host of "unconventional" methods, most of which have no theoretical base at all, and none of which say *what* will be taught through its use. Most seriously:
... most proposals for both syllabus design and teaching method have been made in a psycholinguistic vacuum. Syllabuses generally consist of inventories of items drawn not from any understanding of how a second language is learned, but from the linguist's (partial) descriptions of the language itself and/or sociolinguists' (to date even more fragmentary) descriptions of the ways it is used. It is assumed that the same linguistic or sociolinguistic units ... that were employed in analyzing the full native speaker form or use of the language are also meaningful segments in which to teach it and in which to hope learners will acquire it (Long, 1985:79).

"Task" is a natural concept lying ready-to-hand to fill this vacuum. Long (1989:2) cites research studies that "show that teachers of languages and other school subjects plan, conduct and recall their lessons, not in terms of methods, but rather as sequences of instructional activities, or tasks". "Task" accordingly provides a meaningful unit of analysis in lesson planning as well as other aspects of program design and implementation.

Steps to construct a task syllabus

A number of steps are required to construct a task syllabus, moving through different classifications of task from the real world to the classroom:

1. Develop an inventory of target tasks from a learner needs analysis.
2. Classify target tasks into task types.
3. From the task types, derive tasks.
4. Select and sequence pedagogical tasks into a task syllabus.

Target tasks are occupational, vocational or academic tasks taken from the world of work. Long takes examples from the U.S. Department of Labor "Dictionary of Occupational Titles" (1977). Task types are superordinate categories "whose members share common characteristics, although differing in detail" (92). Thus "selling an airline ticket" and "selling a
train ticket" both come under the task type, "selling tickets". These generalized task types become the base from which pedagogical tasks are developed, i.e. "simplified but transparent concrete exponents of task types for classroom use". A task syllabus may then be constructed. This is simply the final sequence in which selected pedagogical tasks are presented to the classroom language learner. Selection of tasks is handled through ensuring that task types are adequately represented by the pedagogical tasks chosen. Grading is determined by the degree of difficulty of the pedagogical tasks themselves (from simple to complex), as well as such normal considerations as variety, pace and duration (Long, 1985:93).

Comparison with the "Natural Approach"

Long agrees with Krashen (1982:94 and elsewhere) that "the primary function of the SL classroom (is) the provision of opportunities for natural SLA". There are, therefore, similarities in methodology between Task-Based Language Teaching and Krashen and Terrell's (1983) Natural Approach:

Both approaches focus on communication, not form, and both attribute a central role to the provision, through communication, of large amounts of comprehensible input. Consequently, both approaches eschew error correction, and both accept interlingual forms from learners . . . (Long 1985:95).

The main difference between the two approaches is in content. In the Natural Approach, content is whatever the teacher and students happen to talk about. In the task approach, content is defined by a syllabus which will differ for different groups of learners. This leads to differences in sources of input. In the Natural Approach, the teacher is the prime source of target language data. In the task approach, various sources are used appropriate to
the special nature of the task (taped dialogues, visiting "experts", various documents etc.).

These sources include also the language learners themselves working in task groups.

"Task" defined in the context of syllabus

Long and Crookes (1992) use Wilkins' (1974, 1976) distinction between analytic and synthetic syllabuses in pointing out what is distinctive in task-based teaching. In synthetic syllabuses (e.g. structural, notional, functional), the learner's role is to "re-synthesize language that has been broken down into a large number of small pieces with the aim of making his learning task easier" (Wilkins 1976:2). In analytic syllabuses (e.g. procedure, process, task-based), the learners' task is to use their analytic capabilities on whole language in the context of the purpose(s) for which they are acquiring the language. Various units of analysis are used in the synthetic syllabuses, e.g. structure, notion, function, situation, topic, lexical items. Just one unit of analysis, task, is used in the three analytic syllabuses that Long and Crookes describe, but this unit is variously defined.

The procedural syllabus

This is associated with the work of Prabhu, Ramani and others in the Bangalore/Madras Communicational Teaching Project, working with students aged 8 to 15 from 1979 to 1984. It is process-oriented, following the same claim that Krashen made that language form is acquired unconsciously while the learner's attention is focused on meaning, i.e. on task completion, not language form (Prabhu, 1987). It also emphasises teacher control and assumes teacher-fronted pedagogy. Prabhu (1984: 24) accordingly defines task as:

An activity which requires learners to arrive at an outcome from given information through some process of thought, and which allows teachers to control and regulate that process . .
Typical tasks are: interpreting information presented in tables, e.g. library information about books; working out distances between places; plotting travel routes on maps; listening to stories and providing endings with plot solutions. Long and Crookes comment that the Bangalore tasks are similar to "communicative language teaching" tasks which emerged from Europe in the 1970s: "That is, activities in the Bangalore Project were pre-set pedagogic tasks, not related to a set of target tasks determined by an analysis of a particular group of learners' future needs" (35).

**The process syllabus**

This is associated with Breen and Candlin. It focuses on learner processes and preferences rather than language content and regards learning as an outcome of negotiation. Learners contract with teachers on procedures and selection of pedagogic tasks. These can be almost anything learners want to make them. Definitions of task are therefore broad. Crookes and Long cite Candlin's (1987:10) "rather formidable definition of task" as:

one of a set of differentiated, sequencable, problem-posing activities involving learners and teachers in some joint selection from a range of varied cognitive and communicative procedures applied to existing and new knowledge in the collective exploration and pursuance of foreseen or emergent goals within a social milieu.

Somewhat less formidably but no less broadly, Breen (1987:23) defines task as:

any structured language learning endeavour which has a particular objective, appropriate content, a specified working procedure, and a range of outcomes for those who undertake the task. "Task" is therefore assumed to refer to a range of workplans which have the overall purpose of facilitating language learning -- from the simple and brief exercise type, to the more complex and lengthy activities such as group problem-solving or simulations and decision making.
The task-based language teaching syllabus

This is associated with Long and Crookes. Unlike the procedure and process syllabuses, the task-based syllabus identifies real-world target tasks on the basis of a learner needs analysis. Target tasks are classified into superordinate task types. Pedagogic tasks for classroom use are developed from the task types by a process of concretization and simplification. Long defines task in its everyday, non-technical meaning as:

a piece of work undertaken for oneself or for others, freely or for some reward. Thus, examples of task include painting a fence, dressing a child, filling out a form, buying a pair of shoes, making an airline reservation, borrowing a library book, typing a letter . . .

In other words by "task" is meant the hundred and one things people do in everyday life, at work, at play, and in between (Long 1985: 89).

Crookes boils this down to:

a piece of work or an activity, usually with a specified objective, undertaken as part of an educational course or at work (Crookes 1986: 1).

Other definitions of "task"

Nunan (1989:10), like Prabhu, looks at task as "communicative" tasks in the classroom rather than in real-world natural settings.

. . . as a piece of classroom work which involves learners in comprehending, manipulating, producing or interacting in the target language while their attention is principally focused on meaning rather than form.

Doyle and Carter (1984) provide a definition based on Doyle's earlier concept of "classroom task", derived from work in cognitive psychology and cognitive anthropology:

The term "task" is used to designate the situational structures that organize and direct thought and action . . . Tasks organize cognition by defining a goal and providing instructions for processing information within a given setting. A task has three elements:
(a) a goal or product; (b) a set of resources or "givens" available in the situation; and (c) a set of operations that can be applied to the resources to reach the goal or generate the product (Doyle & Carter 1984:130).

In its application this definition is restricted to the "academic" tasks that students encounter in classrooms. These tasks emphasise the role of cognition and information processing operations such as reproducing information or applying algorithms to solve problems. They are, therefore, pedagogic tasks designed for the classroom. However, the second part of the definition which defines task elements (goal/product, resources, operations) matches nicely the notion of task in industrial work study.

Summary

Prabhu (procedural syllabus), Breen & Candlin (process syllabus) and Nunan define "task" exclusively in terms of language learning, i.e. as "communicative tasks". Long and Crookes' (task-based language teaching syllabus) define "task" broadly as a unit of work in real-world terms and for classroom purposes relate real-world "target" tasks to simplified "pedagogic" tasks. Doyle & Carter define "task" in terms of classroom "academic" tasks. However, Doyle & Carter's task elements (goal/product, resources, operations) usefully match the industrial work study breakdown of real-world tasks. In these definitions we have a two-way breakdown of the notion of "task": 1) tasks designed specifically for classroom use and 2) tasks as found in real-world settings.

Psycholinguistic and sociocultural approaches to task

Mohan (1990a) addresses the problem of how to coordinate SL learners' development in language with development in content or, from the teacher's perspective, how to coordinate language teaching with content teaching. He suggests that the notion "task" provides a general
organizing concept to bridge these two areas. He also distinguishes between two approaches to task: the psycholinguistic and the sociocultural, and argues that the sociocultural approach is most productive for the coordination required between language and content learning while, at the same time, embodying sound psycholinguistic principles.

**A psycholinguistic approach**

Long (1985:79) makes the point that "most proposals for both syllabus design and teaching method have been made in a psycholinguistic vacuum". They have been based on an abstract, linguistic analysis of how language is used and not on the basis of SLA research of how language is acquired. Little or no attention has been paid to interlanguages, fixed order of acquisition stages, holistic rather than synthetic acquisition of language, comprehensible input and other concepts which have emerged as key issues in SLA over the past two decades. In a psycholinguistic approach, tasks are designed and sequenced in accordance with these SLA concepts, to create natural opportunities for learners to engage in the second language. The particular thrust of a task will depend upon the leanings and convictions of the designer. Mohan cites Prabhu (1987) as an example of designing tasks to develop grammatical competence through such activities as drawing geometrical figures from verbal instructions, working out the money needed to buy a set of things, and identifying factual inconsistencies in narratives. Prabhu holds that engaging in such communicative tasks is sufficient to develop second language competence without a focus on language form. On the other hand, Loschky and Bley-Vroman (1990) advocate "the use of communicative and meaningful classroom tasks (to) focus learners' attention on grammatical forms in input and, thus, facilitate their acquisition" (161). Long and Crookes' Task-Based Language Teaching
(TBLT) provides for some task-based focus on form where SLA research has indicated that this is desirable, e.g. forms which are not learnable from positive instances alone, or are unlikely to be noticed in the input, or whose learning can be speeded up through practice. Unlike the Procedural and Process syllabuses, TBLT uses real-world tasks, based on learners' needs analysis but does not use them directly. They are put through a process of abstraction and refinement: first the development of task types and then the design of pedagogic tasks for classroom use. Therefore pedagogic tasks are at some remove from the real world.

Tasks described in the psycholinguistic approach tend to be experimental, having been devised by researchers to investigate specific variations of input and interaction. Mohan and Smith (1991) describe two examples: 1) a picture description task in which a learner is given a coloured photograph of a familiar object and asked to describe it in English so as to identify it clearly for an English-speaking listener; 2) a 20-minute interview with a native speaker during which discussions ensue on everyday topics such as school, holidays, cooking and sports and comment:

It is important to note that "task" is seen here in the tradition of psychological experiments: the participants in the task are "subjects", engaged in an experimental task; task characteristics are seen as independent variables; and characteristics of task discourse are considered to be dependent variables.

Many of these tasks are like games developed in micro-worlds. They are ingenious and effective in creating situations that engage the learner in language and learning strategies but bear no resemblance to tasks in the real world. Although Long's pedagogical tasks, in contrast, are derived ultimately from target tasks, they bear an attenuated relationship to them by the time they have been strained through the filters of task types and pedagogical design.
The psycholinguistic approach, therefore, focuses on tasks abstracted from their socio-cultural context. The task is a means to a psycholinguistic end, the engagement of the learner with the language so that second language acquisition takes place, rather than the accomplishment of the task’s goal, which is of secondary importance. This approach does not address the learner's specific needs in the content classroom, which is dealing with the tasks themselves. As Mohan (1990a) points out: "(it) does not aim at the development of academic discourse. It does not speak to a content perspective, because it does not aim at subject matter learning."

Tasks in the psycholinguistic approach lack depth of context and hence ecological validity.

A sociocultural approach

The sociocultural approach to tasks is to learn by doing. Dewey (1916:7) points out that this is the first and natural approach to education and continues still in preliterate societies where there is no such notion as "education" as an activity in itself or of "school" as a special place where education takes place. Children learn the skills, values and customs of adults by sharing in what the elders are doing: "To savages (sic) it would seem preposterous to seek out a place where nothing but learning was going on in order that one might learn" (7). Something of this tradition continues today in craft apprenticeships and in children learning in the home (e.g. cooking). Apprentices and young children are fluent native speakers although they have to learn additionally the language of their trade or task. The absolute blend of learning language and "task" is found in mother-child interactions, e.g. in the game "peekaboo" (Bruner 1983) where the very game is constituted by language. Bruner describes such games as "little protoconversations" (47), invaluable stepping stones to the young child's eventual full communication competence.
Learning by participation implies an expert and novice working cooperatively together, constructing their own social context within a real-world environment. Vygotsky calls this approach to learning "sociocultural" (Bruner 1985; Cole 1985) and coined the term "zone of proximal development" to describe the shifting of control from the expert to the novice:

He said that the zone of proximal development is the difference between a child's "actual development as determined by independent problem solving" and the higher level of "potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Cole 1985:155).

This model of learning is "two way" in contrast to the "transmission" model of teaching in which teachers transmit a stream of textbook knowledge into the passively seated and silent learners. The only voice to be heard in such a classroom is the teacher's with an occasional response from one student at a time replying to a controlling question. In contrast, Ochs (1988:223-4) points out that in sociocultural learning:

bidirectional transformation of knowledge and meaning takes place between members and novices . . . Teachers as well may be socialized by the students they are inducting into some area of expertise. Their understanding of the subject matter may be transformed by the responses and questions of students.

We have, then the notion of task as a cultural, social activity within a context constructed jointly by the expert and the novice. Within this total task "we can distinguish the adult or expert's task (e.g. the full process of book reading, peekaboo, tailoring, or weaving) and the novice's task (initial participation within the context of the full activity) which is progressively expanded into the expert's task" (Mohan & Smith 1991). Mohan (ms.) relates this to language and content teaching:

This approach is important for guidance to language teachers and content teachers seeking to integrate the learning of language and subject matter, because it analyses "language
socialization", the simultaneous learning of language and culture (understood broadly to include subject matter).

**Task related to concepts of practice and theory**

**Theory and practice dichotomized**

Mohan (1991) points out that a false dichotomy between theory and practice emerged when formal schooling replaced apprenticeship as the predominant mode of education in industrial society. School came to be associated with theory, i.e. verbal explanation of rules outside of the context of activity; while apprenticeship came to be associated with practice, i.e. the nonverbal demonstration of examples in the context of activity. This distinction is not without foundation. The modern school, born in the nineteenth century in response to the need for universal literacy in industrial societies, institutionalized the notions of booklearning and academic instruction. The word "academic" comes from the Greek "Akademeia", the gymnasium where Plato taught; and Plato, like the Greek philosophers generally, despised practical matters as beneath the life of the mind. The Greek rational tradition became the basis of Western thought and accordingly the basis of Western education. Cohen (1987:159) traces the paradigm of traditional teaching to our scholastic inheritance from Greek rationality, carrying with it the view, born of the technology of alphabetic writing, that truth consists of objective facts enshrined in the authority of written texts:

In our instructional inheritance, teachers are tellers of truth, who actively inculcate knowledge. Learning is relatively passive: students listen, read, and accumulate what they are told. And knowledge is objective and stable. It consists of facts, laws and procedures that are true, independent of those who learn, and entirely authoritative. These ideas and practices have deep roots in academic habit.
Schools, however, have changed from the early academies whose whole curriculum was based on Greek and Latin. Schools today have science labs, computer labs and workshops where all sorts of practical work is blended with theoretical discussion. Similarly, in modern craft apprenticeships, theoretical explanation is blended with demonstration. The theory/practice dichotomy was never absolute.

**Theory and practice reintegrated**

The sociocultural approach is more than simply dealing with both theory and practice: it is dealing with them in a certain way. Even the heavily theory-oriented classical academies dealt with the practice as well as the theory of writing -- teaching students reading and writing, literacy, was their "raison d'être" -- but they did so serially: first the theory rules (the grammar lesson), then the application of those rules (the composition lesson). In contrast, the sociocultural approach integrates theory and practice in a unified conduct of real-world tasks. Mohan (1991) comments: "Recent research has synthesized the concepts of schooling and apprenticeship into a view that applies to both, 'cognitive apprenticeship' being a term used by some".

Some content teachers still separate theory and practice: the classroom lesson deals with theory while homework assignments deal with practice. Some supplement theory with simplified pedagogic tasks in the classroom. Relatively few use a full sociocultural approach, integrating theory with practice in extensive real-world tasks. It is this that provides the best basis for coordination between content and language teachers. Mohan (1991) gives examples recorded in a B.C. Ministry of Education videotape (1982), "It's a Small World":

(This) shows the teachers intentionally engaging the students in a number of sociocultural activities: cooking, playing volleyball, playing a musical instrument, iceskating, using the
microscope, woodworking, working in the cafeteria. By contrast with the proposals of Prabhu and others, these are sustained activities continuing in some cases beyond a school term. They are not random collections of brief tasks, and there is no reason to believe that students are engaged in them solely to develop their grammatical competence.

Although the challenge is greater, there is no reason why effective sociocultural projects should not be devised for other content areas, e.g. history, geography and the sciences in general. It is a matter of doing history, doing geography and doing science in extensive field projects based on how professionals work in these disciplines. Cummins and Sayers (1990) report on the little known work in the English-speaking world of Celestin Freinet's Modern School Movement, started in the 1920s in France, which worked successfully in this sociocultural mode. Joint projects between sister classes in different schools conducted small group activities in such areas as science projects, community surveys, contrastive geography, and comparative oral histories. Freinet's students documented their work with printing presses they set up in their classrooms (a sociocultural project in itself). Cummins and Sayers also describe a modern version of Freinet's work, the ORILLAS project, which links in a computer network 60 teachers and their students from the United States, Puerto Rico, Argentina, Canada, and Mexico. Joint projects have included investigations of water distribution systems in various countries, online discussions with expert bilingual journalists and other initiatives, all with a major focus on second language acquisition.

The cutting edge of teaching practice is sometimes ahead of teaching research. While these bold innovations have been and are proceeding, task design in research is still restricted to "random collections of brief tasks" like Prabhu's (Mohan 1991) or to simplified pedagogic tasks (Long 1985; Long and Crookes, forthcoming), whose horizon tends to be the single
lesson rather than sustained activity. This does not invalidate what Long, Crookes and others have done to make tasks psycholinguistically authentic. Sound psycholinguistic principles are essential and can be incorporated within the sociocultural model. The sociocultural model, however, offers ecological validity with a greater richness of social interaction and language-using opportunities in the areas of both practice and theory.

**Task and the language of practice and theory**

Cummins implies that Social discourse, the language of interpersonal communication, is more common in most SL classrooms than academic discourse, the language of teaching and learning which students encounter in the content classroom. The sociocultural approach helps students go beyond the interpersonal in two ways: 1) it leads them to the more complex action language needed to talk about the practical things they are doing in their assigned tasks; and 2) it provides a concrete action-base from which they can more readily come to terms with the abstractions of academic discourse which talk about the theory underlying what they are doing. Let us, in the context of the practical and theoretical aspects of task, revisit briefly Cummins' (1984, 1991) and Mohan's (1986) theoretical frameworks.

**Cummins' continua of communication.**

Cummins (1984) shows two aspects of discourse in Figure 2.10: a horizontal continuum ranges from "context embedded" to "context reduced" and, intersecting with it, a vertical continuum ranges from "cognitively undemanding" to "cognitively demanding". The two continua create four quadrants labeled A, B, C and D. In context-embedded communication (quadrants A and B), participants can actively negotiate meaning (e.g. by feedback, and repair). In context-reduced communication (quadrants C and D), they rely
primarily on linguistic clues to meaning so that their understanding of the message depends heavily on knowledge of the language.

Context-embedded communication is characteristic of communication in the world outside the classroom: e.g. normal social interaction falls in quadrant A; interactive cognitive discussion (e.g. in on-the-job training) falls in quadrant B. Context reduced communication is characteristic of many of the linguistic demands of the classroom: e.g. giving a one-way oral account of "what I did yesterday" falls in quadrant C; writing an essay alone falls in quadrant D, the area of greatest difficulty, where the language demands are cognitively complex with no human interaction for negotiating meaning.

Communication within groups on cognitively demanding sociocultural tasks therefore falls in quadrant B where, although cognitive demands are high, there is human interaction and numerous context-embedded aids to help the communication process.
Mohan’s Knowledge Framework.

Mohan (1986) provides in his Knowledge Framework an analytical tool to help address the problem of cognitive complexity in content instruction. Taking a sociocultural approach, he points out that knowledge is communicated through activity (or task) which combines theory (background knowledge) and practice (action situations) . . . Verbal, expository learning is essential for understanding theory and symbolic knowledge, but it needs to be associated with life experience and practical knowledge” (45).

Figure 2.11 The Knowledge Framework: Action & Background Knowledge

<table>
<thead>
<tr>
<th>THEORY</th>
<th>KNOWLEDGE &amp; UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Classification</td>
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<tr>
<td>PRACTICE</td>
<td>Description</td>
</tr>
</tbody>
</table>

The Knowledge Framework distinguishes between the knowledge structures (KSs) of practice (action and experience) and of theory (background knowledge and understanding). Learners can be made aware of these structures with the assistance of language-independent graphical representations. KSs represent universal cognitive schemas which learners bring with them to the task, no matter what their first language may be. Once they are made aware of the KSs employed in the language of the task, they can use their native understanding of those structures as a base for anchoring second language discourse.

Sociocultural tasks related to action and theory

In the area of action, sociocultural tasks provide opportunities for learners to communicate with teachers and others about what they are doing. The B.C. Ministry of Education video (1982), "It's a Small World", provide examples of teachers engaging ESL
students in "talking about the senses" and handling "concrete objects they can relate to" and in using these avenues to interact socially with L1 speakers engaged on the same tasks. In other words, action and experience in sociocultural tasks provide a basis for communication. This process uncovers more complexities in language use than superficial consideration leads one to expect and has been little covered by research (see Mohan & Helmer 1988). In Cummins terms, it is closer to the demanding end of the cognitive continuum than social discourse but less close than academic discourse. Like social discourse, it is highly context-embedded with all the possibilities that provides for feedback, repair and exophoric reference.

In the area of theory, sociocultural tasks provide opportunities for learners to communicate with teachers and with each other about the knowledge and understanding that the task demands. Students have the advantage of practical concrete experience to underpin this more demanding discourse. They can be further assisted by graphical representations of the task's theoretical knowledge structures to help them understand and give language to the abstract ideas involved. In Cummins' terms, this area is at the far end of the demanding half of the cognitive continuum but is context-embedded with the support this provides for reaching understanding.

**COMPUTER-ASSISTED LANGUAGE LEARNING (CALL)**

**Changing directions in CAI and CALL research**

Dunkel (1990), in a review of effectiveness research on computer assisted instruction (CAI) and computer-assisted language learning (CALL), echoes the concern of Maddux (1988) "that a backlash of public and professional opinion against educational computing has been gathering momentum since the mid-1980s". One reason advanced for this is unrealistic
claims and promises made by educational computing advocates that have not been substantiated in the classroom. Dunkel likens this situation to the reaction against the audiotape language laboratory that has largely faded from the educational scene after its introduction with similar "hype" in the late 1950s and 60s. A common fallacy has been entertained in both cases: that the medium, in and of itself, will produce great improvements in learning.

**CAI and CALL research**

There has been no shortage of research on CAI and CALL: Dunkel refers to about a thousand empirical studies over the past 30 years, including more than 20 comprehensive and integrative reviews. These include Pederson's (1987) analysis of the CALL research base and Roblyer and other's (1988) review of CAI reviews and analysis of CAI research reports and doctoral dissertations between 1980 and 1988. One objective of the reviews is to establish whether computer-based learning treatments have produced significant differences compared with other treatments (usually traditional classroom instruction) in such factors as achievement, learning time and attitudes. Roblyer et al. (1988), although admitting that their conclusions are tentative, maintain that a number of significant trends have emerged which appear to favour CAI. However, there are serious problems with these reviews and the studies which they examine. These include "over-emphasizing the role of the computer and ignoring the role of factors such as teacher intervention and quality of the CAI programs" (Dunkel, 1991:10); very small samples, flawed design or both (Clark, 1983; Dunkel, 1991, Note 8, Kleinman, 1987); a very slight research base for CALL (Kleinman, 1987; Pederson, 1987;

**Move towards experimental and ethnographic studies**

Dunkel (21-23) notes that researchers' recognition of these many problems has resulted in two new trends in CALL research. Both are away from media comparison studies that use the traditional experimental "treatment" model of research. One is towards single-medium experimental research; the other is towards ethnographic research. Both are concerned with gaining "a greater understanding of the psycholinguistic processes involved in working with CALL and the way in which the medium can best be used to enhance second language acquisition" (21). These two trends are linked to the two different (but not conflicting) approaches to task I have described: single-medium experimental research represents the sociolinguistic approach; ethnographic research represents the sociocultural approach.

I have made the case for the sociocultural approach to task. Therefore, I also follow the ethnographic research trend in CALL which sees the computer not as a medium to compare with other media but as one of a large number of interacting variables; and also sees two facilitating roles for the computer: 1) as a device to promote social interaction or, as Weir (1989:61) puts it: "as an adjunct to socially mediated learning"; and 2) as a device to reorganize (as distinct from amplify) cognitive processes. The first role has received significant research attention; the second role less so.

**Computer as facilitator of social (group) interaction**

Under this heading we will look at: the computer's impact on the organization of learning and learning interactions in the classroom based on Hawkins & Sheingold's (1983,
1986) work; the computer's potential as "humaniser" to use Weir's (1989) metaphor based on her teaching experience in teaching with Logo; and the social factors in, specifically, Computer Assisted Language Learning (CALL).

Computers and organization of learning

Dunkel (1990:23) comments on the need for L2 researchers to engage in more ethno methodological research on the social impact of using computers:

As Sheingold, Kane, and Endreweit (1983) argue, it is essential to consider the interaction of the computer with the social system that surrounds it. It is also important to examine how this interaction changes over time, as computing activities influence the social system, and the social system, in turn, shapes use of the technology. Case study approaches may be the appropriate methodology to answer research questions about the social effects of CALL. As Sheingold and her colleagues learned when using the case study method, the effects of microcomputers on education often depend on the social and educational contexts within which they are embedded.

Hawkins and Sheingold (1986) summarize findings based on three programs of research conducted over the a period of five years. One was a two-year study of a third- and fourth-grade class working with Logo; another was a two-month study of a sixth grade social studies class and an eighth grade science class working with a commercial database management system; the third was a one-month field-test study of science and mathematics simulation and games software in thirteen classes in seven public schools. They present their observations on four levels of learning organization: the curriculum, learning interactions, management of classrooms, and monitoring and assessment of student progress. They point out that specifics vary according to variations among teachers, schools and districts (to which one could add variations among students):
Thus, when looked at closely, each classroom is a novel setting, an interpretation of the formal properties and goals of the educational system uniquely instantiated in practice. As educators experiment with and revise their particular settings, the organization of classrooms is, like technology itself, under development. Therefore, the impact of microcomputer technology on classrooms entails malleability of two kinds: of the technology as it is shaped to educational goals and of classrooms as teachers and students use and interpret the technology in different ways (42).

The two levels, learning interactions and classroom management, concern us particularly in considering the computer's role as facilitator of group interaction. The researchers noted two kinds of changes: ways in which teachers interact with students and ways in which students interact with each other.

**Learning interactions**

In the Logo studies, students (some working in pairs, others solo) collaborated more on programming tasks than on other classroom tasks consistently over time and classrooms. Some students acquired considerable programming expertise and became "experts", readily consulted by other students. Teachers, however, had difficulty knowing how best to support students in this new "learning-by-doing" environment: "when they noticed students running into problems, they felt that they did not yet have sufficient intuitions about how or whether to go beyond the specific needs of the individual student".

In the science software studies, one piece of software was a simulation for learning navigational concepts and their associated geometries (part of the Bank Street series "Voyage of the Mimi"). This required students to form teams. The results bear out my observation that cooperation is not a universal native gift and must be learned:
While some teams of students worked effectively together, others had difficulty knowing how to distribute the work among themselves. In some teams, one child dominated the work and made the decisions, leaving others confused as to what was happening. The incorporation of all children into effective collaborative work, then, is a design challenge for software developers and an issue for teachers in organizing learning activities . . . (49).

There were differences among the teachers in how they interacted with the students and these interactions changed as both students and teachers became more familiar with the software. The new (and untraditional) roles for the teachers were active participation in the task, active monitoring of the task, and being available as a resource when called upon.

In the series of games to teach programming concepts, some teachers successfully adopted a "learning chain" strategy: teaching the games to one pair of students who, in turn, taught another pair and so on. This provided the instructional advantage of students learning by tutoring. The value of peer tutoring has been observed in other research: e.g. Levin (1985) found it more cost-effective than CAI in the Cross-age Structured Tutoring Program for Reading and Mathematics in the Boise (Idaho) schools.

**Classroom management**

In the Logo studies, the teachers showed uncertainty in knowing how to proceed with the assignment of students to computers. It was convenient to assign pairs to begin with because there were more students than machines. As students increased their knowledge of each other and of programming, the pairs broke down. Assignments were then made to single students who could choose a partner if they wished. Teachers encouraged students to use each other as resources but were uncertain how best to support the students' learning. Individual teacher differences showed in the second year after they had decided that formal instruction in programming concepts was needed. One did this with the whole class; the other did it in
small groups organized by level of expertise. Both experimented with "group sharing": single
groups would present their work to the whole class. One teacher found this valuable and
continued the practice. The other dropped it because of lack of student interest.

In the database studies, the students, although accustomed to working in groups for
science experiments, did not know how to assemble results for the whole class. The teacher
also was unsure how best to use the potential of the software in the classroom setting. This
led to a conflict between developing individual group formats and a whole-class standard.

Future implications

Problems arose because the various activities observed -- Logo, database, simulations,
games -- did not fit the curriculum in place in the school system. The standard curriculum
emphasises a product, the accumulation of knowledge, whereas the computer software used
emphasises process, different ways in which that knowledge is acquired. When the emphasis
changes from product to process, teachers are challenged because their role in learning
interactions must change as also must their approach to classroom management. Hawkins and
Sheingold comment on implications for the future:

. . . teachers may need to become less the providers of content specific knowledge and more
the facilitators of students' acquisition of knowledge. Instruction might shift away from
emphasis on information-giving to emphasis on helping students find relevant information,
learn how to solve problems, ask questions, think critically, and communicate ideas . . .
Teachers may be managing pairs or groups of students rather than conducting the more typical
whole-class or individual activity. To manage and support such work effectively requires
observational skills different from those teachers normally apply and new intuitions about
when and how to intervene in student-based activities
The experience in these classrooms illustrates some of the issues I have discussed in connection with task and group work: in particular that, while these approaches hold great promise for greater educational effectiveness, they do not yield their dividends without a considerable investment in planning and in teacher and student training in new patterns of working together.

**Machine as humanizer**

Weir (1989:62), is primarily interested in the role of the computer as a facilitator of group action to achieve the type of benefits Hawkins and Sheingold talk about. Accordingly, she gives her paper the subtitle **Machine as Humanizer**. She takes the Vygotskian position that "cognitive change comes from the transformation of knowledge among persons -- interpersonal understanding -- into knowledge within a person -- intrapersonal understanding". She is interested in the computer, therefore, as an adjunct to socially mediated learning:

One setting that allows social interactions to function as the source of intellectual change is group work on projects. The joint goals and shared problems of such a project require negotiated solutions. The resulting talk helps bring knowledge to the level of consciousness. Hearing one learner articulate the problem can help another see it more clearly. Hearing someone else's misunderstanding can help a learner see a better way into a problem (66).

She bases her position on experience in teaching Logo, Papert's (1980) visually-oriented programming language, to elementary students. What she says is equally applicable to teaching with other visually-oriented software, e.g. hypermedia authoring systems. On an individual basis, Logo lends itself to discovery learning by allowing "exploratory messing about". In the group mode, students both within their own group and with their peers in other groups exchange ideas and activities and learn from each other. These activities are not, however, likely to lead to a transfer to formal thinking without the participation of a teacher.
who has an explicit academic goal in mind. Vygotsky holds that cognitive change takes place through collaborative effort acting upon the "zone of proximal development", defined as the difference between the students' level of independent problem solving and the level they can reach with help. The teacher provides that help -- wherein lies a challenge.

Weir echoes Hawkins and Sheingold's (1986) caution that many teachers are likely to find difficulty in adjusting to this different learning environment. The free give-and-take of students working collaboratively and in groups presents a challenge because it means for many a significant change in teaching style. "Teachers need to feel comfortable in not being the sole provider of knowledge. They need to be prepared to learn from students, to learn with students" (66). Instead of being the omniscient provider of information to students through a one-way process, the teacher must learn to be a partner in discovery with students, working with them through a two-way process both one-on-one and in small groups.

Moreover teachers, to cultivate conscious systematic thinking in students, need to improve their own powers of self-reflection. Weir suggests that computer programming, particularly Logo (one can add hypertext/ hypermedia authoring), will assist them attain this goal in the same way as it assists their students. This brings in yet more change because most teachers have had very little or no computer training.

Social factors in CALL

Johnson (1990) reviews research on the social aspects of computer use in second language and content learning and records a number of conclusions which we abbreviate and comment on:

1. The computer is a dependent variable in a social context.
2. The computer does not necessarily foster rich language use.

3. The computer adapts well to group work and cooperative learning.

4. Students can be "computer experts" in a content classroom.

5. Students can learn socially from writing with computers.

**Computer as dependent variable**

Johnson (1990) cites the work of Hawkins, Sheingold, Gearhart, and Berger (1982) as "the best-known study of the effects of computer technology on the social life of classrooms" (65) and makes the point that this and other studies of that period (e.g. Piper 1986) treated the computer as an independent variable that would affect classroom social interactional patterns:

The focus of the research, we might say, was a search for the social effects of the medium. Clark and Salomon (1986) and Salomon and Gardner (1986) have addressed this issue in papers about the cognitive effects of CAI. They claim that the computer itself does not affect learning. Similarly, the computer itself does not determine interpersonal second language use and interaction patterns. Rather, the computer is only one element in a complex language-use situation (Johnson 1990: 67).

Salomon and Gardner (1986) criticise computer-in-education research and particularly meta-analytic reviews (e.g. Kulik, Kulik, & Cohen, 1980) for repeating the naive assumption of much television-in-education research: "that the medium, rather than some specific attribute or quality of it, affects learning" (14). "Does it teach better than . . . ?" is a false question. It ignores differences in television programs (or computer software); and takes no account at all of the different "assumptions, proclivities, and active learning strategies" that learners bring to the medium. The traditional analytic, experimental, "treatment" model of research should be used with discrimination and applied, according to Papert (1987) "only where changes are
supposed to be small, can be anticipated from the outset and attributed to a particular computer-related quality". It should:

follow, rather than precede, more exploratory, open-ended observations in which anecdotal and ethnographic methods are employed. The latter provide the opportunity for identifying the possible variables that make a difference, paving the road for better controlled experimentation" (Salomon & Gardner 1986:15).

Papert (1987) calls "technocentric" the type of thinking engendered by indiscriminate use of analytic CAI research. It leads to the posing of simplistic questions like "Does CAI work?". He likens "technocentrism" to Piaget's "egocentrism", the period when the young child cannot imagine the existence of the world independent of himself. Technocentrism "gives a similar centrality to a technical object" (Dunkel, 1990:20).

Johnson (1990) cites Hawkins, Sheingold et al. (1982) as reflecting this technocentric assumption while Salomon and Gardner (1986) cite Sheingold, Hawkins and Char (1984) as an example of recognizing the dependence of technology on context (18). Hawkins and Sheingold (1986:40-41) state clearly how experience led them to modify their views:

When we began our research, we assumed that we could assess straightforwardly the impact of the technology on classrooms. Now, however, it is clear that the situation we set out to document and understand is not a stable one. The educational functions for the technology and the ways in which they are interpreted by teachers and students are under development. While the technology has the potential of gradually shaping the organization of classroom learning in profoundly new ways, only small changes are visible now. Therefore current research cannot be conclusive. It can provide important insights into and raise questions about this evolving phenomenon.

There is, however, a hint that perhaps one day the technology will have matured, students and teachers will have learned how best to use it, and a final verdict will be in.
Cazden, Michaels and Watson-Gegeo (Microcomputers and Literacy Project, forthcoming) firmly reject the technocentric notion of the computer as an independent variable. They studied the use of computers and QUILL writing software in a two year study of two urban, multi-ethnic, sixth-grade classrooms. They came to the study with the unstated and unexamined "technocentric" assumption that, with the same computer and software, they were introducing the same writing tool into the two classrooms. Observation proved this assumption to be incorrect:

Because the two environments differed, the same computers with the same writing software ended up being used differently, and came to serve as different writing tools. It is for this reason that we have come to think of the computer as a "dependent" variable, itself affected by the classroom context, and in turn, having an influence upon it. Another way to think about this is that the computer was assimilated into the already established patterns of control, instruction and evaluation and constrained by them. But once a part of the classroom writing system, it created opportunities for reading and writing that had not existed before . . . Thus the computer and the social setting are "mutually constitutive" (Mehan 1978), or reflexive influences . . . (Cazden, Michaels & Watson-Gegeo, forthcoming)

The computer as a dependent variable is another illustration of Lincoln and Guba's (1985) notion of "mutual simultaneous shaping": everything affects everything else.

What sort of language does computer-use foster?

Johnson (1990) cites Piper (1986) as another example of starting a study with the initial technocentric assumption that the computer is an independent variable. If this assumption is true then an important finding of Johnson's study is disturbing: that student conversations around the computer consist of very short turns with a limited range of vocabulary and syntax. This finding is corroborated by other studies. Mohan (1990b) compares the dialogue of two students, Heinz and Tojo, in two different situations: 1) as they
jointly do a CAI grammar exercise on the computer; and 2) in a free discussion on the topic of "apartheid". The dialogue in front of the computer is similar to that described by Piper: very short turns, mainly confined to a large number of one or two word utterances to express agreement, disagreement, evaluation and confirmation requests, e.g. "yes", "yes, OK?", "no", "very good", "yes, I see". In Mohan's transcript, very few sentences exceed five or six words and most are highly fragmented. In contrast, in the free discussion in Mohan's study, most sentences are fully formed and while, as in any dialogue, there are many one-word responses and brief interruptions, there are also several sustained long turns of several sentences with varied vocabulary.

One key to the difference lies in whether exophoric or endophoric reference (Halliday & Hasan, 1976) predominates. Exophoric reference points to some person or thing outside of the text of the dialogue; endophoric reference to some person or thing within the text. The main clues are the personal and possessive pronouns, the demonstrative pronouns (this, that, these, those) and the demonstrative adverbs (here, there, now, then). When in Heinz and Tojo's dialogue in front of the computer, Heinz says to Tojo, "Can you understand this?", "this" is an exophoric reference to text or graphics on the computer screen. Heinz does not have to describe it. All he has to do is point at the screen. Berwick (1990) notes the same distinction in the dialogues he recorded although his students were not using computers. He also suggests that endophoric reference characterizes expository discourse while exophoric reference characterizes experiential discourse (40-43). Sitting in front of a computer screen in interactive mode is highly experiential. Students do not have to describe, only point.
Fragmented speech with predominating exophoric reference is natural and has its own value. Piper (1986) noted that negotiation was going on between the student and the computer screen, "perhaps through inner speech". In other words, cognitive processing was taking place and students were "getting" the content or, if in difficulty, could point to what they were unsure about. Educators can provide computer interactive material with graphical and pictorial support that communicates a great deal of content without well-formed language exchanges. The main objective of a content class, after all, is to "get" the content. Working with each other and the teacher, students can do this with the help of exophoric reference. At the same time they do learn new terms and add to their vocabulary. Johnson's (1990:67) comment on Piper's study is however justified: that having students interact at a computer is not enough "to guarantee rich oral language use":

In order to tap the benefits of learning both from the program and through conversation, the structure of the academic task and the social structure of the situation need to be thoughtfully planned so that they will require rich language use.

Again, as with the Hawkins, Sheingold studies, we see the teacher's role changing: from provider of information to designer of tasks and structurer of situations, aiming to create opportunities for students to both acquire and talk about concepts. Because the computer is not an independent variable, language in computer-based tasks does not have to be confined in the way Piper (1986) describes.

Computer-based group work and cooperative learning

Bork, 1985 found that groups of two or three were optimal for mutual learning on computer-based math and science materials. Lieberman (1985) cites Trowbridge and Durnin's (1984) finding that students working in triads tended to compete more. Dickson and Vereen
(1983) recommend groups of two or three but add the proviso that each student be provided with a role. Johnson, Johnson and Stanne (1986) studied cooperative learning with upper elementary students centred around a computer simulation of an ocean voyage of discovery. The objective was to learn map reading and navigation. They compared three kinds of group: cooperative, competitive and individualistic. They found that students with cooperative goal structures did significantly better on a number of measures and, in particular, engaged in more task-related interaction. Johnson (1990: 69) comments:

These results indicate that group size and group goal structures need to be carefully planned and monitored to achieve the most beneficial kinds of interaction in computer settings . . . the instructional environment is what affects interaction and learning, and the computer is viewed as one element in that environment.

**Students as computer experts**

We have noted from Hawkins and Sheingold (1986) that some students acquired the status of "experts" in two Logo classrooms. They were four in number, all boys, and three of the four were not identified as experts in other fields (Hawkins, Sheingold et al. 1982). The same phenomenon has been noted in SLA settings. In the COMSIS (1984) project, ESL students taught L1 students how to use software. In observations of an ungraded ESL class in a MAC Lab, Rice (1990, unpublished) noted how students with previous experience of using MAC HyperCard acted effectively as tutors to help their peers. Two benefits spring from this phenomenon: 1) the interaction between students -- the "experts" and those they assist -- generates language use and increases comprehensible input; 2) the "experts" gain status and prestige. The latter is important because, frequently, the computer "experts" are not the most academically advanced students. Rice (1990) notes that the student who was most disruptive
in the regular classroom, and who did poorly academically, excelled in the MAC Lab and displayed maturity and sensitivity when helping his peers. The success he experienced was, in the opinion of his teacher, the main reason why he continued with the program and did not drop out. Johnson (1983, 1988) and August (1987) report on the use of ESL elementary students to teach content to their L1 peers, resulting in both language gains and more interaction (and hence language use) between the L2 and L1 students in non-teaching situations. Johnson (1990:72) hypothesizes that the same benefits would accrue if L2 students were to teach computer use. She adds:

Taken together, the findings of this group of studies . . . indicate that microcomputer use offers opportunities for L2 students to develop expertise in a valued area and to use English in motivated contexts in which they are viewed as authorities by their peers. In school, ESL students are often viewed globally as "low achievers" in all areas because of their lack of proficiency in English. The reality is that they have and can easily develop areas of knowledge and expertise that will make them valuable resources for their peers.

Again, the challenge to teachers is to design tasks and arrange classroom activities so that L2 students are given the opportunity both to gain much-needed status and to extend their L2 use in authentic communication settings.

Social learning from writing with computers

Research on writing without a computer in L1 (Calkins 1986) and L2 (Urzua 1987) indicates that students' writing improves as a result of discussing their compositions with their peers. Daiute (1986) reports positive results from L1 collaborative writing projects: the students learned from each other and improved their mastery of writing. Interestingly, those who collaborated made more errors but also made more improvements in fluency and overall quality than those who worked individually. Levin et al. (1985) report on a study of L1
elementary students writing collaboratively with computers: they devised their own system for collectively discussing topics, assigning responsibilities for typing, monitoring and responding, and supporting one another's writing by providing immediate audiences. Johnson (1990:73) comments that similar results might be expected with L2 writing:

For second language writers as well, using the L2 to discuss such a range of activities centered around computer use can provide rich contexts for both written and oral L2 use and growth. This kind of language use environment stands in sharp contrast to that described in the Piper study . . . because students needed to talk to write together.

Students in these contexts will produce a higher quality of language than the short turns and fragmented utterances reported by Piper (1986) in a CAI context (see above). Also, Langer and Applebee (1987) show that L1 secondary students remember academic content better when they write about it (no reference to computers) than when they simply study and discuss. It is reasonable to believe that L2 students would reap the same benefit from collaborative writing with computers. Johnson comments that this is a promising area for continued research.

**Computer as reorganizer of cognitive processes**

Johnson (1990:62), contrasts research on the role of the computer as a facilitator of social interaction with "the bulk of research on computers and learning in educational environments (which) has focused on the cognitive aspects of learning". This use of "cognitive" refers to the didactive use of the computer in such well-developed applications as CAI, simulations and games. These applications are different from the use of the computer as a tool whose operations reorganize the computer user's patterns of thinking.
Pea: cognitive reorganization vs amplification

Pea (1985) makes the distinction between two effects that the cognitive technologies (writing, print, computers) have on the mind of their users: amplification and reorganization. The amplifier metaphor is a descriptive concept, implying empowerment and greater volume and speed. Like writing over oral transmission and print over writing, well designed CAI achieves this -- more of the same but faster with greater efficiency. The reorganization metaphor is a value concept, implying a change not of scale but of character -- a different cognitive process emerges. This is a more interesting, more radical effect.

Writing promotes objective thinking (the world objectified on paper); printing promotes serial thinking (words lined-up sequentially on the page). Computer applications promote a number of processes which, if not "new" in an absolute sense, are new in the context in which they are used. Pea gives some examples: spreadsheets, in which the effect of changes are simultaneously recalculated throughout a complex budget, restructure the mental work of budgeting from routine calculation to sophisticated "what if" planning and hypothesis testing; symbolic manipulation software in mathematics restructures students' thinking away from mechanical calculation, which the program can do automatically, to the problem-solving task of search and discovery for a path of operations that will solve for the unknown; hypertext software reorganizes the thought processes used for writing and enables the user to discover different perspectives and idea structures during the writing process.

We will look particularly at programming and database applications as examples of this "cognitive reorganization" use of the computer in content classrooms to promote problem solving and discovery learning skills. Such uses model and illustrate the cognitive processes
represented by the high-level knowledge structures (KSs) in Mohan's Knowledge Framework. Programming embodies sequence in the overall structure of a program, and evaluation and choice in IF ... THEN, WHILE ... DO, and similar conditional structures. A computer-driven database embodies description in its individual records, classification in its assembly of all records, and various choices of principle in custom searches of the records. As Mohan (1986) has pointed out, all of these KSs can be represented graphically. Computer graphics is one more cognitive restructuring tool for doing this.

**Hawkins & Sheingold: LOGO and database**

Hawkins and Sheingold (1986) reported on two examples of this type of application:

1. programming with Logo in an elementary and middle-school classroom; and
2. database in a sixth-grade social studies and an eighth-grade science classroom.

Results were disappointing despite the enthusiasm of the teachers concerned. The main problem was at the level of the curriculum.

Logo "did not find a comfortable conceptual home in the curricula of the classroom" (44). The teachers' hoped that Logo would help the students develop general problem-solving skills. However, because Logo was not in the curriculum, there was no prescribed learning sequence for it and no formal expectations for student performance. The result was that "teachers and students alike expressed discomfort with this ambiguous status" and the hoped-for learning of general problem-solving skills did not occur. The teachers moved from a problem-solving approach to teaching programming concepts with no more success because, again, this was new to the curriculum with no guidelines for incorporating this new computer activity into classroom work.
A similar situation developed with the database applications. Both teachers had high initial enthusiasm and expectations but found that what could be done with database programs was not called for in the curriculum. The social studies teacher "had difficulty thinking of ways consistent with her curriculum to make use of this capacity for organizing comparative information", and the science teacher "found it difficult to conceive of how his typical activities and experiments could make use of the data-recording capacities of the computer".

The researchers comment (Hawkins & Sheingold 1986:46-47):

Education is currently facing the complex problem of adapting to an information age and determining what such an age requires of and makes possible for its young citizens . . . If access to vast amounts of information is made possible through technology (large databases via telecommunications) then learning of facts may become less important than understanding structures of information so that appropriate material may be readily found. Skills in finding, synthesizing, and interpreting information are likely to become centrally important in the educational process.

School authorities play lip service to these new ideas but curricula change slowly with good reason: "The tasks of designing systems effectively for these uses and of reshaping the curriculum are profound" (47). However, until curricula do change from a product to a process orientation (with everything that implies for evaluation), classroom practices will inevitably gravitate back to the "status quo" to defeat even the most enlightened efforts to change direction. A case in point is the Scardamalia, Bereiter and others' (1989) CSILE project in Ontario which creates a learning environment that encourages learners to exert intentional control over their own learning. The teachers were enthusiastic but frustrated because this way of working demanded time and created conflicts with the curriculum. The
children also resisted. As one of the teachers commented: "the children soon learn that it is more important, in school, to do the task, not to learn how to learn" (Cumming 1988: 160).

**Hooper: Integration of language and content**

Hooper (1988) describes the construction and use in a seventh-grade science class of a computer database that accomplishes the content objectives of the lesson and, in the course of so doing, 1) integrates language and content and 2) makes transparent the cognitive processes (knowledge structures) students are working with. Hooper cites Marzanbo and Arredono's (1986) manual on thinking skills:

... you cannot separate the teaching of thinking from the teaching of content. You must practice thinking about something; classroom content is that "something". Similarly, learning content involves the use of complex thinking skills. Thinking and content are inexorably linked.

Hooper was interested in promoting and observing the linkage between content and thinking skills and in leading students into generating academic discourse to articulate their activities. CALL research has neglected the study of academic discourse in the content classroom. It has focused primarily on interpersonal discourse in the language classroom.

The subject of Hooper's study was a grade 7 science unit on "The Classification of Living Things". The students developed their own database, focusing on "vertebrates". They used as a guide a key visual of a classification tree of living things based on a prescribed text. Their task was to brainstorm as many names of animals as they could; with the teachers help, differentiate between vertebrates and invertebrates; then work in pairs on various tasks, e.g. suggest characteristics (descriptors) which vertebrates have in common with examples
(e.g. skin covering: smooth, hair, fur, scales), and rank the characteristics in order of
importance. This exercise provided a structure for writing later definitions of the vertebrate
divisions and provided the core format for the database. The students had a total of six tasks
of this type.

In completing these tasks, the students learned simultaneously 1) the content of this
particular science unit, i.e. a classification scheme for living things; 2) how to describe,
define, and classify; and 3) the language (academic discourse) of description, definition and
classification. They were not the passive recipients of a product (a classification scheme)
through traditional knowledge transmission but were the active processors of that product
through cooperative knowledge construction. The knowledge structures (KSs) of description
and classification were made explicit in graphic formats, e.g. multi-record format for database,
classification tree etc. These formats helped the students to generate language forms for
describing, defining, and classifying (academic discourse) and to compose formal definitions
(expository writing). Hooper comments:

The content teacher was amazed at the students' sustained interest in discussing and writing
accurate definitions. Both the science teacher and the language specialist regarded the state of
the students' definitions as an opportunity for further development of the students' academic
discourse.

This unit integrated as product the learning of content and language and as process the
combination of a sociocultural approach to task and the use of the computer as a tool. There
was also a significant additional product: ways of thinking that were new to the students.
METHODOLOGY

We have reviewed peer tutoring, task-based teaching, the notion of sociocultural natural tasks which integrate content and language learning, and the use of the computer as an integral tool. This combination creates a new challenge to teachers. The elements of peer tutoring, task and computer will not produce results automatically either singly or in combination. Success depends upon the intelligent structuring of tasks and learning situations. The teacher's role therefore shifts from being a transmitter of knowledge to being a designer of tasks and situations through which students may learn through cooperative knowledge construction.

Therefore we need to look at task methodology. This brings us to issues of task design in language teaching and to the broader methodology of Work Study, which has evolved over many years for the systematic examination, analysis and improvement of tasks in the workplace. The workplace in our study is the classroom.

Task Design

Communicative task design

Long (1989:12) complains about taxonomies of pedagogic tasks in the second language literature that make no reference to supporting research: "Given the way these things tend to work in our field, it is safe to assume that many others will follow, eventually leading to data-free arguments about whose taxonomy or list is 'best'". He suggests that, before examining pedagogic criteria, it is important to identify which psycholinguistic properties of tasks the designer should look for. He identifies two properties of overriding importance: 1) the potential to encourage negotiation work, particularly reformulation of utterances and
attention to feedback; and 2) the potential to "stretch" learners' interlanguages, to use as complex speech as possible and as much optional syntax as possible. Three types of task offer one or other of these properties.

Two-way tasks

Long (1980) distinguishes between one-way and two-way tasks. Both are "information gap" tasks. The difference is that in two-way tasks completion is not possible without information exchange. Long (1980:14) gives examples:

A task in which one person (teacher or student) describes a picture which only he or she can see so that others can draw it is one-way. A task in which each member of (say) a four person group has exclusive access to information about a crime, all of which must be pooled before a villain can be identified, is two-way.

Several studies support the claim that two-way tasks produce more negotiation and more useful negotiation than one-way tasks, e.g. Long (1980) for NS/NNS conversation; Doughty and Pica (1986) for interlanguage talk.

Planned tasks

A planned task is one in which the participant(s) have time to plan their discourse or written text in the sense of thinking about the words, phrases and ideas they will use. Ochs (1979) found that L1 planned discourse such as prepared lectures or expository text contained more varied and more complex language than unplanned discourse. Crookes (1989), in an experimental study, studied the monologic speech of 40 Japanese learners of English. He found that the half who had ten-minutes planning time produced syntactically more complex speech than the half who had no planning time. They also showed trends towards more target-
like use of certain linguistic forms (notably articles) and more varied vocabulary. Planned tasks would therefore appear to "stretch" interlanguages more than unplanned tasks.

Open and closed tasks

An open task is one with a wide range of discourse options without any predetermined correct solution, e.g. free conversation, debate, or explanations without soliciting feedback. A closed task is one with either one or a small set of predetermined correct solutions, e.g. identifying the perpetrator of a crime, or naming differences between two near-identical pictures. Long (1989) suggests, without experimental evidence but interpreting "post hoc" results from a number of studies, that closed tasks produce more negotiation work than open tasks, provided participants know that the task is closed. Amongst other studies, Long refers to Berwick (1990) to support this claim. Berwick shows that tasks combining "non-teaching goals and experiential processes" (e.g. construction of a Lego toy), which tend to be closed, produce more negotiation than tasks emphasizing "teaching goals and expository processes", which tend to be open. The non-teaching, experiential type of task depends on cooperative work with two-way communication to achieve the predetermined solution. The teaching, expository type of task can be completed with one-way communication with little or no feedback from the interlocutor. It may not be completed successfully this way, i.e. the interlocutor may not learn what he or she is supposed to.

Sociocultural tasks

The sociocultural task is a natural, cultural, social activity within a context constructed jointly by an expert and novice. The students, by doing the task, learn the language necessary for the task's completion. The task's goal is of central importance. In this the sociocultural
task differs from the psycholinguistic task in which a linguistic goal is primary and the task's goal secondary. We have discussed these issues in our earlier section on "Task-based language teaching". From the viewpoint of task design, the teacher's task is to identify natural tasks through which both content and language can be learned.

**Work Study (Industrial Engineering)**

"Industrial engineering" is American, "work study" British. The two terms have different connotations; but for the practical purposes of the discussion which follows, they may be treated synonymously.

The word "industrial" has a negative connotation in education, conjuring up, as it does, images of conveyor belts and assembly lines, so brilliantly parodied by Charley Chaplin in his 1930s movie "Modern Times" and, in more recent times, by the 1960s British movie "I'm Alright, Jack". It also suggests, in association with education, a return to outmoded concepts of curriculum based upon an industrial model: the school is a factory, teachers are the workers, the child is the raw material, and an "educated" adult is the finished product:

By 1918, curriculum making in the United States was beginning to follow an industrial or scientific management model. By applying principles of management drawn from time and motion studies in industry, individuals such as Franklin Bobbit and W. W. Charters argued that the efficiency of schools could be vastly improved. Vague statements of curriculum objectives must be replaced by particularized objectives based on the activities, especially the occupations, of humanity. These ideas were set out in two influential books, "The Curriculum" (1918) and "How to Make a Curriculum" (1924). Through his most famous student, Ralph Tyler, Bobbit influenced later curriculum making and anticipated modern behavioural objectives and competency-based approaches (Tomkins 1986:142-43).

An educator's instinctive response to "industrial engineering" is "we've been there before".
However, as notions of education and curriculum have changed, so have notions of organization and management in industry and hence of industrial engineering. In both education and industry, it is often more theory than practice that changes; but while old traditions die hard there are in both fields many notable examples of instantiations of new and enlightened principles. Moreover, not all the old ideas are bad, e.g. striving after efficiency is not a retrograde endeavour. More at issue is the way such objectives are pursued rather than the objectives themselves. And the way in which things are done marks the character of the organization (be it industrial or educational) in which activity takes place.

**Industrial engineering and metaphors of organization.**

Industrial engineering, like all corporate activities, takes on the nature of the organization within which it operates. As the nature of an organization changes, so changes the nature of industrial engineering. Morgan (1986:12) looks at organizations on the premise that "our theories and explanations of organizational life are based on metaphors that lead us to see and understand organizations in distinctive yet partial ways". Three metaphors (among many) help us understand differences among organizations (including educational institutions) from the point of view of work study. They are: organizations as machines, as brains, and as cultures.

**Organizations as machines.** The machine is the earliest metaphor for organizations, denoted by the Greek word organon, meaning a tool or instrument. Organizations are instruments formed to coordinate and direct human goal-oriented activities, i.e. tasks. Tools and mechanical devices were essential components of organization from earliest times for the realization of such objectives as the building of pyramids, churches and armies. Above all, the
army became the model for modern industrial organization. It was also where the discipline of engineering was born. Turner, Mize and Case (1987:3) note that the term civil engineering was first used in 1750. Not until then was it found necessary to make a distinction from military engineering, which is what engineering always had been.

Morgan (1986) identifies Frederick the Great of Prussia, (ruling from 1740 to 1786) as the creator of the modern army. He borrowed ideas from the practice of the Roman legions and the reformed European armies of the 16th century but also added reforms of his own. These included the introduction of ranks and uniforms, standardization of regulations, increased specialization of tasks, use of standardized equipment and systematic army training. Modern military bureaucracy was born and provided the model for modern civil bureaucracy. Max Weber, the German sociologist, connected the mechanization of industry with bureaucratic forms of organization: as the machine routinizes production so bureaucracy routinizes administration. The military bureaucratic style of organization received formal expression in the early years of this century as "classical management theory". This stated that management is a process of planning, organization, command, coordination, and control.

This view of management and organization led to the recognition that simple management practices that had worked well for small shops and farms were not adequate for large, complex, mechanized industries. The need for better management systems gave birth to industrial engineering. The early pioneers were Frederick W. Taylor, Frank B. Gilbreth and Henry L. Gantt. Taylor (1911) set forth his views in "Principles of Scientific Management" which, as we have seen, strongly influenced early ideas of organization and curriculum in the public school system in America at a time when the system was under heavy strain from a
flood tide of immigrants and their families arriving from Europe. Taylor's great contribution was his recognition that the performance of any job (or task) could be greatly improved by analyzing its work content and redesigning it for maximum efficiency. He advocated the use of time-and-motion study as a prime tool of analysis. Gilbreth extended Taylor's work. He introduced the notion of predetermined time-and-motion studies which, with the aid of motion pictures, brought micro-movements like "reach" and "grasp" within the field of measurement. Gantt introduced the notion of a systematic graphical procedure for representing time by bars on a horizontal time scale for planning, scheduling and controlling work activities.

The downside of these innovations (but inherent in Taylor's principles) was the total shifting of responsibility for organization of work away from the worker to the manager. An even more serious consequence was the dehumanization of the worker. This, above all, gave industrial engineering a not altogether deserved bad name. Morgan (1986:32) comments:

While Taylor is often seen as the villain who created scientific management, it is important to realize that he was really part of a much broader social trend involving the mechanization of life generally. For example, the principles underlying Taylorism are now found on the football field and athletics track, in the gymnasium, and in the way we rationalize and routinize our personal lives. Taylor gave voice to a particular aspect of the trend towards mechanization, specialization and bureaucratization that Max Weber saw as such a powerful social force.

"The evil that men do lives after them / The good is oft interred with their bones" (Julius Caesar, III,i,74). The evils of stop-watch engineering live on in the popular imagination. The good work that industrial engineers do is buried beneath the memories of the past. However, as metaphors of organization change, so does the orientation of industrial engineering. Let us look at a more contemporary metaphor.
Organizations as brains. Classical organization theory reflects the technology of machines: the organization is an intricate array of complex intermeshing parts working together to achieve a desired end. Its lifeblood is the printed word, mechanized information that supports and sustains its bureaucracy. A new technology, the technology of computers, has transformed the way organizations do business and introduced a new metaphor, organizations as brains, the hallmark of which is information processing through electronic communication.

Turner, Mize and Case (1987:5) point out that the distinguishing characteristic of engineering is a concern with the design of systems. Hence the formal definition of industrial engineering by the IIE (Institute of Industrial Engineers) is in terms of systems: "Industrial engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, information, equipment and energy". The term "industrial" is interpreted in the most general way: "The basic principles of industrial engineering are being applied in agriculture, hospitals, banks, government organizations, and so forth" (17). Clearly, educational institutions would not be out-of-place in this list.

As the computer has transformed the organization, so it has also transformed industrial engineering. While the old functions of time standards and incentive schemes etc. continue, a new predominating function has emerged: the design and maintenance of management and information systems. The industrial engineer becomes the link between operating departments and centralised data processing for the design and implementation of computer-based systems. To the extent that computing power is decentralized through the vastly increased power of
mini- and micro-computers, the data processing function itself becomes decentralized through networking and distributed processing.

Marshall McLuhan observed that before people learn the characteristic idiom and full potential of a new medium, they will use it to continue the operations of the old. Thus early film makers shot movies of stage plays and early TV continued with the idiom of cinema movies and continues to broadcast old movies. In the same way, computers have been used to implement the old "print" ways of doing things, and in doing so have often added rather than reduced the burden of paper and bureaucracy in organizations. The paperless office is a long way from realization. However, computers have been used effectively in the design of less routinized information systems that allow for various levels of decision making, facilitate management by exception and provide instant information on a computer screen. The general public is in touch with such systems whenever a person buys an airline ticket or checks out groceries over a laser-controlled check-out station in a supermarket.

But what connects all this with education? In a word, databases, with all that word implies for the electronic organization of information. Just as these industrial systems depend on databases, so do educational systems. Libraries are the databases of education. Already, university libraries are managed by computer systems. How long before school libraries are managed the same way? or are connected with central school district control systems? Information in books and journals is stored predominantly in print. Already this is being significantly supplemented by electronically stored information like dictionaries and encyclopedias on CD ROM. As in industry, so in education, information will more and more be accessed on a computer screen as well as the printed page. The students in Hooper's
(1988) study were constructing an information database and, in the process, learning how to analyze, process and manage information electronically.

The systems we have discussed perform brain-like functions: distributing and monitoring information and exercising control. A further leap is required, however, for the organization itself to become brain-like. This requires systems that not only learn but learn how to learn, i.e. they not only compare information against operating norms (like a thermostat) but also question whether those norms are appropriate. Morgan (1986:93) finds a non-computerized example of such a cybernetic system in the Japanese management ritual of ringi, a collective decision-making process in which a policy document passes from manager to manager for approval:

The ringi is as much a process for exploring and reaffirming values as it is for setting a direction. Cybernetics shows us that coherent direction can emerge from a domain defined in terms of values, and the ringi provides an illustration in practice. By contrast, the emphasis placed in Western management is a lot more mechanistic in orientation than Japanese management, which reveals a good intuitive grasp of cybernetic principles... In the American view objectives should be hard and fast and clearly stated for all to see. In the Japanese view they emerge from a more fundamental process of exploring and understanding the values through which a firm is or should be operating.

Winograd and Flores (1986) describe under the heading "Tools for Conversation" computer systems that facilitate the ringi process (agreement) or any other of the speech acts that constitute conversation (requests, clarifications, affirmations, denials etc.). Winograd calls these, unglamorously, "coordination systems" or "workgroup systems". An implemented example is described by Benson, Ciborra and Proffitt (1990) in a paper whose title indicates the area of application: "Some social and economic consequences of groupware for flight
crew". Significantly, such systems are examples not of total automation but rather of the use of computer systems in partnership with humans. People inject human, not artificial intelligence into the system while the machine records, stores, searches and compares transaction information, provides instant feedback on status, and indicates action options. Such systems are now well beyond the research stage: the software vendor Symantec, with their "Lotus Notes" package, is the first to score an outstanding commercial success with this new type of software called "groupware" in the industry. Other major vendors are following fast with competitive offerings. Lotus Notes relies upon networking to pull together the "members" of a group and points the way to the new paradigm of work in the world of business: human cooperation mediated electronically through computers.

As industrial engineers move into the design of these sorts of system -- traditional database systems and non-traditional workgroup systems -- they leave behind the stop-watched time-control and work measurement systems that they have been associated with in the past. There is also a message here for educators: these are the systems that students will encounter when they move into the world of work. Such systems reflect what students should be learning now in the classroom: how to intelligently manage rather than mechanically process information. As Pea (1985) has pointed out, in an age of exploding information and rapid knowledge obsolescence, while knowledge of facts is needed, our predominantly fact-oriented curricula must change to emphasise the cognitive skills of information management, problem solving, creative thinking and the meta-cognitive skills of learning how to learn.
One more metaphor throws into perspective an important facet of organizations in today's world, which is of equal relevance to education: organizations as cultures. This metaphor also puts industrial engineering (the study of tasks) in a new light.

**Organizations as cultures.** The metaphor of culture is close to another metaphor, organizations as organisms. The word "culture" is derived metaphorically from the notion of cultivation and refers to a created environment in which an organism can take root and grow.

In talking about culture we are really talking about a process of reality construction that allows people to see and understand particular events, actions, objects, utterances or situations in distinctive ways. These patterns of understanding also provide a basis for making one's own behaviour sensible and meaningful (Morgan 1986:128).

Culture, therefore, is created and sustained by members of cultural groups who enact the "realities" of the world they share. These social constructions are so deeply internalized that they are accepted as "the way things are". Other groups with other values appear odd and sometimes perverse.

The fact that culture makes a difference is dramatically illustrated by the rise of Japan as an industrial power, now challenging the heretofore undisputed economic supremacy of America. Morgan (1986) cites Murray Sayle, an Australian expert on Japan, who believes that Japanese organizations combine the cultural values of the rice field and the samurai. Traditional rice cultivation is a family cooperative enterprise that calls for teamwork with sharing and support between neighbours. It is reflected in employee cooperation and consensus in the workplace. The samurai represent a tradition of elite clans that protect their own, support each other and wage war on threatening outsiders. It is reflected in Japanese management style: concern for employees' welfare, cooperation between organizations
(industry, government and banks working together), and competitive aggression towards the outside world. This culture clashes with the competitive individualism of American culture where individuals compete with each other for advancement, management-labour relations are confrontational, cooperation between industries is prohibited by anti-trust legislation, and government enacts protective legislation against foreign competition in order to "level the playing field". Both sides recognize each other as competitors but each accuses the other of "unfair" trading practices. Two "realities" in conflict or two "isolations", to borrow a Canadian phrase.

Cultural differences characterize not only nations but also organizations and work groups. "Corporate culture" is now recognized as an important factor, even the most important factor, in an organization's success. Hewlett-Packard in America, a recognized leader in the microelectronics industry, and Marks and Spencers in the United Kingdom, a recognized leader in retailing, are two examples of organizations who have deliberately built up cultures of openness to innovation, and open communication and trust between management and employees. In organizational thinking, the problem of change is more and more perceived as a problem of changing organizations' cultures. This means changing the "socially constructed realities that rest as much in the heads and minds of their members as they do in concrete sets of rules and relations" -- not an easy task.

A school district is an organization with its own culture. Each of the schools in the district is also an organization with its own culture. Within the school, each classroom is a separate workgroup, with its own sub-culture. To move in the classroom from predominantly teacher-fronted whole-class teaching to working with groups and cooperative learning cannot
be accomplished by fiat. Changes have first to take place within the heads of the teachers and students. Changes in the classroom culture, however, may be restrained by limits imposed by the culture of the school, which in turn may be restrained by limits imposed by the culture of district, which in turn may be restrained by the culture of the "Ministry". To propose change is easy; to implement change is hard because it means changing cultural values and habits.

The industrial engineer or the educational researcher, to be successful in designing systems for people, i.e. new ways of doing things, must be aware of how compatible proposed changes are with the various levels of cultures and sub-cultures that will be affected. If the system runs counter to the cultures, particularly at the work group level, it will suffer negative consequences running from outright rejection or open sabotage to passive neglect. It is this fact of life that makes the constructivist research paradigm relevant: solutions to problems are not imposed nor preconceived but emerge (are constructed) from dialogue with all stakeholders. The final result may not be the desired ideal but it will, at least, be workable.

Let us now look at the characteristic features that industrial engineering or work study has evolved for the study of tasks in context.

**Work Study: origins and features**

**Work Study origins.**

"Work Study" is a term adopted from Europe. It was coined just after the conclusion of WWII when the UK and the countries of Western Europe were searching for new approaches to reconstruct their industries. The goal of increased productivity was emphasised not only for its own sake but also because of the acute shortage of skilled labour at that time.
The Organization for European Economic Cooperation (OEEC, later OECD) established a productivity programme which loosely coordinated the Productivity Councils in each of the European nations. Work study received powerful support in the UK from Imperial Chemical Industries, who by 1960 had a staff of 1,500 engaged in the discipline and made their training programs widely available to other institutions. The first head of these activities was R. M Currie, author of the 1960 text "Work Study".

Work study came to Canada under the auspices of the National Productivity Council of Canada, established by the Federal Government in 1960 and later incorporated into the Economic Council of Canada. Work study training was launched in B.C. in 1963 through the joint efforts of the National Productivity Council, the University of British Columbia and a number of B.C. companies.

"Work study" refers broadly to the same range of activities as "industrial engineering" but work study practitioners are not necessarily members of the engineering profession. Typically, an organization staffs a work study department from a number of disciplines: engineers, plant managers, accountants, systems analysts and others. What gives the department coherence is an extensive and intensive program of training. The result is an interdisciplinary group representing a wide range of skills and expertise and united by a common methodology. Work study has been widely applied not only in the manufacturing industries but also in agriculture, construction, hospitals, government administration, the armed services, retailing, and research institutes.
Work study methodology

Work study is preeminently a discipline for the study of task in context. It can be applied to the design of new tasks or the improvement of existing ones. Turner, Mize and Case (1978:26) comment:

Truthfully speaking, almost all human activity systems are not really designed; they simply evolve. Few industrial and systems engineers really engage in overall system design. Almost all are concerned with improving... an existing system.

In terms of the classroom, therefore, work study techniques can be used for designing new task units. As soon as they are introduced, they become candidates for periodical review and improvement.

Work study methodology divides into two parts: work measurement and method study. Method study is the most relevant to the study of classroom tasks but one work measurement technique has great practical value: activity sampling.

Activity sampling. Activity sampling (U.K. usage) or work sampling (U.S. usage) is one of many measurement techniques used by industrial engineers to find out how workers are spending their time and how long they are spending on the different activities or elements identified. The point of sampling is to avoid the costs of measuring 100% of the work under study, whether by stopwatch or by pre-determined motion time study (PMTS). Activity sampling, therefore, is fast and easy to use and answers the question: "What's going on"?

In an SLA classroom, interesting questions are: what proportion of class time is occupied by teacher talk? by student talk? by teacher-led whole-class activity? by autonomous solo student activity? by autonomous group activity? by off-task activities? If computers are in the classroom, what proportion of the time are they used? Is there a correlation between whole-
class activity and off-task activity? How much off-task activity occurs in group work? or when computers are used? Activity sampling, in this context, is an initial survey technique to raise interesting questions and to indicate the most promising areas for improvement. It thus paves the way for method study.

The basis of today's work sampling was laid by L. H. C. Tippett (1935) in a paper entitled "A Snap Reading Method of Making Time Studies of Machines and Operatives in Factory Surveys" and published in "The Journal of the Textile Institute" in the U.K. Tippett's innovation was to sample at random intervals of time. This produced estimates of element time unbiased by the cycle time of the whole job. It also made possible a precise calculation of estimating error from the theory of the binomial distribution (Flowerdew & Malin, 1963). Activity sampling was found to be an effective and versatile work measurement tool and was applied in many different industries and areas of work, including education, health care, building maintenance and office work. Ralph Barnes (1957), in his comprehensive text "Work Sampling", quotes an early activity sampling study in education by Paul E. Christensen (1955) to determine how 26 teachers in an elementary school of the city of Royal Oak, Michigan, utilized their time.

The basic procedure underlying Tippett's approach is known as simple random sampling (SRS). Moder (1980) points out that Tippett did not, in fact, use SRS but introduced adjustments to overcome some of its problems. The main problem is caused by the use of random times to ensure that each minute in the work day has an equal chance of being included in the sample. Inevitably some intervals are inconveniently far apart while others are closer than the time required to make a round of observations. Industrial engineers looked for
alternatives, one of which is **fixed interval** or **systematic random sampling** (SyRS) or, as it is also called **systematic activity sampling**. Haines (1958) reports the successful use of a two minute interval and shows empirically that results are even more accurate than using SRS. SyRS with a two-minute interval is a simple and suitable method for use in classrooms.

**Method study.** Method study follows a six-stage process: select, record, examine, develop, install and maintain. Stages may overlap. Discoveries in a later stage may lead to backtracking and additional work on earlier stages. However, the stages as listed are in their logical sequence. The key techniques are in the first three stages.

**Select** is naturally the first stage of a method study. What are we going to look at? Are we going to improve an existing task? Or design a completely new task? Or simply study the layout of the classroom? Activity sampling can help answer this question by telling us what is happening already in terms of percent of time on existing activities and by showing up significant correlations. Another helpful concept is **Pareto's Law** (Pareto was an early 20th century Italian economist) which states:

In any series of elements to be controlled, a selected small fraction, in terms of numbers of elements, always accounts for a large fraction, in terms of effect.

For example, a small percent of product lines or inventory items will account for a large percent of total sales or inventory dollars. In an educational setting we could predict that a small percent of students will account for most classroom management problems, or a small percent of titles will account for a large percent of library loans, or a small percent of L2 language forms will account for a large percent of syntax problems. The most productive strategy is to attend first to the small percent of elements that are creating a large percent of effect rather than dilute study efforts over the whole population of elements.
Record, the data gathering stage, takes the longest time. A great variety of techniques can be used. Some of these, such as interviewing and observation (participant and non-participant), are standard techniques in any ethnographic study and are particularly necessary for filling in the wider context of the study, understanding the needs and problems of various stakeholders, and understanding the human dynamics of the work operations. Other techniques are designed to help record the nature and sequence of the work itself. Examples are operation flow process charts (for the nature and sequence of operations), information flow charts (for the nature, form and sequence of information), multiple activity charts (where several streams of operations are happening simultaneously), physical workplace layout charts (particularly important when computers and other items of equipment are being used) and a number of variations on these themes (see Currie's (1960) "Work Study", Nadler's (1970) "Work Design: A Systems Concept", and Carlisle's (1986) "Analyzing Jobs and Tasks").

Examine is the critical analytic stage for making sense of the data and discerning possible solutions to problems and likely areas for improvement. Currie (1960) describes the core technique of work study called critical examination (CE). It addresses a common problem in studies of tasks: data overload. Rather than examine every single piece of data recorded, CE identifies the critical operation (sometimes more than one) that represents the heart of the task. All other operations either lead up to the critical operation or fall away from it. Any change in the critical operation automatically dictates changes in the other operations. The first thing is to look at the critical operation in depth.
For example, in an SLA content task, the critical operation may be defined as "academic discourse is generated". How effectively does the existing operation accomplish this goal? How can it be redesigned to accomplish the goal more effectively. CE moves into the brainstorming of alternatives with the help of Kipling's "six honest serving men":

I keep six honest serving men
(They taught me all I knew)
Their names are What and Why and When
And How and Where and Who. (Kipling, The Elephant's Child)

We have already answered the What question by identifying the critical operation. The next question is "why"? Is the reasoning behind this operation valid? Usually it is, but sometimes the "why" question produces surprising results, leading the researcher into unexpected new directions. After "why", the questions "how", "when", "where" and "by whom" follow with the further probes, "how else"? "when else"? "where else"? and "by whom else"? This process generates a large number of alternatives which are all recorded with critical judgment suspended in the tradition of brainstorming. This intensive period of analysis and brainstorming is followed by a critical synthesis of the best alternatives for development. CE assumes that not only is improvement possible but also many valid alternatives for improvement are possible. The final output of CE is selection of the optimum alternative that best meets the needs of the various stakeholders. If a constructivist approach is used, then the stakeholders will be involved throughout the process so that the final result will represent as near consensus as is possible.

1 Note: A formal critical examination is not presented in this study because peer tutoring was preselected for investigation.
Carlisle (1986) describes other examination techniques that complement the core technique of critical examination.

**Develop, install and maintain:** *Develop* is the synthesizing process that concludes critical examination. Where two or three alternatives seem to have near equal merit, final selection is determined by cost-benefit studies which should be expressed not only in dollar but also in qualitative terms. *Install* is the implementation stage which includes planning, training and rehearsal. Installation is a project in its own right and should be supported by project management methodology. This provides for the production of a project plan. The installation is broken down into well defined operations; appropriate times and resources are assigned; and an implementation schedule is produced. Actual installation is tracked against the schedule. *Maintain* is the stage in which the work study practitioner (or researcher) and team withdraw from the study after a period of follow-up and systems audit to ensure that initial implementation problems are resolved and final objectives are met.

**Implementation**

We have considered, therefore, what has to be done: the design for L2 students of natural tasks, with or without computer assistance, that will produce content learning and generate academic discourse and expository text in the work place of the content classroom. We have examined some of the tools available for this undertaking: in particular, the psycholinguistic design principles derived from experimental work on communicative task design, and the well proven methodology of work study, expressly developed for the design and improvement of tasks in the sociocultural setting of the workplace.
Equally important is a consideration of how these tools are to be applied. We have seen how Taylor’s principles of "scientific management", backed by stop-watched "time study", led not to "a spirit of hearty cooperation between management and the men", which he claimed later to have been his intent, but to the treatment of workers as cogs in the wheel of the industrial machine. Their job was to do what their managers told them without any say of their own. Taylor was not so much an evil genius as a reflector of forces for the mechanization of society that culminated in the industrial revolution. The following document, referring to the “Old Derby China Manufactory” is from the early days of that period:

I Thomas Mason, this 22nd day of December, 1792, solemnly pledge myself to use my utmost caution at all times to prevent the knowledge transpiring that I am employed to use a stop watch to make observation of work done in Mr. Duesbry's manufactory; and to take such observations with the utmost truth and accuracy in my power and to give the results thereof faithfully to Mr. Duesbry (cited in Currie 1960:2).

Two centuries of management-labour strife bear witness to the havoc wrought by this attitude.

The same "zeitgeist" moved in education. The 19th and early 20th century schoolroom was designed on the factory model. Students, like factory workers, were set in serried rows under the supervision of their teacher-manager. They were expected to do what they were told and were thought to have nothing to contribute to the learning situation except obedience.

The notion that learning is a process of active construction rather than passive assimilation . . . is still quite novel . . . And the idea that minds actively construct knowledge is only beginning to be explored in psychological research, despite earlier philosophical intimations and announcements (Cohen, 1987:162).

If the workplace, whether factory or school, is conceptualized in these mechanistic terms then it is quite natural to investigate tasks as though they were physical phenomena.
Accordingly, past research has been conducted using the experimental, quantitative methodology that has had conspicuous past success in the physical sciences. This tradition assumes a single reality and simple causation determined by constant Laws of Nature. So the work study practitioner or the educational researcher approaches the study of task as the "expert" who will find out what is "really happening", identify problems and fix them. The human element -- whether workers and managers or students and teachers -- is simply grist to the research mill. Although still active, this tradition has fallen from dominance.

The "other way" is a hermeneutic (interpretive) approach, which assumes that multiple realities exist. Giddens (1989) points out that this is already accepted in the "newer (post-Kuhnian) philosophy of science". Guba & Lincoln (1989:12-13) express this approach in terms of "constructivist" methodology:

It begins with the assumption that realities are not objectively "out there" but are constructed by people, often under the influence of a variety of social and cultural factors that lead to shared constructions. But socially shared constructions are not equivalent to the positivist's "reality"; there is no "reality" except that created by people as they attempt to "make sense" of their surrounds. Obviously such socially constructed realities are not only not independent of the "observer" (read "constructor") but are absolutely dependent on him or her for whatever existence they may have.

The work study practitioner or researcher is not dealing primarily with physical entities of science but with people. Work study, through task design, affects the way people work. Therefore work study practitioners ignore the human element at their peril and are well advised to take the "constructivist" approach, treating people on the job -- workers, managers, students, teachers -- as their most valuable resources for design and improvement ideas. A
work study is successful when the new way of doing things is so much taken for granted (owned) by the stakeholders, that the work study (and its analyst) are long forgotten.

CHAPTER SUMMARY

"Peer tutoring", with which we started this chapter, has had a long and successful history but has not been widely implemented except in its early days at the turn of the 19th century under the leadership of Bell and Lancaster. The criteria for its success which these pioneers formulated hold good today. They include careful matching of tutor with tutee, regularity, training in tutorial techniques and correction procedures, monitoring, and evaluation. Implementations that ignore these criteria have usually been short lived with disappointing results. Despite the success of well planned and executed implementations, peer tutoring is still not widely used mainly, it is suggested for three reasons: political obstacles, psycho-logical reluctance to innovate, and administrative reluctance to change curricula timetables.

Peer tutoring as a task in second language teaching, integrates both content and language. Therefore we reviewed task-based language teaching, the concept of a task syllabus and the distinction between a psycholinguistic and sociocultural approach to task implementation. We noted the advantage the sociocultural approach has in leading students beyond conversational to academic discourse (Cummins' terms). Its concrete action base leads to talk not only about what has to be done but also why and how, i.e. academic discourse of both action and theory. Mohan's Knowledge Framework illuminates the concepts of action and theory in both discourse and non-verbal communication (e.g. key visuals) and provides an analytic tool for both designing tasks and cognitively analyzing discourse generated by them.
We are concerned both with task- and computer-based peer tutoring. We therefore reviewed research in CALL. We noted a move away from a focus on the computer as an alternative medium to accomplish traditional results to either single-medium (computer) experimental research or ethnographic research in which the computer is one of several interacting variables. Following the latter path, we looked at the computer as a facilitator for group interaction; and as a reorganizer of cognitive processes, particularly in new patterns of thinking for working with the development and application of databases and hypermedia.

We then reviewed methodology appropriate to dealing with task-based teaching, either with or without computer support. We looked at principles of task design and at Work Study, the large body of research developed specifically for dealing with tasks in the workplace. In education, the classroom is the workplace, students are workers and teachers are managers: but not working in the authority-obedience mode of the 19th century in which knowledge transmission in the classroom paralleled the flow of production processes in the factory; but rather working in cooperative work groups which are becoming the norm in the networked workplace and are reflected in cooperative knowledge construction in the classroom.
CHAPTER 2C: SELECTIVE REVIEW OF LITERATURE (3)

THE COMPUTER IN EDUCATION

In discussing "The methodology of discourse analysis" in Chapter 2A, we cited Edwards and Westgate's (1987) comment that the identification of the all-pervasive I-R-E (Initiation, Reply, Evaluation) teaching mode is "the most enduring legacy" of the work of Sinclair and Coulthard on discourse analysis. Mehan's (1979) study in Courtney Cazden's classroom produced the definitive documentation of the I-R-E phenomenon in the form of discourse transcripts which he analyzed in depth. This experience and subsequent studies led Cazden (1988) to identify I-R-E as the "default" pattern of classroom discourse: i.e. "what happens unless deliberate action is taken to achieve some alternative". This is important for our study because we have identified I-R-E as the predominant pattern of the tutor/tutee discourse in the first peer tutoring sessions, PT(1).

I-R-E is associated with the traditional teacher-centred knowledge-transmission style of classroom teaching. An alternative is the student-centred knowledge-construction style of teaching. Both of these styles have their place. However, one of the objectives in the second peer tutoring sessions, PT(2), was to move the tutors away from a knowledge-transmission to a knowledge-construction style because it was believed that cooperative knowledge construction would produce a higher quality of academic discourse. In this chapter, we will:

- describe alternative teaching styles and their link with technology;
- enquire why schools apparently resist the electronic technologies in the classroom;
- discuss the relevance of the computer and electronic technologies to learning.
Figure 2.12 depicts the traditional teacher-fronted model of classroom teaching. As Hoebel & Mussio (1990:10) point out in their discussion paper concerning the B.C. Ministry of Education's "Year 2000" initiative, the teacher's traditional role is "a packager of knowledge and interpreter of information for groups of students" while the student's traditional role is "the recipient of prepackaged knowledge". The teacher (T) stands in front of the class and by speech and by writing on the board delivers to the students the text they are expected to "learn". This style is born of the technology of print (McLuhan & Logan, 1977; Eisenstein, 1979; Ong, 1982; Olson, 1987). The preferred method of delivery is by a series of initiatory questions (I) to focus the students' attention and elicit responses (R), which the teacher evaluates (E) in sufficient detail that by the end of the lesson the knowledge package has been fully delivered in a series of I-R-E exchanges.

The text may be a printed textbook or something the teacher has authored; but what the teacher delivers is "knowledge" derived from printed texts. Even though the students may be assigned copies of a particular text for pre-reading, the teacher still packages it for them in the classroom. The students' task is passively to "receive" the text from the teacher's spoken words and from the words written on the board. The students repackage this knowledge in
their notebooks so that they can commit it to memory and be prepared to answer questions about it orally in class (in typical I-R-E style) or in writing a test.

This traditional model of teaching is increasingly under attack. William Bennett (1986:26), former U.S. Secretary of Education and former Headmaster criticizes it under the rubric "recitation method". "If science is presented like this", says Bennett, "is it any wonder that children's natural curiosity about their physical world turns into boredom by the time they leave grade school -- and into dangerous ignorance later on"? Tharp and Gallimore (1989:21-22) comment:

What is this ubiquitous "recitation"? It consists of the teacher assigning a "text" (in the form of a textbook or a lecture), followed by a series of teacher questions that require the students to display their mastery of the material through convergent factual answers. Recitation questioning seeks predictable, correct answers. It includes up to 20 per cent "yes/no" questions. Only rarely in recitation are teacher questions responsive to student productions. Only rarely are they used to assist students to develop more complete or elaborate ideas.

Goodlad (1984) gives a similar picture in his survey of 38 U.S. schools in various communities and regions. Teacher talk predominates, students are mostly passive, there is little adaptation to individual differences, and few challenging exchanges between teachers and students take place. Cuban (1986), in his survey of the classroom use of technology since 1920, also reports the persistence of this mode of teaching and its resistance to technological change.

Knowledge construction

The need for change is widely recognized. Technology is widely advocated as the means for making change. Mecklenburger (1990), like Cuban, recognizes that the school
system came about through the application on a massive scale of nineteenth century technology. The problem, he suggests, is simply that it has not kept up to date. He notes that electronic technology -- telephones, films and videotape, computers and optical data storage -- has transformed the world of work but has left the world of schools unchanged. Adding onto the existing school technology in a piecemeal fashion is not the answer, as is demonstrated by the disappointing results of introducing computing technology into the schools. What is required, according to Mecklenburger, is as massive an application of today's technology as of yesterday's technology (print) in creating the system now in place.

Educators are not deaf to these issues. The Report of the Provincial Advisory Committee on Computers (B.C. Ministry of Education, 1987:1) recognizes clearly the technological base of "education for literacy" and the need to update that base so that schools are using the same technological tools as the surrounding society uses in home and at work:

The invention of the computer can be viewed, simply, as the most recent stage in the history of information technology. More than 2000 years ago, the creation of the alphabet by the ancient Greeks provided a method by which information could move from place to place independently of the person who produced it. Fear was expressed at that time that the use of the alphabet would ultimately reduce the ability of people to remember information. . . Similarly, when Gutenberg invented the printing press in the 15th century it was broadly suggested that the skill of handwriting would be lost to the printed word. What actually happened was that printing technology produced books at such dramatically-reduced cost that it aided the industrial revolution and hastened the arrival of universal public education. The computer, in the same tradition, has taken the processing of information another significant step forward.
The Report notes and accepts the increasing dependence of society upon computers and the pressures from parents and society to make computers an integral part of the curriculum.

Hoebel and Mussio (1990) describe the new role for the teacher as "shifting from being a packager and interpreter of knowledge for groups of students, to being a learning coach and guide, working with individual students to help them learn how to learn" (10). The student's role shifts from passively consuming prepackaged knowledge to actively constructing knowledge and creating meaning.

**Print product and electronic process**

Olson (1987) contrasts the textbook model of knowledge as product, derived from print literacy, with the model of knowledge as process, derived from the electronic technologies of communication. Textbooks accumulate propositions into fixed bodies of knowledge which students are required to learn, with an emphasis on memory. Properly used, the electronic technologies help students move away from knowledge acquisition to knowledge creation and problem solving. This is the direction called for in "Year 2000" (B. C. Ministry of Education, 1989).

Although linked by Olson with electronic technology, knowledge construction is by no means dependent upon technology. Figure 2.13 serves to depict the Our World students engaged in knowledge construction in the school library. They work individually and in small
groups. The library resources are available to them -- mostly books but also the library computer with commercial HyperCard programs. The students identify useful texts (and computer programs), go through them for needed information and then organise their information into a written text. The librarian-teacher acts as coach and consultant and is there when they need help.

Also relevant is the teaching style that preceded all technology including writing itself. Tharp and Gallimore (1989b) call this "assisted performance".

Assisted performance

Dewey (1916) identifies communication as the essence of education. He contrasts the directness of communication and learning in preliterate societies with the indirectness of the education process in modern, complex industrial societies (see also Erikson, 1950:109-180, on childhood in two American Indian tribes). Children learn the skills, values and customs of adults by sharing in what the elders are doing. Communication is direct through intimate association. Learning is direct through performing real tasks or indirect through dramatic plays which reproduce the actions of adults. Dewey (1916:7) points out: "To savages (sic) it would seem preposterous to seek out a place where nothing but learning was going on in order that one might learn". Learning by direct sharing is more difficult in literate societies where tasks become increasingly specialized, complex and remote from everyday experience. So formal schooling is born: knowledge and experience is represented symbolically and stored in books; society delegates the task of transmitting this knowledge to a special group of persons called teachers. Dewey warns of a "conspicuous danger" that, in contrast to the vital, direct sharing of experience in preliterate instruction, "formal education, on the contrary,
easily becomes remote and dead -- abstract and bookish, to use the ordinary words of
depreciation" (8).

The intimate assisted performance that Dewey describes as the norm for preliterate
societies rarely takes place in our Western literate culture. One of the few occasions when it
does is when our own children are still preliterate. Bruner (1983) describes how mother (or
other caregiver) plays games like "Peekaboo" with the very young child. These games are
constituted by language. In playing them, children have fun and at the same time find
themselves in a learning environment where they explore, discover and negotiate new uses of
language. Bruner describes such games as "as little protoconversations" (47). Tharp and
Gallimore (1989b) comment that "as common as assisted performance is in the interactions of
parents and children, it is uncommon in those of teachers and students".

We may therefore say that no matter how powerfully technology may assist teaching
and learning, assisted performance, based on orality and hands-on assistance, will never be
obsolete and, in fact, may well be too much neglected.

Two false assumptions

Let us identify two false assumptions in order to put them aside:

1. That moving away from the traditional transmission model of teaching
necessarily means moving into electronic-technology-based teaching, i.e. using
the computer and networked telecommunications. Socrates did not employ
technology; he did, however, achieve impressive knowledge construction with
his interlocutors with only the human voice and hearing.
2. That traditional teaching does not employ technology. On the contrary, it is based upon the massive technology of print which is so deeply embedded in our culture that we uncritically take it for granted.

**Technologies of communication**

The technologies of communication were called by McLuhan (1964) the "Media". We are concerned with the three main branches of the media which are, in historical order, writing, printing and the electronic technologies.

**Writing**

Literate education has always been shaped by technology because writing itself is a technology -- one of humanity's earliest and the one that largely shaped all those that followed. Ong (1982:81-82) describes how Plato thought writing to be an inhuman artifact, pretending to establish outside the mind what in reality can be only in the mind and destroying memory in the process:

Plato was thinking of writing as an external, alien technology, as many people today think of the computer. Because we have by today so deeply interiorized writing, made it so much a part of ourselves, as Plato's age had not yet made it fully a part of itself (Havelock, 1963), we find it difficult to consider writing to be a technology as we commonly assume printing and the computer to be. Yet writing (and especially alphabetic writing) is a technology, calling for the use of tools and other equipment: styli or brushes or pens, carefully prepared surfaces such as paper, animal skins, strips of wood, as well as inks or paints, and much more.

As Olson (1987:83) points out, "schools are essentially literate institutions and were begun when reading and writing had become common activities in Classical Greece . . .

Schools, like the great world religions, are institutions of the book." However, both literacy
and schooling, based upon scarce and expensive handwritten manuscripts, were confined to a privileged few and for more than a millennium passed by the great masses of humankind.

**Printing**

The dawn of universal and compulsory education towards the end on the nineteenth century, depended upon another technological revolution:

With the printing press we finally encounter a technology whose impact on the use of the alphabet is so great that it must be ranked in importance with the alphabet itself ... The differences between the handwritten manuscript and the machine-manufactured, print artifact are so great that these two forms of alphabetic text must be considered as completely different media. This fact is reflected in the dramatic change in European civilisation and society that the printing press effected ... (which) was of the same order of magnitude as the impact of the alphabet itself approximately 3,000 years earlier (Logan, 1986:177).

Here, in print, we have the technological underpinning of the **continuation** today of the recitation-IRE-based transmission model of teaching; because, as Cohen (1987:159-60) points out, the role of the teacher as transmitter of knowledge and truth remained (and remains) unchanged from the days of the medieval academy:

In medieval Judaism and Christianity, the teacher was the voice of authoritative knowledge, which originated elsewhere. He was a pipeline for Truth. The teacher's assignment included codification and clarification of established knowledge ... Teachers were the centre of instruction. (So) in our instructional inheritance, teachers are tellers of truth, who actively inculcate knowledge. Learning is relatively passive: students listen, read, and accumulate what they are told. And knowledge is objective and stable. It consists of facts, laws and procedures that are true, independent of those who learn, and entirely authoritative.

In schools today in the age of print, as then in the age of the handwritten manuscript, the teacher is the high priest of the text. Now, however, the text is ubiquitous through the
mass production of print, and schools are ubiquitous through the changes from the medieval to the modern world made possible by the power of print.

The revolution of electronic information

The new electronic technologies are radically transforming society before our eyes. These changes are the subject of comment from scholars in various disciplines: e.g. sociologist Daniel Bell in "The coming of the post-industrial society" (1973); computer scientist Tom Forester in "High-tech society" (1987); and economist, social scientist and business management scientist, Peter Drucker, in "The new realities" (1989). The changes from the middle ages to the modern era are often cited as analogous to the changes now well in process from the "modern" era to the "post-industrial society" or "information age" or whatever other label is chosen to designate the "brave new world" that is already upon us. As the "post-modern" world is born of the electronic technologies, so the "modern" world was born of print technology (McLuhan, 1964; Bolter, 1984; Logan, 1986). Gutenberg's printing press appeared 500 years ago. The impact of print technology on society and education evolved over the succeeding centuries. The personal computer appeared barely twenty years ago and has already, in combination with the longer established electronic technologies of TV and telecommunications, radically changed (and continues to change) the workplace and how we communicate and do business.

Yet to date, as documented by Cuban (1986) in his survey of the classroom use of technology since 1920, these changes have barely touched the classroom: Cuban comments:

Since the mid-nineteenth century the classroom has become home to a succession of technologies (e.g., textbook, chalkboard, radio, film, and television) that have been tailored to the dimensions of classroom practice. Yet the teacher has been singled out as inflexibly
resistant to "modern" technology, stubbornly engaged in a closed-door policy toward using new mechanical and automated instruction aids (2).

However, Cuban recognizes the great demands society lays on teachers for the mass instruction and socialization of students and points out that the tools of traditional teaching, textbook, chalkboard and worksheets, were once successful innovations designed to cope with crowded classrooms. "The chalkboard and textbook were efficient, flexible technologies providing students with the same information at the same time. Some of what were once innovations for earlier generations of teachers became conventional and durable practices for later ones" (1).

This raises the question: if teachers innovated a century-and-a-half ago with the technologies of the time, why is there so much apparent resistance to innovating today with new technologies? Lepper and Gurtner (1989:174) comment, "Arguably, the last 'technology' to have had a major impact on the way schools are run is the blackboard". Mecklenburger (1990:106) agrees: "Yet chalkboards, lectures, and textbooks continue to dominate instruction almost everywhere".

We have seen that the traditional knowledge-transmission model of teaching associates with print technology while the knowledge-construction model of teaching associates with the new electronic technologies. This, together with Cuban's study, raises the question: Why, apparently, do schools resist technological change and hence resist a change to a knowledge construction mode of teaching which could be facilitated by the new technologies?
**Why do schools resist technological change?**

Cohen (1987), after examining all aspects of this question, has the insight to turn it around. Instead of asking "What are the sources of resistance to change?" he asks "What are the sources of persistence in traditional teaching"? He comes up with two answers:

1. **Our scholastic inheritance.** We have already referred to this: the teacher, like the scribes and priests of medieval times, is the guardian of the text that has to be passed authoritatively along to students who are expected to "listen, read and accumulate what they are told". And what they learn are "facts", objective, authoritative and unchallengeable.

2. **Popular teaching practices.** Most adult North Americans are unlicensed teachers of children and other adults over a whole range of activities from driving a car to shopping at the supermarket to teaching new employees how to do their job. This informal teaching follows and reinforces the popular model which every adult encountered at first hand when he or she was at school. In all these cases the traditional model of instruction is followed, which, as Phillip Aries (1962:334-6) and others have argued, has been "passed down unwittingly from medieval times . . . across the generations outside the stream of formal schooling, as well as inside it by teachers and students".

To the reasons for persistence that Cohen gives can be added what scholars like Ong (1982), Greenfield (1984), Logan (1986), Postman (1987) and Olson (1987) would rate as the most powerful reason of all: the underlying power of the print medium to foster the tradition of the authoritative text. Ong (1982:132) points out that "print encourages a sense of closure, a sense that what is found in a text has been finalized, has reached a state of completion".
Manuscript writing also has something of this effect. The finality of print is, however, more convincing, "enclosing thought (as it does) in thousands of copies of a work of exactly the same visual and physical consistency". With this sense of closure goes a fixed point of view. The modern textbook, fixed cover or paperback, is still modelled on the paradigm of Peter Ramus (1515-72), complete, authoritative, self-contained.

Therefore the traditional model of teaching is deeply set in the collective unconscious and is not likely to change on demand or soon. The task of change is analogous to a total change in the culture of a corporation or the total overhaul of an institution from the ground up that goes today under the rubric "re-engineering", the process of a corporation "reinventing itself" (Hammer, 1994). Such radical change is forced upon the commercial world through the competitive pressures brought about by technological change, especially the speed of relatively cheap electronic computer and communications technology, that for the first time enables small firms to compete with large and sometimes grow rapidly at their larger rivals' expense (Peters, 1989). These pressures, however, do not operate (for the moment) in the school system. Cohen draws the conclusion that other technologies, in particular computers, are unlikely to be widely adopted or used unless they can be accommodated, like books, to traditional practices. As we shall see, this is very much what has happened. First, however, let us examine new patterns of thinking and learning facilitated by the computer that lead away from knowledge transmission towards knowledge construction.
Computers and new patterns of thinking

Print vs computer mediated thinking

Olson (1987) contrasts the textbook model of knowledge derived from the medium of print literacy with the program model of knowledge derived from the medium of the computer. The underlying structure of the textbook is the proposition, a relation between two entities expressed as a simple assertion of fact, e.g. "Water boils at 100 degrees centigrade." The underlying structure of the computer is the program or branching procedure, a number of simple, discrete steps which are described by a dynamic goal statement, e.g. "If you heat water to 100 degrees centigrade, then it will boil". Textbooks accumulate propositions into large bodies of knowledge which students are required to learn, with an emphasis on memory. The potential of computers as a medium is not realized by using them for teaching the content of books, as is done with much of CAI (Computer Assisted Instruction). Rather they should be used for thinking in this new, procedural way which is done both by writing programs and working with large, provided databases.

Properly used, the computer allows the student to move away from knowledge acquisition to knowledge creation and problem solving. Our model of intelligence then changes from the notion of knowledge acquisition and graded performance to a notion of a series of simple operations applied to representations to achieve a complex knowledge product as a goal.

The computer as reorganizer of mental functioning

We restate here and amplify in a broader context what we introduced under the division "CALL" in the preceding chapter. Pea (1985) makes the point that what he calls the cognitive technologies, which include writing and print, have two effects on the mind:
amplification and reorganization. He defines a cognitive technology as any medium that helps transcend limitations of the mind in thinking, learning and problem solving. It has long been recognized that such technologies, e.g. written language, are cultural amplifiers (Bruner), empowering human cognitive capacities. What has not been recognized is the Vygotskian notion that these technologies can also qualitatively change forms of thought, i.e. they can functionally reorganize cognition.

Applied to the computer in education this means that software can be used to not only amplify children's cognitive efforts but also reorganize their patterns of thinking. Pea gives the specific examples we have already considered: spreadsheets, which restructure the mental work of budgeting from routine calculation to sophisticated "what if" planning and hypothesis testing; symbolic manipulation software in mathematics, which restructures students' thinking away from mechanical calculation to the problem-solving task of search and discovery for a way to solve for the unknown; and outlining and hypertext software, which restructures thought processes used for writing to encompass different perspectives and idea structures during the writing process. Olson's example of writing programs is also a case in point.

The amplifier metaphor is a descriptive concept, implying empowerment and greater volume and speed. Well designed CAI achieves this -- more of the same but faster with greater efficiency. The reorganization metaphor is a value concept, implying a change not of scale but of character from which a different cognitive process emerges. It is the reorganization effects of a technology, the cognitive restructuring it brings about, that addresses the important issue: what type of thinking do we want technology in education to encourage?
Pea suggests that in an age of exploding information and rapid knowledge obsolescence, while knowledge of facts is needed, our predominantly fact-oriented curricula must change to emphasise the cognitive skills of information management, problem solving, creative thinking and the meta-cognitive skills of learning how to learn. Unfortunately, as experience shows from the invention of writing to the invention of the computer, the cognitive restructurings that technology brings about are rarely predictable: "they have emergent properties that come to be discovered only through their use" (170). Therefore we also need an activist research paradigm that, using these criteria, will design and engineer environments embodying the desired reorganizing structures. Research after the fact is becoming irrelevant: "more specifically, to inform education effectively, theory and practice will need to be unified through the invention of research-informed electronic learning systems that work in educational settings" (179). Under this concept, research is married to development in major projects assigned to interdisciplinary teams of researchers, teachers and other specialists in much the same way as major projects are developed in industry.

Computers as facilitators of collaborative learning

Here also we restate in the broader context of this chapter what we introduced under the division “CALL” in the preceding chapter. Weir (1989), instead of looking at what the machine does inwardly to learners' thinking, looks rather at what learners can do together outwardly with machines. Accordingly, she calls her paper "Machine as Humanizer".

As we saw, Weir takes the Vygotskian position that "cognitive change comes from the transformation of knowledge among persons -- interpersonal understanding -- into knowledge within a person -- intrapersonal understanding" (62). She is interested in the computer,
therefore, as an adjunct to socially mediated learning. She bases her position on her experience teaching Papert’s visually oriented LOGO programming language to elementary students. She sees as important the non-verbal “new set of cultural symbols” generated by the computer like the LOGO turtle and other graphics screen objects. Because the children can do interesting things with these symbols such as making animated figures perform various actions, they take interest in what each other achieves. This leads to exchanging knowledge and hence learning from each other: “So now, in addition to internalizing social knowledge from the adults around them, students suddenly find themselves the producers of knowledge their teachers and parents do not yet have. This ownership is sweet indeed” (62).

The children are therefore acquiring for themselves pragmatic knowledge by working collaboratively on computers with such creative programs as LOGO or HyperCard. They are active co-generators rather than passive recipients of knowledge. However, “students do not, typically, on their own, gain an appreciation of the formal significance of the operations they are performing”. The teacher’s job is to channel their pragmatic knowledge into an understanding of the formal principles which underlie it, i.e. to bridge the gap of the Vygotskian “zone of proximal development” that lies between the students’ independent knowledge and the level of formal thinking that they could reach with help. And this should be done “without depriving the student of a sense of identification with and ownership of that pragmatic knowledge” (63).

The teacher is therefore challenged to enter into the process of collaborative learning, to “be prepared to learn from students, to learn with students” (66). This is not easy because
it means leaving the security that lies with being the sole provider of information for the harder task of guiding students along the path of knowledge construction.

Having reviewed the potential of computers to encourage new and desirable patterns of thinking, let us return to Cohen's prediction that new technologies are unlikely to be adopted in schools unless they can be accommodated to traditional, print-based practices.

Inappropriate uses of technology

Using new technology like the old

McLuhan (1964) made the point that each of the new technologies of communication (media), before the appropriate way of using it evolves, is at first used to continue the tradition of the technology it is replacing. Thus early movies filmed a drama like a stage play before fully exploiting the idiom of film: cutting, panning, zooming, fades, dissolves, flashbacks and rapid scene changes etc. Early TV followed the idiom of film, which indeed it shares, before "making for TV" with greater attention to close-ups necessary for the small screen and exploiting the potential of TV for presenting more rapid alternating shots (e.g. in a 60-second commercial) and processing multiple subplots within a short time period (1-hour) as in a show like Hill Street Blues (which Greenfield (1984), a habitual print reader and not a TV viewer, confessed herself quite unable to follow). So it has proved with the computer brought into the print dominated classroom. Its major use has been in CAI, which attempts to do the job of print better than print itself -- and, according to the research, in some circumstances, to a limited extent, succeeds.
Computer Assisted Instruction (CAI)

Kurland & Kurland (1987:320) point out that the first use of computers in education in the late 1960s was the delivery of CAI by central mainframe computers. "The dream of these early computer pioneers was to create national databases of instructional units that would cover the entire breadth of kindergarten through the 12th grade (K-12) . . . The central computer would maintain the programs, monitor student progress, and generate reports for teachers, parents, and school officials". In other words, the idea was to use the computer to mechanize the traditional teaching process. The advantages claimed were that instruction would be delivered more efficiently -- students would learn more content faster -- and on an individualized basis. The arrival of the microcomputer, a more flexible and decentralized alternative, saw the end of using centralized mainframes in schools. However, as the number of microcomputers increased in the schools, CAI remained the dominant pedagogical application (Becker 1986). Results were hardly dramatic: a number of surveys (Ragosta et al. 1982, Bass et al. 1986) concluded that CAI was "at least as successful" as conventional instruction methods and "somewhat" more effective in mathematics, language arts and reading.

However, the root criticism of CAI is not that it is more or less efficient than conventional teaching but rather that it represents a continuation of the text-based transmission model of teaching (with the one advantage of dealing with students individually). The computer screen replaces but serves the same function as the textbook with its predefined content. The computer becomes both page-turner and replacement of the teacher as the fount
of all wisdom. The student continues in a passive role as receiver or respondent under the total and predictable control of the computer program (i.e. the unseen computer programmer).

**Using new technology to preserve old curricula**

Kurland (1987) describes the chaos in the schools in the early 1980s. Computers of all different types, incompatible with one another, came into the schools with little overall planning or clearly defined notions of how they were to be used, and with no training provided to teachers in how to use them. At the same time parents in many school districts were applying pressure for their children to "have computers", again without clear notions of what they were to "have them" for. The schools turned with relief to a new area that emerged in the curriculum called computer literacy, "an innocuous blend of history, programming, tool use, and social issues relating to computers or computer use" (323). Computer literacy temporarily solved a number of problems, including giving parents evidence of action, avoiding heavy capital investment (computer literacy courses could be handled with a few simple machines), and avoiding heavy demands on computer-novice teachers. One last advantage Kurland mentions is significant: "by offering computer literacy as a separate course, schools could keep computers neatly compartmentalized and insulated from the rest of the curriculum". Kurland comments (323):

In the educational computing arena, the battle lines are clearly drawn between the revolutionary forces who would use the computer as a wedge to open up education to new ideas, new teaching techniques, and new goals for students, and those conservative forces who view the computer as a means of strengthening the existing curriculum rather than changing it. Which vision will predominate remains to be seen. However, conservative forces are currently clearly in the ascendant at the state and district level.
Beatty (1985) ascribes similar motives to the 1983 "Computers in Ontario" education report. She regards as rhetoric progressive sounding words about using computers "for enhancing and extending the dynamic processes of learning and self expression". What the authors really envisage she sees expressed in the words: "centralized control over the approval, production and distribution of software" followed by the recommendation that "software be clearly related to the objectives spelled out in the Ministry's documents" (135). She argues (51) that the criteria for this software are unrealistic and adds:

Not only do I think the criteria cannot be met, but as significant is the fact that the terms "lessonware" and "courseware" are regularly used in speaking about the software that should be developed. "Courseware" is defined as "materials analogous to a textbook" and "lessonware" as "a small unit of instruction corresponding to one or two lessons" (p. 19). It is interesting to note that it is "anticipated" that "courseware will be part of a total educational package" consisting of "accompanying text, teacher's manual, student's workbook (and a) guide to courseware".

Ontario in 1983, therefore, was advised to preserve the traditional curriculum with a mechanized and purportedly more efficient version of the traditional, text-based model of teaching. The software may produce somewhat improved traditional results but will not be used to facilitate new ways of learning.

Cummins and Sayer (1990:3-4) also suspect proposed curriculum "reforms" proposed in such reports as the U.S. "A Nation at Risk", considering them retrogressive rather than progressive and calculated to entrench the traditional transmission model of teaching and "co-opt" technology to the ends of the "reformers":

The extremely powerful computer-based technology that has become available to most schools will continue to be used for socially and pedagogically trivial purposes, except in the case of some elite groups of students. Within transmission approaches to pedagogy, the
focus of educational computing will continue to be on how to transmit "the basics" more efficiently to students. This focus subverts (probably intentionally) the tremendous potential of the new technology to facilitate a process of student empowerment and ultimately social transformation through the development of international learning networks.

As the following section documents, there have been some well conceived and executed projects, including two reported by Cummins and Sayer, but they have not "taken" in the school system as a whole.

**Appropriate uses of technology**

Our considerations to this point suggest three criteria for the appropriateness or otherwise of classroom uses of technology (the first two are quoted from the "Year 2000" B.C. Ministry of Education, 1989): 1) that learners "be able to employ critical and creative thinking skills to solve problems and make decisions"; 2) that they "have well developed interpersonal skills and be able to work cooperatively with others"; 3) that an application of new technology should not simply duplicate what has been done well with an older technology. Some examples can be cited.

**The CSILE project**

CSILE, described by Scardamalia, Bereiter et al. (1989), stands for a Computer-Supported Intentional Learning Environment. This system is designed to encourage learners to exert intentional control over their own learning and avoid passive line-of-least-resistance approaches. It calls for planning, monitoring, goal setting and problem solving strategies, based upon characteristics of successful learners as documented by cognitive science researchers. Students build a collective hypermedia database, collecting, organizing and sharing their thoughts in the form of pictures and written notes. It is, therefore, a learning or
classroom-study utility which can be used with all subjects and facilitates learning by cooperative knowledge construction. What is interesting, however, is the way this most appropriate application of computer-communication technology was subverted by the pressures of the print-based traditional system.

Cumming (1988:160) describes the pilot implementation of CSILE through the self reports of two experienced teachers. Throughout, two conflicts are apparent: a conflict between the way of teaching called for by the new environment and the way of teaching the teachers are used to; and a conflict between the way of learning called for by the new environment and the demands of the curriculum in place. Cumming comments and quotes the teachers:

More profoundly, the teachers saw the students' cumulative experiences in school working against the learning or use of higher order thinking (despite the obvious criticisms of conventional education this implies): "Intentional learning" (they say) "is something that has to be taught. And it has to be taught all through school and all year long. It has to be constantly reinforced. Generally speaking, children are not taught in school to monitor their own thinking, to plan their learning, or to question their knowledge. The children soon realize that it is more important, in school, to do the task, not to learn how to learn (my emphasis) . . . They're not familiar with searching or digging deeply into a topic. It's not part of their background in education. It may have been there originally when they came from home into kindergarten, but a lot of their urge to inquire has been taken out of them by their schooling."

The teachers considered computer literacy the major achievement of the project and also saw improvements in students' writing and in their ability to produce and use visuals. Both teachers and students wish the system to continue and consider even the present
implementation successful. However, it would seem that CSILE is under pressure to support traditional teaching by default rather than achieve its original objectives.

Learning networks

Cooperatively based networks dedicated to learning relevant to students have operated with print technology. Cummins and Sayers (1990:13) examine in detail one which began in the 1920s in France, based on the teaching approaches of Celestin Freinet (1896-1966). Freinet founded the Modern School Movement (MSM) in a small town in the French Alps in 1924. His work exerted considerable influence in Eastern and Western Europe and Latin America but is largely unknown to English-speaking educators because his works have not been translated into English. Freinet based his approach on the print technology of his time. He brought into the classroom the most advanced print applications of the day, the mimeograph machine and the movable type press, so that students could produce real printed and bound books:

Central to Freinet's approach was the almost daily printing of pages for students "life books." These were personal portfolios of children's writings based on their daily lives and on frequent field trips throughout the community. Life books were... bound as a book at the end of the semester. Once students were comfortable with drafting, sharing, revising, printing and publishing page after page... they began to regularly exchange their writings with a class of distant correspondents. These two phases, the organization of literacy skills development around educational technology and the sharing of writing with student correspondents, are at the heart of Freinet's critical pedagogy.

The arrangement for postal exchanges between the MSM schools was remarkably similar to today's structuring for electronic message systems. Sister Class partnerships were formed between teachers, based on common teaching interests and student grade levels.
Several Sister Classes were arranged in a Cluster to represent as many regions and countries as possible. Sister Classes engaged in: 1) monthly exchanges of culture packages of maps, photos, tapes and schoolwork; and 2) jointly executed projects involving collaborative small group activities at both sites in such areas as international journalism, science projects, community surveys, contrastive geography, and comparative oral histories. Monthly samples of exemplary work was sent to all cluster classes, involving hundreds of students, which assured students of a wide audience for their writings, including parents and other teachers both at home and in faraway locations. Having such an audience was strongly motivational in fostering a keen pride of authorship.

Freinet was no uncritical advocate of the technologies of his day. To the contrary, he thought that the mass media tended to alienate children from their social and physical environment by making them passive rather than active experiencers of it. His remedy was to give them power over these threatening technologies, to use them in active engagement with their social and physical worlds and, in doing so, "construct their personalities and reflect on their lives" (Freinet translated by Sayers). As Cummins and Sayers observe, the contemporary quality of Freinet's pedagogy is remarkable, embracing student and group-authored writing, naturalistic contexts for genuine compositions to real audiences of peers, collaborative learning and small group work, technology-mediated learning, and teachers working collaboratively as researchers in observing, experimenting, modifying and validating new approaches.

Freinet's Modern School Movement is brought up-to-date by the ORILLAS computer-based network, also reported by Cummins and Sayers, which closely follows the MSM model
except that computer technology replaces the technology of print. The structure, however, remains unchanged: pairs of Sister Classes working jointly together and making up a larger Cluster with monthly exchanges of cultural packages. Classes still exchange monthly cultural packages through the postal services, as the original MSM did, but computer-communications adds the new dimension of a direct exchange of electronic mail messages between individuals and the direct electronic distribution of written texts to the wider audience of all users.

ORILLAS was started in 1985 by a small group of Mexican, Puerto Rican and American teachers from California and New England and now includes about 60 teachers and their students from the United States, Puerto Rico, Argentina, English- and French-speaking Canada, and Mexico. It forms elementary and secondary Sister Class partnerships from two groups: 1) second language acquisition and deaf education teachers in the United States; and 2) teachers of any subject area in other nations. Joint projects have included investigations of water distribution systems in various countries, online discussions with expert bilingual journalists, cultural investigation of proverbs, and various projects between Puerto Rican mothers in New York and Puerto Rico. Second language acquisition is a major focus as is cooperative learning techniques to promote positive intergroup relations and foster cross-cultural understandings.

ORILLAS stands as an exemplar of the type of approach to computer applications in schools that Cummins and Sayers advocate. It is based, not on technology, but on a critical pedagogy that is "consistent both with social constructionist views of learning processes and whole language or interactive experiential perspectives on literacy development" (25). It recognizes, however, the centrality of technology in society, and uses that technology in the
form of computer-mediated learning networks. Used in this way, technology empowers all students but particularly minority students, rather than being the preserve of a dominant group. It moves away from the transmission model of teaching with its notion of predetermined facts to be conveyed by the teacher into the heads of the students. Instead, students themselves construct meaning by cooperative work on projects relevant and meaningful to them, which are directly and actively under their control.

Multimedia (hypermedia)

Multimedia is the term used in current writing about computers to mean much the same as the alternative term, Hypermedia. "Hyper" unfortunately carries the connotation of "hype" (which is far from absent in some computer writing). However, in the context of "Hypermedia", it is the Greek prefix "hype-" used in scientific writing to mean "extended" or "generalized", as in "hyperspace", "hyperdimensionable" etc. Thus "Hypertext" is an extended or generalized form of text as "Hypermedia" is an extended or generalized form of media, i.e. text plus pictures, graphics, sound, animation and video etc. Hypermedia represents a truly idiomatic use of the computer to organize and present material in a way not possible by other technologies -- not by print alone, not by video alone, not by audio alone (Lanham, 1993; Landow, 1992, Landow & Delany, 1991, Pea, 1987). Hypermedia applications can vary from single lesson plans authored by teachers to large projects created by interdisciplinary teams, e.g. Bank Street College's Voyage of the Mimi, aired on PBS channels and portraying a scientific investigation of whales; or Stanford's Shakespeare Project, under development, using an interactive videodisk computer program to bring students into touch with all aspects of theatrical creation (Ambron & Hooper, 1988). The technology is dazzling (as are the
costs, although these are falling) and the power of well developed systems is impressive. The learner has a wealth of materials at his command from encyclopedia articles to computer simulations to full length movies, all linked so that the voyager in this sea of information can chart any course he or she likes from any point in the multimedia file. Multimedia is, however, an emerging technology (Pea, 1987). We have not yet learned fully how it affects learners nor how best to use it. HyperCard, as used by the students in our case study, is a pioneering but very elementary instantiation of multimedia.

The Internet

The full potential of multimedia to realize the "learning networks" described by Cummins and Sayers is beginning to be seen in the current explosive growth of the Internet (Rheingold, 1993; Smith & Gibbs, 1994) which puts the user in touch with databases and services across the globe. Many of these databases incorporate Hypertext or Hypermedia and their providers offer user-friendly graphical user interfaces (GUIs) instead of unmemorizable cyphers, dear to the heart of only computer scientists and engineers, that have characterised the use of communication networks until now. In this type of use would seem to lie the true power of the computer, married to telecommunications, for education. However, like hypermedia, networking on the Internet model is also an emerging technology and we have much to learn to use it appropriately and effectively. In particular, the Internet is unsupervised and somewhat chaotic: nobody can give an index of sources, which expand daily; and nobody can say who exactly are the subscribers although their numbers grow daily and include as well as university researchers in all disciplines, merchants, vendors of all types of services, and such lower forms of life as hate-mail merchants and pornographers.
What is needed is an "Edunet" carved out from the Internet and made available on a managed basis for schools, drawing on the expertise of universities world-wide who have used the Internet extensively over the past decade. The "Global Schoolhouse Project", sponsored by the U.S. National Science Foundation with support from AT&T and other corporate sponsors and the University of Illinois, is an initiative in this direction (Vacca, 1995). Its objectives include: demonstrating use of the Internet as a classroom tool for research and collaborative learning, teaching students to become active learners and information managers, providing training and support for teachers, and encouraging business, government, higher-education and community partnerships to integrate technology for the classroom.

**Cognitive effects of hypermedia**

Pea (1987) sees hypermedia as redefining the media experiences involved in reading, writing, watching and listening and redefining what "literacy" itself means. He traces the history of hypermedia from the foundation notion of hypertext, a textual database conceived of as a web, with pointers provided throughout the text to associated information in other places within the database. If similar pointers were provided in a linear text, they would direct the reader to other texts on bookshelves or in library stacks. The concept of hypermedia is the idea of hypertext generalized to include other media: audio (voice, sounds, music), video (graphics, animation, film, photographs, drawings) and programs (simulations, microworlds, interactive demonstrations). Hypermedia is made possible by the use of computer controlled optical disk storage systems which provide access within a single
hypermedia system to massive files of text, images and film. It is another example of the power of computers to reorganize rather than merely amplify mental functioning (Pea, 1985).

Few empirical studies are available for guidance. Pea suggests issues to be addressed: 1) How will users "keep track of where they are going in these vast information grottoes" and not be distracted, become lost and suffer cognitive entropy"? 2) Although cognitive science holds that multiple representations of knowledge are more effective than single, we have no experience of the unconstrained multiple representations of hypermedia nor how they will function together in an individual's cognitive processes. 3) How does one find with minimum cost what one is looking for in these "electronic information jungles"? 4) What is the nature of multimedia literacy? How will it affect our notions of reading and writing as we move into paperless environments? Single symbol systems have profoundly impacted our minds and society. What will be the impacts of hypermedia multiple symbol systems?

Heller (1990) makes many of the same points in speaking of Hypermedia Assisted Instruction (HAI), defined as the application of hypermedia techniques to educational software. Its advantages are: ease of creating and tracing references in a body of material, modularizing the information, and being able to keep many threads of instruction alive at once. These advantages bring problems with them. One is disorientation and cognitive overload, leading to flagging commitment and unmotivated rambling. Related to this are learners' problems of knowing where they are in the system, how big the system is, and how to get somewhere else. The ability for unlimited browsing, one of the strengths of hypermedia, also presents problems, e.g. causing users to overestimate how much of the system they have seen. Then, while browsing is presented as a way out of cognitive overload,
experience shows that some users use browsing to avoid cognitive overload rather than deal with it.

Heller notes that Hypermedia shares many of the characteristics of discovery and incidental learning. Therefore independent research in these areas may point to solutions to hypermedia design and use problems. For example, research indicates that specifically stating objectives and making explicit the hierarchy of knowledge have positive value for discovery learning. On the other hand, research on cognitive style has found that students with high anxiety or overly concerned with what others think of them are not well served by discovery learning. This suggests that developmental studies are needed to document students' experiences with HAI by profile, including age, maturity, attitudes and cognitive style. We may therefore conclude that, while hypermedia in its nonlinear structure and multi links would appear well related to knowledge construction and discovery learning, many problems remain to be answered before the classroom teacher can know how best to harness its power.

Finally, granted that large hyper/multimedia databases can be harnessed for the use of schools, and that some school version of the Internet can be funded (two large "granteds"), how can one be sure that these powerful tools, using technology appropriately, will not suffer the fate of CSILE, suborned to serve the familiar and comfortable agenda of the traditional transmission model of teaching based upon the well entrenched technology of print?

**The future**

We have shown that a considerable body of research in education generally and in second language acquisition in particular is critical of the traditional teacher-fronted, I-R-E/recitation, transmission model of teaching. Those that advocate a knowledge construction
rather than a knowledge transmission approach argue that students learn to do by doing and to speak by speaking and should therefore be actively engaged in meaningful tasks for which they take responsibility, rather than sitting passively listening to teacher-dominated discourse. In this way they really learn and internalize content and language. This is the process of knowledge construction called by Gattegno (1970) "the subordination of teaching to learning". The teacher's role changes radically, as pointed out by Weir (1989), from the authoritative source of textbook knowledge to counsellor and coach jointly engaged with the students in the knowledge construction process.

The traditional system has served well in the past. Transmission teaching has indeed transmitted knowledge and values. The three “Rs” have given any motivated person the basic tools for advancing towards any goal in society he or she may have chosen. All adults now living who have completed their basic education are products of that system, including those at the top of their respective professions and occupations. Without the basic ability to read, write and count, none would have reached those levels. However, many now urge that more now is needed, particularly the ability to function effectively with computers in a networked environment. Apart from this approach facilitating a knowledge construction approach to learning, it also introduces students to the way information is increasingly obtained and presented in the world of work and the way it is likely to be accessed in the home. Already electronic information competes with newsprint. Anyone with a modem has free access to local bulletin boards for information on entertainment, restaurants and other local services; and on the Internet, paid access to international news services, up-to-the minute sports news, stock market information and an infinity of special interests.
All of this is but prelude. Major corporations in telecommunications, computers, cable/TV and software are investing billions of dollars in partnerships, mergers and takeovers to be the first to put a black box on our TV sets to make our TV/computer monitor the gateway to a networked world for every type of electronic activity from downloading movies and playing computer games to taking educational courses. As the telephone became interactive radio, so the TV with black box becomes interactive TV. Perhaps the future will not work out exactly in this way. What seems certain, however, is that a delivery system of some sort will be devised to exploit, certainly the commercial, and perhaps the educational potential of universally available global information. Over time this may well cause as large an upheaval in our way of perceiving and thinking as the technology of print caused to the settled thinking of the Middle Ages (Menzies 1989; Toffler 1990, 1981, 1971).

The school system, like the rest of the world, is caught in this unsettling period of transition between two major technologies of communication. Moving from an oral to a manuscript culture was unsettling; moving from a manuscript culture to a print culture was even more unsettling, introducing as it did the modern world as we have known it; moving from the "modern" world of print to a "postmodern" world of electronic information may be more unsettling still. But our present school system is the house that print built. Implementing accommodating changes to adjust the system to new technology misses the point. The system does not adjust but subverts the new means to serve the old ends. Sooner or later, for better or for worse, the new technology will build a new house. A not unlikely scenario is that the old house will stand firm until a new generation has emerged that has known nothing but the
world created by the new electronic media. That generation will feel at home in the new house and out of place in the old. The old house will then become a monument to history.

"There are profound consequences of this paradigm shift for what we do in education" says Pea (1985:176):

To know is no longer to have knowledge in one's own memory, but to be able to effectively search for, find, and use the information one needs for particular purposes . . .

With our predominantly fact-oriented curricula, we are hardly preparing our children for the lifelong learning the information age requires. Regardless of our media, our aim should no longer be the hopeless task of pouring an ocean of facts through a straw into the child's memory in the hopes of the well bucket coming up full when it is needed. Instead we can work to help children learn for themselves how to seek out, organize and use information for different purposes.

Knowledge transmission is the paradigm appropriate to print-based, fact-oriented curricula; knowledge construction is the paradigm appropriate to electronic-based, process-oriented curricula. The problem is, as many researchers see it, that although we have some process-oriented words in our curricula, the curriculum core remains fact-oriented, as does our educational evaluation system and continuing teaching practices. Introducing process-oriented changes in a fact-oriented environment goes against the grain. Therefore it is problematical whether those changes will "take" or endure. The classroom environment itself must change.
CHAPTER 3: STUDENT ACTIVITY SAMPLING RESULTS

We will first look at the results of activity sampling of students' time spent on the Our World unit, and then at the students' evaluation of their group and solo work modes and their different working environments.

Scheme of presentation

The theoretical basis of activity sampling has been described in the preceding chapter 2B in the section on Work Study. The type of activity sampling used was Fixed Interval (or Systematic Random) Sampling, with a fixed interval of approximately two minutes: i.e. each student's activity was observed and recorded about every two minutes. Six single and five double periods were observed in the library, eight double periods in the computer lab and four double and three single periods in the homeroom. The computer lab and library periods were Our World periods throughout the study. The homeroom periods were periods from other units with a similar content demand to Our World (Our World was not taught in the homeroom), observed at different times throughout the study. In addition, four tutor/tutee pairs were sampled from video recordings of the tutoring sessions held at the end of the Our World unit. Results are presented at various levels of aggregation and by two sets of activities.

Levels of aggregation

1. Total students for all periods observed in:
   a. Computer Lab;
   b. Library;
   c. Homeroom.

2. Total students for each period observed in Computer Lab, Library and Homeroom.

3. Each group for all periods observed in Computer Lab and Library.
4. Each student by group for each period observed in Computer Lab and Library.

Sets of activities

1. Students' work modes

   a. Teacher-led activity: teacher-fronted, whole-class work.

   b. Solo: students working on their own.

   c. Solo with teacher: students working individually with a teacher.

   d. Group work: students working in their groups of two or three.

   e. Group work with teacher: students working in their groups with a teacher.

   f. Working with peers: students working out of their groups with peers.

   g. Pause: time out of the room, waiting for a teacher or not on assigned task.

   h. Other: time spent at library shelves, the board, or the computer lab printer.

2. Students' communication modes

   a. Speaking: time spent in the act of talking or (in the homeroom) reciting.

   b. Reading: time spent reading notes or printed material (not computer screen).

   c. Writing: time spent writing on paper (not computer screen).

   d. Other: time spent on everything else, including listening (a large part of whole class activity), watching, reflecting, moving around, pause time, solo computer work in the computer lab and working with the library computer.
Total students for all periods

By student work mode

Figure 3.1 shows results for all students for all periods observed by work mode (whole-class work, student task activity, and pause time) in three learning environments (homeroom, computer lab and library).

**Figure 3.1**

**ACTIVITY SAMPLING: OUR WORLD UNIT**

Total Student Time by Learning Environment & Work Mode

Accuracy limits
Activities are calculated within 95% confidence limits:

**Homeroom** based on 3,876 observations:
Whole Class, 74% ± 1.4%; Student Task, 25% ± 1.4%; Pause, 1.4% ± .4%.

**Computer Lab** based on 2,749 observations:
Whole Class, 20% ± 1.5%; Student Task, 73% ± 1.7%; Pause, 7% ± 1.0%.
Library based on 2,024 observations:
Whole Class, 23% ± 1.6%; Sharing Time, 7.0% ± 1.0%; Student Task, 62% ± 1.9%;
Pause, 8% ± 1.0%.

Comments

The dominant activity in the homeroom is whole-class work (74%) with student task making up most of the rest (25%). This pattern is approximately reversed in the computer Lab where whole-class work is 20% and student task is 73%, and in the library where whole-class work is 23% (or 30% with sharing time) and student task is 62%. The higher proportion of student task in the computer lab and library is to be expected as these environments are created primarily for the purpose of students engaging in the special activities they make possible. Pause time is higher in the computer lab (7%) and library (8%) than in the homeroom (1.4%), reflecting the more controlled structure of whole-class work. About half the pause time in the computer lab was spent waiting for help from the teacher.

Communication between groups in the library took place in special whole-class "sharing times". When a group had finished writing up its topic, the librarian had all the students sit down in a circle on the floor so that the group in question could report its progress. The students in the other groups were encouraged to ask questions to challenge the students who were reporting and so generate discussion with them. Sharing time in the library represents 7.0% of total time. It could be regarded as an informal whole class session with the emphasis on communication from the students rather than by the teacher.

Student task breakdown. Figures 3.2 and 3.3 show the breakdown of student task, which predominated in the computer lab and library.
Figure 3.2

ACTIVITY SAMPLING: OUR WORLD UNIT
COMPUTER LAB: Break-Out of Student Task Time

Figure 3.3

ACTIVITY SAMPLING: OUR WORLD UNIT
LIBRARY: Break-Out of Student Task Time
Student task breaks down into group work, working with peers (i.e. with peers outside of a student's group), and solo work. Group work is the major student task activity in both computer lab and library and taken together with working with peers is approximately the same (52%) in both environments. Solo work is more in the computer lab (20%) than library (10%) and reflects a difference in the two environments. In the computer lab, students were at times assigned to work solo at their own computers on the HyperCards for which they were individually responsible. In the library, they worked solo only intermittently (e.g. reading library books and writing their notes) while remaining and freely conversing in their groups.

Another difference in the two environments is reflected by the virtual absence of working with peers outside of groups in the library. In the computer lab, students were encouraged to check the work of other groups in order to share ideas in different ways of using the computer to set up and display their content material. In the library, the focus was on the content material itself: because each group had responsibility for its own unique content, the students focused on that and had little to gain by checking out with other groups.

By student communication mode

Figure 3.4 shows results for student talk in Our World activities carried out in the computer lab and library and in similar content activities carried out in the homeroom.
Accuracy limits

Activities are calculated within 95% confidence limits:

Homeroom based on 2,404 observations: Speaking, 11% ± 1.5%.

Computer Lab based on 2,024 observations: Speaking, 13% ± 1.5%.

Library based on 2,155 observations: Speaking, 16% ± 1.6%.

Peer Tutoring based on 196 observations: Speaking, 56% ± 7.1%.
Comments

Student speaking time approximately correlates with the amount of group work, working with peers and sharing time (in the library) because these activities, as distinct from whole class and solo work, most stimulate student talk. This is shown in Figure 3.4a.

Student talk is lowest in whole

Figure 3.4a

class in the homeroom (11%) where group/peer work also is lowest (25%); higher in the computer lab (13%) and library (16%) where group/peer work is higher (53-56%); and highest of all in peer tutoring (56%) where group/peer work is highest (100%).

Working in groups and with peers facilitates student talk but these activities also include components that do not compel talk, e.g. reading and writing on paper and/or screen, consulting notes, and reflection. Talk, however, is the whole point of peer tutoring: speaking and listening are the sole components except for some silent reflection and minimal note-taking. Peer tutoring is therefore an optimum activity for the generation of student talk.
Total students for each period

Computer Lab

Figure 3.5 shows results by work mode for all students for each period observed.

Accuracy limits

Activities are calculated within 95% confidence limits. For the average, based on 2,749 observations, they are:

Whole Class 20.3% ± 1.5%; In Group 46.4% ± 1.9%; With Peers 6.1% ± .9%; Solo 20.4% ± 1.5%; and Pause 6.8% ± .5%.

For each period, accuracy limits are wider because of the lower number of observations. Taking Period 5 as an example, based on 380 observations, they are:

Whole Class 36.8% ± 4.9%; In Group 12.4% ± 3.4%; With Peers 13.2% ± 3.5%; Solo 31.6% ± 4.8%; Pause 6.0% ± 2.4%.

Davidson, Hines and Newberry (1960) point out that fixed interval or systematic activity sampling (SAS), which was used, has an accuracy equivalent to stop watch measurement provided that the sampling intervals (in this case, 2 minutes) are smaller than the activity duration observed. Most observations made satisfy this condition. It is, however, possible for pause time to create exceptions. It is possible for a student to pause for less than two minutes and return to an activity for less than two minutes before pausing again.

Therefore I have used, conservatively, the binomial distribution variance formula applicable to simple activity sampling rather than the variance formula applicable to SAS. The actual accuracy attained would lie somewhere between the results of the two formulas and is therefore greater than I have stated.
Comments

The first period observed was the second computer lab period of the unit. The first four periods observed had a similar pattern: a brief whole-class introduction followed by group work. Harry set out the tasks to be accomplished and demonstrated them either on his instructor's computer, networked into the students' computers so that they could see what was happening on their own screens, or on one student's computer with the rest of the students gathered around, The class then went into groups for the rest of the lesson.
The first period had higher than average working with peers. This was caused by a complication when the Our World students (the "experts") helped the other half of the class (the "beginners") to retrieve a new program (MAC Paint). One of the beginners accidentally locked up the disk drives of his and two other machines. The experts were recalled and Harry fixed the problem. The second period had higher than average solo work. This was because two groups had only one member present (who therefore worked solo) as the other group member(s) were away at a high school orientation. This period also had higher than average pause time occurring mostly in the two groups who had three students. In one case two students worked well together with the third student "odd boy" out and therefore frequently not on task; in the other case one girl incited giggling among the three of them, a pattern which repeated itself in other periods.

The fifth period marks a change in pattern. In the first four periods, the students worked on the "Question and Answer" cards in group mode. With these almost finished, they moved on to the "Topic" cards for each of which an individual student was responsible. Therefore group work decreases and solo work increases. Whole class work also increases because Harry introduced the students to new HyperCard features for copying a new template for the Topic cards onto their machines, for copying their pictures onto the template, editing the pictures, and entering text. Working with peers increases in this fifth period because Harry encourages the students to look at each group's Question and Answer cards to see if they can answer the questions. In the sixth period, Harry sees each group in turn to check for consistency of format, discuss problems and give direction. This takes longer for some groups than others and causes higher than average pause time because different groups at different
times are waiting to see Harry. The last two periods observed (7 and 8) are marked by a high level of concentration and activity. The pressure is on to get enough cards finished to print an Our World booklet for the forthcoming Open House. There is also lost time to make up because of two cancelled library periods (caused by other school events) so that some of the drawing and text work normally done in the library has to be completed in the computer lab. Pause time in these two sessions is less than 1%.

Three sessions remained, which were not activity-sampled, followed by the last two sessions which were devoted to peer tutoring.

Library

Figure 3.6 shows results by work mode for all students for each period observed.

Accuracy limits

Activities are calculated within 95% confidence levels. For the average, based on 2,735 observations, they are:

Whole Class 22.9% ± 1.6%; In Group 51.9% ± 1.9%; Sharing Time 7.0% ± 1.0%

Solo 10.3% ± 1.2%; Pause 7.9% ± 1.0%.

The accuracy limits for each period are wider because of the lower number of observations. They are of the same order as those stated above for Period 5 in the computer lab.
Comments

Unlike activity in the computer lab, which moves from periods of predominantly group work to periods of greater solo work, activity in the library maintains a fairly even pattern of group and solo work throughout all periods with group work predominating. Whole class work is slightly higher on average in the library (23%) than the computer lab (20%). It is particularly high in periods 4 and 6 because in both periods Harry had a whole class session to help students relate their library work to their HyperCard tasks in addition to Jim's usual review and outline of library objectives. There was no whole class time at all in period 11.
which was marked by intensive group work to get work finished for the impending Open House. Distinctive to the library are Sharing Time sessions. These are occasions when all the students gather in a circle, sitting on the floor, to hear a group present its completed work to date, ask questions and discuss. They are not high on average (7%) but do represent a significant proportion of the time in the periods in which they are held: 24%, 32% and 28% in the three periods 2, 3 and 7.

Pause time is slightly higher on average (8%) than in the computer lab (7%) and is particularly high in periods 1, 2 and 7. As in the computer lab, this was mainly with the group of three boys with the "odd boy" out and the group of three girls with the giggling complex.

Homeroom

Figure 3.7 shows results by work mode for all students for each period observed.

Accuracy limits

Activities are calculated within 95% confidence limits. For the average, based on 3,876 observations, they are:

Whole Class 73.9% ± 1.4%; Solo/Group 24.7% ± 1.3%; Pause 1.4% ± .4%.

Comments

The homeroom, as would be expected, has different characteristics from the special purpose computer lab and library environments. Whole class work predominates. This is not, however, what is often thought of as traditional teacher-fronted work. I quote from my observation notes on the first period observed:
I arrive to find the class sitting in a semi-circular group on the floor at the top of the room with Karen on a stool by a small table in front of the blackboard. The feeling is light, there's good humour in the group and all are attentive. The dynamics are much better with the students sitting close together and close to her rather than isolated at their individual desks in rows over the whole (large) room. The topic is the atmosphere and the environment . . . The students maintained a good level of attention throughout with little or no observable pause time.

Also different is the category Student Task. When the students were not in whole class mode they sometimes sat in three loose groups of 7-8 students with their desks moved and arranged so that they were close together and facing each other. At other times they sat in
self-selected pairs on a "buddy" system. Karen encouraged them to discuss topics and her questions with each other and then write out or draw what was required in their individual notebooks. There was no large group or pair group end-product. Each student was responsible for his or her own work. Some students sometimes discussed with others extensively; others sometimes chose to work alone. With 21 students and these different arrangements, it was not practical within a 2-minute observation cycle to consistently distinguish between "solo work" and "working with peers". However, working with peers was encouraged.

As shown in Figure 3.4, there was more student talk in the computer lab (13%) and library (16%) where group work predominated, than in the homeroom (11%) where whole-class work predominated. Pause time in the homeroom was noticeably minimal.
Each group for all periods

By student work mode

Figures 3.8 and 3.9 show results for each group by work mode for all periods observed in the computer lab and library.

Accuracy limits

Table 3.1: Activity Sampling: Accuracy limits for Groups by Work Mode.

<table>
<thead>
<tr>
<th></th>
<th>GROUP 1</th>
<th></th>
<th>GROUP 2</th>
<th></th>
<th>GROUP 3</th>
<th></th>
<th>GROUP 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Obs</td>
<td>± %</td>
<td>% Obs</td>
<td>± %</td>
<td>% Obs</td>
<td>± %</td>
<td>% Obs</td>
<td>± %</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total # Obs</td>
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<td>491</td>
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<td>2.7</td>
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<td>45.4</td>
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<td>50.3</td>
<td>3.3</td>
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<td>6.3</td>
<td>2.2</td>
<td>5.7</td>
<td>1.6</td>
<td>4.9</td>
<td>1.8</td>
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<tr>
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<td>24.7</td>
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<td>17.6</td>
<td>2.5</td>
<td>19.1</td>
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<tr>
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<tr>
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<td></td>
<td></td>
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<td></td>
</tr>
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<td>3.4</td>
<td>46.5</td>
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<td>7.3</td>
<td>2.2</td>
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</tr>
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<tr>
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<td>1.7</td>
<td>13.5</td>
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<td>6.0</td>
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</tr>
</tbody>
</table>
Comments

Computer Lab. Group 1 (3 boys) had more pause time (9%) than the other groups. Off-task time (7%) accounts for most of this and is mostly due to one boy, Charley, who was "odd man out". The other two worked together while he tended to wander off. Group 2 (2 boys) had least pause time (5%) of which only 2% was off task. They tended to work solo at their own computers (25%) more than the other groups (17-22%). Group 3 (3 girls) had most group (50%) and least solo work (18%) but were closely matched by Group 4 (2 girls) with 48% group and 19% solo work. Group 4 had the next highest pause time (7%) to Group 1. However, rather than off task, most of this was waiting time (5.2%). Ivy and Jeannie, who
made up this group, were two of Karen's "quiet ones". They would frequently sit waiting for
Harry to be free rather than attract his attention as vigorously as the other groups.

**Figure 3.9**

![Activity Sampling: Our World Unit](image)

**Library.** Group 4 (2 girls) had less group work (47%) and more solo work (17%) than
the other three groups (51-55% group work, 6-10% solo) because they did more reading and
writing on their own. This reflected particularly Jeannie's natural tendency to work on her
own, leaving Ivy with little choice than to do the same. As in the computer lab, this group
had more waiting time (3%) than the others, amounting to about half their pause time (6%).
Group 3 (3 girls) had more pause time (14%) than the other three groups (4-6%). Most of this
was off task (12%), reflecting their tendency to "have fun", mostly at the instigation of Hetty.

Group 1 (3 boys) had less pause time (6%) than in the computer lab. Most of this was off
task (5%), again mostly attributable to Charley, the "odd man out". As in the computer lab,
Group 2 (2 boys) had the least amount of pause time (4%). They worked together particular
well, as perhaps reflected in their group time (56%) which was higher than in the other three
groups (54%, 51%, 47%).

By student communication mode

Figures 3.10 and 3.11 show results for all students by group and communication mode
for all periods observed in the computer lab and library.

Accuracy limits

Table 3.2: Activity Sampling: Accuracy limits for Groups by Communication Mode

<table>
<thead>
<tr>
<th>Activity</th>
<th>GROUP 1</th>
<th>GROUP 2</th>
<th>GROUP 3</th>
<th>GROUP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Obs</td>
<td>± %</td>
<td>% Obs</td>
<td>± %</td>
</tr>
<tr>
<td>Computer Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # Obs</td>
<td>603</td>
<td>346</td>
<td>645</td>
<td>430</td>
</tr>
<tr>
<td>Speaking</td>
<td>13.3</td>
<td>2.8</td>
<td>12.7</td>
<td>3.6</td>
</tr>
<tr>
<td>Library</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # Obs</td>
<td>630</td>
<td>428</td>
<td>669</td>
<td>428</td>
</tr>
<tr>
<td>Speaking</td>
<td>10.7</td>
<td>2.5</td>
<td>12.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Reading</td>
<td>6.1</td>
<td>1.9</td>
<td>10.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Writing</td>
<td>7.3</td>
<td>2.1</td>
<td>6.4</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Comments

Computer lab. Reading and Writing in these charts refers to reading books and notebooks and writing in notebooks. There was no measurable amount of this in the computer lab although there was extensive reading and writing on screen, which was not measured. Group 4 (two of Karen's "quiet ones") spoke least (9%) while Group 3 (the three exuberant girls) spoke most (16%). The two boys' groups were in between at 13% each.

Library. The same pattern shows in the library: the two girls spoke least (10%), the three girls spoke most (15%) and the two boys' groups were in between at 11% and 13%. The three girls read the least (2%) and wrote the most (9%). When they got down to work, they were highly productive with minimal resource material. The two boys read the most (10%). The boys' groups and the two girls were fairly evenly matched in writing (6-7%).

Each student by group for all periods

By Work Mode

Figures 3.12 and 3.13 show results for each student in group order for all periods observed in the computer lab and library. If a student was absent in any period then results for all students in the absent student's group have been excluded so that group dynamics are not distorted. This adjustment has excluded results for two groups from one computer lab period, two groups from two library periods, and one group from one library period.
Accuracy limits

Table 3.3: Activity Sampling: Accuracy limits for Students by Work Mode

<table>
<thead>
<tr>
<th>Group and Student</th>
<th>Total # Observations</th>
<th>Group % Obs</th>
<th>± %</th>
<th>Solo &amp; Non-Group % Obs</th>
<th>± %</th>
<th>Pause % Obs</th>
<th>± %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPUTER LAB - STUDENT TASK</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/A</td>
<td>191</td>
<td>62.8</td>
<td>7.0</td>
<td>29.9</td>
<td>6.6</td>
<td>7.3</td>
<td>3.8</td>
</tr>
<tr>
<td>1/B</td>
<td>191</td>
<td>58.6</td>
<td>7.1</td>
<td>36.7</td>
<td>7.0</td>
<td>4.7</td>
<td>3.1</td>
</tr>
<tr>
<td>1/C</td>
<td>192</td>
<td>52.1</td>
<td>7.2</td>
<td>20.8</td>
<td>5.9</td>
<td>27.1</td>
<td>6.4</td>
</tr>
<tr>
<td>2/D</td>
<td>190</td>
<td>59.0</td>
<td>7.1</td>
<td>34.7</td>
<td>6.9</td>
<td>6.3</td>
<td>3.5</td>
</tr>
<tr>
<td>2/E</td>
<td>190</td>
<td>58.4</td>
<td>7.2</td>
<td>35.8</td>
<td>7.0</td>
<td>5.8</td>
<td>3.4</td>
</tr>
<tr>
<td>3/F</td>
<td>237</td>
<td>62.9</td>
<td>6.3</td>
<td>27.0</td>
<td>5.8</td>
<td>10.1</td>
<td>3.9</td>
</tr>
<tr>
<td>3/G</td>
<td>236</td>
<td>57.6</td>
<td>6.4</td>
<td>36.5</td>
<td>6.3</td>
<td>5.9</td>
<td>3.1</td>
</tr>
<tr>
<td>3/H</td>
<td>236</td>
<td>69.9</td>
<td>6.0</td>
<td>24.6</td>
<td>5.6</td>
<td>5.5</td>
<td>3.0</td>
</tr>
<tr>
<td>4/I</td>
<td>218</td>
<td>61.9</td>
<td>6.6</td>
<td>29.8</td>
<td>6.2</td>
<td>8.3</td>
<td>3.7</td>
</tr>
<tr>
<td>4/J</td>
<td>219</td>
<td>60.3</td>
<td>6.6</td>
<td>31.0</td>
<td>6.3</td>
<td>8.7</td>
<td>3.8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2100</td>
<td>60.6</td>
<td>2.1</td>
<td>30.6</td>
<td>2.0</td>
<td>8.8</td>
<td>1.2</td>
</tr>
</tbody>
</table>

| **LIBRARY - STUDENT TASK** | | | | | | | |
| 1/A               | 165                  | 81.2        | 6.1 | 12.7                    | 5.2 | 6.1         | 3.7 |
| 1/B               | 165                  | 77.6        | 6.5 | 21.2                    | 6.4 | 1.2         | 1.7 |
| 1/C               | 165                  | 69.1        | 7.2 | 13.9                    | 5.4 | 17.0        | 5.8 |
| 2/D               | 179                  | 82.1        | 5.7 | 11.2                    | 4.7 | 6.7         | 3.7 |
| 2/E               | 178                  | 82.6        | 5.7 | 12.4                    | 5.0 | 5.0         | 3.3 |
| 3/F               | 198                  | 73.2        | 6.3 | 6.1                     | 3.4 | 20.7        | 5.8 |
| 3/G               | 196                  | 69.4        | 6.6 | 16.8                    | 5.3 | 13.8        | 4.9 |
| 3/H               | 202                  | 70.8        | 6.4 | 6.4                     | 3.5 | 22.8        | 5.9 |
| 4/I               | 181                  | 67.4        | 6.6 | 22.1                    | 6.2 | 10.5        | 4.6 |
| 4/J               | 180                  | 67.2        | 6.6 | 25.0                    | 6.5 | 7.8         | 4.0 |
| TOTAL             | 1809                 | 73.9        | 2.1 | 14.6                    | 1.7 | 11.5        | 1.5 |
Figure 3.12

**ACTIVITY SAMPLING: OUR WORLD UNIT**

**COMPUTER LAB: Each Student by Group & Student Task, All Periods**

*Student Task Work Mode*
- Group
- Solo
- Pause

1. Albert
2. Bobby
3. Charley
4. Denis
5. Eric
6. Flo
7. Gladys
8. Hetty
9. Ivy
10. Jeannie
11. AVGE

Figure 3.13

**ACTIVITY SAMPLING: OUR WORLD UNIT**

**LIBRARY: Each Student by Group & Student Task for All Periods**

*Student Task Work Mode*
- Group
- Solo
- Pause

1. Albert
2. Bobby
3. Charley
4. Denis
5. Eric
6. Flo
7. Gladys
8. Hetty
9. Ivy
10. Jeannie
11. AVGE
Comments

Results at the individual student level, as shown by Figures 3.12 and 3.13, show more clearly the nature of differences between the groups and how the individual students contributed towards them. Taken together with qualitative observations, a number of points can be made which indicate the variety which lies concealed beneath the average for all students in all periods and even the average for each group for all periods. Even more variety would be shown by data for each student for each period. However, the data for each student for all periods support well enough observations on the characteristics of each group and its members.

Both in the computer lab and library, the two-student groups (#s 2 and 4) were more cohesive than the three-student groups. In both cases the individuals in each pair show close to the same pattern for group and solo work. Observation corroborated that they worked steadily and harmoniously together. In the computer lab, their group times (boys 58-59%; girls 60-62%) are approximately equal to the average (61%). In the library, the two-boys of group #2 have most group time (82%, 83%) well exceeding the average (74%) and the least pause time (3%) for their group as a whole. The two-girls of group #4 - two of Karen's "quiet ones" - have least group time (67% each) well below the average (74%) and more pause time (8%, 11%) than the two boys (5%, 7%). The older girl, Jeannie, would frequently read and become apparently oblivious to the presence of her partner, Ivy, whose face would downturn in a look of unhappy frustration. As a result these two did more solo work (22%, 25%) than the average (15%) in contrast to the two boys (11%, 12%) who did less solo work (11%, 12%) and more group work. The two girls were good friends and cooperated well when they
did work together. Their pause time (8%, 11%) was more than the two boys (5%, 7%). This was because they spent more wait time, remaining quiet rather than calling attention to themselves.

The two groups of three were less well integrated. In both computer lab and library, Charley, the third member of the three-boys group, showed himself as "odd man out" with excessive pause time (27% computer lab, 17% library). He was tolerated but not well liked by his partners. He would thrust himself forward and respond to rebuff with criticism. The other two would ignore him and get on with the group task by themselves. Charley would then wander off and make a nuisance of himself with the girls. The other two boys would complain about Charley not doing his fair share of the work, especially in the library. As a whole, the three boys did not work well in group mode. Rather than work cooperatively and divide up their tasks, e.g. one call out text while another enter it and the third check, they simply took turns with one working on the complete task and the other two looking on. Their cooperation extended mostly to turn-taking. As a result of this pattern, they worked solo for varying amounts of time: 21-37% in computer lab, 14-21% in library. In both computer lab and library, Bobby worked the greatest amount of solo time (37%, 21%). He worked with single minded concentration and would frequently "get on with it" while Albert and Charley argued. Individually, Bobby had the least amount of pause time in both environments (5% computer lab, 1% library). His greater (although still small) amount of pause time in the computer lab was because of unavoidable waiting.

The dynamics of the three-girl group was different. Individually they were hard working students, applying themselves quietly to whatever task they had in hand. Collectively
they had an unfortunate propensity to giggle amongst themselves, sometimes to the point of disrupting neighbouring groups. Hetty, a quick and capable but often willful student, played the role of inciter. Flo, who had the lowest study skills, was more than willing to be diverted. Gladys, a very capable and outgoing student readily joined in as "part of the group". As time went by, Gladys more and more tended to drop out of the "fun" and work alone. This can be seen from the charts by the noticeably higher amount of solo work (37% computer lab, 17% library) and correspondingly lower amount of group work and pause time for Gladys compared with Hetty and Flo. Hetty and Flo would then carry on with their fun and work together. Sometimes they would break off from their task in hand and sometimes would carry on with it while laughing together. The amount of pause time for the group as a whole (19%) and for Hetty and Flo in particular (21%, 23%) was highest in the library where the average was 12%. In response to a teacher’s intervention, the girls would complain that the work was "so hard". Certainly their pause time was lower in the computer lab (7%), perhaps because the work - to enter and edit text and pictures - was structured by the computer itself whereas in the library the tasks of reading and composing notes were less structured and sometimes frustrating, especially for Flo.

Summary

All groups eventually turned out good work which collectively led to the production of a creditable Our World HyperCard stack. The three boys had difficulty working effectively as a group, tending to "take turns" rather than work cooperatively. Charley in particular was often out of the group altogether. The three girls could work effectively together but lost time in both environments, particularly in the library, because of their determination to "have fun"
from which Gladys gradually withdrew but Hetty and Flo continued. The two boys worked effectively together in the library. However, in the computer lab, Eric, the older boy, controlled the computer most of the time thus reducing Denis (who was highly competent with the computer) to the role of "assistant". The two girls worked effectively together in the computer lab but in the library, Jeannie, the older girl became abstracted in her own reading thus causing Ivy some frustration and somewhat higher pause time. The two girls lost time in both environments, silently waiting for help. On the whole there were more problems with the two groups of three than with the two groups of two, supporting the observation of Bork (1985) that groups of two are more effective than groups of three for mutual learning of computer-based science materials.

Students' evaluation of group work

I talked with the students on several occasions in their homeroom during spare periods. After they had been six weeks working together in groups in the computer lab (and a longer period in the library) I asked their preferences between working solo and in groups. I showed them four squares representing desks. In front of one square was a small circle representing a student working alone; in front of the next were two circles representing a pair; and so on up to a group of four as shown in Figure 3.14.

Figure 3.14: Solo and Group Seating Arrangements
Of the three boys, Albert and Bobby chose the pair arrangement. Albert said there is only enough work for two and the third one has nothing to do. Bobby said that with three or four "there's too many people" so that "it's hard to explain". Charley had his finger hovering over the "solo" square but moved it on to the pair. When I questioned him, he admitted to sometimes liking to work on his own. However, he liked the idea of a pair with "your best friend" or rather, as he qualified his statement, "you find out who is your best friend". He did not like threes or fours because "it's too much people . . . everybody has their own ideas . . . and get into fights". That certainly reflected the experience of this group of three boys.

Charley was the outsider who desperately wanted to be "inside" but did not have the social skills to attain insider status. He complained about Albert and Bobby, who got along together but not with Charley: "they're silly", he said to me, and with reference to the library, "they don't help me". "You have to give ideas" responded Bobby indignantly. Albert and Bobby both complained about Charley not doing his fair share of the work. Bobby, who was industrious and assertive, particularly clashed with Charley and produced a counter reaction from him. Albert, more passive, "put up" with him.

Of the three girls, Flo and Hetty liked a group of three best. Flo said that you get better ideas with three talking together but that four is "too many". Hetty was definite: three is "not too many and not too few". Gladys, on the other hand, liked two people best because with three people you get more argument. On one occasion I heard Gladys exclaim quite loudly to Hetty, "How can you be so selfish"! Both Hetty and Gladys had strong personalities. Gladys was older and Hetty could not manipulate her. As time progressed Gladys worked more frequently on her own while Hetty paired with the more passive and less experienced
Flo, often pausing from the task in hand while Gladys continued working. However, when the occasion demanded it all three girls could successfully work together with less discord than the three boys.

Jeannie was the only one opting for a group of four. Her reasoning was that "you can ask if you don't know" and that therefore, the bigger the group the better. Ivy, Jeannie's partner, preferred a group to working on her own and preferred three "friends" together rather than two. This may reflect her experience of Jeannie's reticence. Jeannie worked steadily but spoke little. Jeannie and Ivy together spoke less than any other group.

Denis and Eric were away during this interview session. My observation was that they worked well together and were happy on the whole with the pair arrangement. However, I did at a later time ask them why Eric did most of the computer operating. Denis said it was because "He (Eric) wont let me". Eric said "He (Denis) isn't quick enough". Eric (age 13) was two years older than Denis. They struck me very much like two brothers who liked each other, the younger respecting the older, but with some of the stresses that an age difference can bring.

From Karen's profiles of the students, from my own observations and from talking with the students, Charley and Hetty both seemed to be a frequent source of problems in group situations. These problems reappeared later in the peer tutoring sessions.

**Students' evaluation of working environments**

Over several sessions in homeroom free periods I asked the students both singly and in groups two evaluation questions at different times. The first was a two-part question to rate
on a scale of one to five how much they liked or disliked a) working in the computer lab and

library; and b) writing in the computer lab and library, using the following measures:

<table>
<thead>
<tr>
<th>DO NOT LIKE</th>
<th>DO NOT LIKE MUCH</th>
<th>DO NOT MIND</th>
<th>LIKE</th>
<th>LIKE VERY MUCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The second question was to say what they liked most and what they liked least about working in the computer lab, the library and their homeroom.

On the like/dislike scale for normal working in the two environments (question 1, part a), six preferred working in the library to the computer lab: five by a rating of "5" for the library (like very much) to "4" for the computer lab (like) and one by a rating of "4" for the library (like) to "3" for the computer lab (don't mind). One expressed no preference, rating both environments "5" (like). Three preferred the computer lab to the library by a rating of "5" to "4".

On the like/dislike scale for writing in the two environments (question 1, part b), eight preferred writing on the computer over writing in the library: five by a rating of "5" for the computer (like very much) to "4" for the library (like), one by a rating of "5" for the computer lab (like very much) to "3" for the library (don't mind) and one by a rating of "4" for the computer lab (like) to "3" for the library (don't mind). Two expressed no preference, rating both environments "4" (like).
Reasons given for these preferences included:

Albert: liked computers best, especially for typing and for being a "grown up" skill.

Charley: liked computers best because they're easier than books but also liked finding information in the library.

Eric: liked computers best, especially for typing, and wanted to get better because "my hands are slow".

Ivy: liked computers best, especially for typing which was "a good skill to learn".

Jeannie: liked computers best, especially for drawing but liked reading in the library.

Denis: liked the library best, especially for getting books to learn English, but did not like writing sentences in the library (he rated this "1", the only outright negative); he also liked drawing on the computer.

Bobby: liked the library best, especially looking out books but also liked typing on the computer.

Flo: liked the library best because no-one talked too loudly and did not like the computer lab because it was noisy. She did, however, prefer typing on the computer to writing by hand.

Gladys: liked the library best because it was quiet and she liked finding books: "you can't find information in the computer lab". However, she rated writing in the computer lab over writing in the library.

Hetty: liked the computer lab and library equally but preferred typing on the computer to hand writing.
For all of these students except Albert (nearly 4 years in the school) and Ivy (born in Canada and attended Canadian kindergarten) the wealth of books in the well stocked school library was a new experience. My observation was that they responded positively and with pleasure to the treasure trove of information they found in the well illustrated books. No one expressed dislike for the library although Denis, exceptionally competent on the computer, rated the library a 3 (don't mind). However, nine of the ten preferred typing on the computer rather than writing by hand in the library, including four who otherwise preferred the library environment. The tenth preferred the library but did not express a preference about writing.

It is easy to understand the students' preference for typing on the computer rather than writing by hand. They immediately get a pleasing-looking product which they can edit and embellish easily and then print out to get clear and good-looking hard copy. However, another factor enters into the problem of writing in the library: the task of composing the writing in the course of getting it down on paper. This is what the three girls complained about as being "so hard". The three boys also said that they found it hard finding ideas and taking notes. In the computer lab, they were mostly entering their already composed text. Therefore, while I think it true that they all preferred typing to writing, they were also saying that they found the task of composing a severe challenge - a challenge, however, that they met and which brought with it the pride of authorship once the HyperCard stack was assembled.

The replies to the second question, what they liked most and least about the computer lab, library and homeroom, largely confirmed what they had said about the computer lab and library in answer to the first question and brought new information about the homeroom.
Library. All students stated as liking best about the library that there were "lots of books" and "you can find information". Albert inferred the same thing by remarking that there was no encyclopedia in the home room. Only four of the ten students volunteered anything under "liking worst" in the library. Charley said the worst was "having to find information", a remark that perhaps lends credence to Albert and Bobby's complaints about Charley not pulling his weight. Bobby said the library was sometimes noisy. Gladys said there was not always a teacher on hand to come and help you. Ivy found worst the frustration of not being able to find what you are looking for. No one registered an overall dislike of the library.

Computer lab. A varied list of "bests" were given for the computer lab. They included: typing notes on HyperCard, scanning hand drawn pictures into HyperCard, doing new things on your own work with HyperCard, finding information with the HyperCard "find" button, using computer programs to improve keyboard skills, playing computer games, and producing in a HyperCard stack something that other people can come and look at. The "worsts" were a shorter list including: clicking the wrong button, not being able to find programs, and distracting noise. Only Flo outrightly did not like the computer lab.

Homeroom. The positives far outweighed the negatives. Among the "worsts" were: too much work (Denis and Ivy) with Denis adding heavily, "it never stops"; not many books or information on hand (Hetty and Charley); and "spelling with ten kids and not all know English" (Albert). The "bests" were remarkably similar, bearing in mind that I talked to the students individually and not all together or in their groups. Seven of the ten named working with the larger group of either 10 or 20 students. Five named being able to ask the teacher for help: "Teacher tells you how to do things", "Teacher can help you do work". Five liked best
working with 10 fellow students: that's "not too many", "we're the older kids", the others are "not at our level". Three preferred the larger class of 20 students. One (Hetty) said the fewer kids the better "down to three".

The homeroom was important to these students. My observation was that it really was a home to them. Even though the range of ages was wide (9-13), all got along together, including even Charley, in the reassuring presence of their teacher, Karen. I observed the class both in regular teaching sessions and in free periods. The atmosphere was light, the rhythm of activity easy. In free periods the students formed into self selected groups or occupied themselves alone as they chose. The source of stability was Karen. She gave the students freedom to sit together with whom they liked or sit alone, encouraged them to help each other and at the same time maintained an easy discipline. From this secure haven they could sally forth each day to their special classes and then return again "home". And if they had any special problem they could turn in confidence to Karen knowing that she would help them solve it. They were like a large family and had the security of this family until they were ready to "mainline" into the regular school classes.

We will now move into the final phase of the Our World unit and deal in the next two chapters with the peer tutoring results.
CHAPTER 4: PEER TUTORING (1) RESULTS

PEDAGOGICAL ANALYSIS

Task and Objectives

The discourse task

The last task at the end of the Our World unit was peer tutoring. The more experienced students, who had produced the HyperCard stack, were to teach the less experienced students the contents of the stack and also HyperCard operations. During the unit the students producing the HyperCard stack were called "the experts" and the less experienced students were called "the beginners". They will now be referred to as "the tutors" and "the tutees". The peer tutoring took place during the last two double sessions of the unit on June 4 and 18. Because of time limitations, the tutors were instructed to concentrate on the Question and Answer cards (see Appendix 1) and go through the Topic Cards (see Appendix 4) only to the extent that time allowed. The students were paired off. Some pairs had their first language in common, which they were permitted to use. Other pairs did not have a common first language and were therefore dependent on English.

The worksheets

Two worksheets were provided for the task:

1. Checklist of questions (Appendix 2) to help the tutors check that they had covered the content of the Question and Answer Cards.

2. Classification Worksheet (Appendix 5) with blanks to be filled in by the tutees to help them understand the classification structure of the whole stack.
The pedagogical objectives

The teachers identified the following pedagogical objectives:

1. The tutors learn to:
   a. consolidate their understanding of the cards they had worked on;
   b. become familiar with the cards in the stack that they had not worked on.

2. The tutees learn to:
   a. understand the content of the Our World stack;
   b. become familiar with HyperCard operations for navigating the stack.

3. In general:
   a. to promote language use between tutors and tutees;
   b. to test the usability of the Our World stack with new learners.

The Students

Transcript conventions

The following conventions are used in the extracts from discourse transcripts which are given in this and the next two sections:

Table 4.1: Transcript conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>italics</td>
<td>Explanatory or interpretive comments</td>
</tr>
<tr>
<td>. . .</td>
<td>Pause in middle or at end of utterance</td>
</tr>
<tr>
<td>. . . {#secs}</td>
<td>Pause measured by seconds</td>
</tr>
<tr>
<td>^</td>
<td>Utterance interrupted</td>
</tr>
<tr>
<td>&gt;</td>
<td>Utterance left uncompleted</td>
</tr>
</tbody>
</table>

S1 = Tutor; S2 = Tutee; T = Teacher
Tutor/tutee pairs

The pairs reported on in this section are (tutors named first, tutees second):

1) **Hetty** from China, age 11¾, in Canada 2¼ years, paired with
   **Olly** * from Vietnam, age 9¾, in Canada 2¼ years.
2) **Charley** from China, age 13¾, in Canada 1¾ years, paired with
   **Kenny** from Vietnam, age 13½, in Canada 9 months.
3) **Denis** from Hong Kong, age 11¾, in Canada 1¾ years, paired with
   **Lenny** from Poland, age 11, in Canada 9 months.
4) **Gladys** from China, age 12¾, in Canada 2¼ years, paired with
   **Nancy** from Vietnam, age 10¾, in Canada 9 months.

(*) Olly, although in Canada longer than some of the tutors, was included as a tutee because he was behind in his language development. He arrived in Canada illiterate in his first language, having come from a refugee camp in Hong Kong where he had been since the age of five.

These pairs were selected for recording because the tutors in the pairs were the strongest in the class in English and were matched with tutees who did not share their first language.

**Qualitative analysis of discourse**

The tutor/tutee discourses are analyzed first by pedagogical objectives (see above) and then by the tutors' teaching style.

**Analysis by pedagogical objectives**

**Objective 1: The tutors learn**

The tutoring task was successful in extending the tutors' knowledge beyond the cards they had worked on and deepening their understanding of the concepts underlying all the cards. They discovered, as all teachers discover, that sometimes you know less about a topic
than you think you do when you come to explain it to somebody else; or else you know but
cannot readily find the words to describe it. This discovery led, in the course of the sessions,
to cooperative work between pairs and references to the teacher to clarify doubts and
uncertainties as illustrated by the following observations and transcript extracts.

**From Hetty and Ollie:**

**What is Solar System?**

S1 I don't know "What is solar system?" *(a checklist question)*
T That is the solar system. *(pointing to the card on screen)*
S1 Oh, the solar system is the nine planet?
T And what do they do?
S1 They go around the sun.
T That's what it is.

Hetty knew all the parts of the system and what they do but had not firmly grasped the
concept of system as a higher level entity:

**What is Moon?**

S2 What is moon?
S1 I don't know. I don't know how to answer. I ask Bobby.

Hetty breaks off and engages in a 4-minute discussion with Bobby and other students in a
mixture of L1 and L2. This leads to a comparison of notes and a refinement of understanding
on a number of questions.

**What Does the Sun Do?**

S1 The sun give us day and night. No, the sun give us day and night, alright?
And then the sun, and then the sun . . . I ask Bobby.

Hetty was not sure how to answer the checklist question: "What does the sun do?" She has
great respect for Bobby ("He's so clever" . . . Oh boy, that's a man") and invariably checks
with him when she is uncertain. She returns satisfied:
S1 You know what the sun do?
S2 The sun give us day and night and ... it give ... 
S1 And it gives to you something ... (5sec)
S1 It give us energy to use.

Hetty waits for Olly's reply as though he should know the answer although she had only just discovered it herself.

**What are Planets?**

S1 Mr Gray, what are planets?
T Well, what do you think they are?
S1 Don't know. Planets are planets, nothing else.
T Well . . .
S1 Just planets.
T But here they are {pointing to the card on screen}. Is there something you can see in common to all of these planets?

Hetty's problem here is with the checklist question: "What are planets?", a problem raised with her by Gladys. Hetty checks with the teacher, who elicits from her that all the planets are round, made of rock, go around the sun and are bodies in the solar system.

**What is Daytime?**

S1 {reading the next checklist question} "What is daytime?" Eyah I don't know what is daytime. Ivy! {calling another student} I don't know what causes daytime.

Hetty's final problem returns to day and night. Once again, the issue is resolved by discussion with fellow students and reference to the teacher.

**From Gladys and Nancy:**

**What are planets?**

In the June 4 session, Gladys raised the question "What are planets?". She had worked on the solar system cards in the stack and undoubtedly had a general image of "planets" which she had helped draw in relation to the sun. Her problem was articulating a working
definition. She checked with Hetty who also was unable to formulate an answer. Hetty checked with the teacher as he passed her workplace. The teacher engaged Hetty in a dialogue (referred to above) and elicited an answer that satisfied both of them. In the June 18 session, Gladys raised two additional questions:

**What are planetary rings?**

S1 Mr Gray, what are planetary rings? I know what they are but... how does they live? *{Gladys knows they are rings around certain planets but doesn't know what they are made of or how they function.}*

T They're made up of rocks and ice.

S1 Oh.

T And they condense in what looks like a very thin ring. But it's actually lots of little rocks and dust and ice revolving around the planets.

S1 Eyah! *{the students' habitual response to indicate either alarm or impressed surprise}*

**What causes the atmosphere to move?**

S1 What causes the atmosphere to move? Is it a wind?

T Well, wind is the atmosphere moving, that is wind and the atmosphere moving are the same thing... What causes the atmosphere to move is that the sun heats up the air and then the hot air moves up, the cold air moves down and there's a constant movement of air going from hot to cold, hot to cold.

S1 *{to S2} Understand? *{Gladys was able to remember this topic from an earlier class discussion.}*

**From Charlie and Kenny:**

Charley and Kenny were being recorded on a side table away from the general computer lab area and so were not a part of the general cooperative discussions. Also, Charley was less inclined to ask questions than Gladys and Hetty. Sometimes he went along with a wrong answer:

S1 Okay, let me ask you some question first. What is the sun?

S2 The sun is like one of this one flying up *{looking on screen at a picture of the planets in which it is not clear that they are revolving around the sun}*
S1 Yeah, a big planet.
S2 Big planet.
S1 What is the sun like? . . . {8 sec.} What is the sun like? . . . {4 sec}
S2 The sun li-. . . in th-. . . Sun li-. . .
S1 Do you know the answer?
S2 No.
S1 Like a burn planet . . . it's a burning all the time.

Later Charley shows that he knows that the planets revolve around the sun and speaks accurately about the force of gravity but fails in this exchange to make a distinction between sun and planets. When the teacher comes round, however, he does correct another misunderstanding through an exchange:

S1 Okay, now I ask you some question. {reads} How long does it take for earth to spin? . . . {4 sec}
S2 What? . . . {10 sec}
T Spin. This is spin {demonstrates spinning}
S1 Oh, that's rotate {distinguishing between earth spinning on its axis and rotating around the sun}
T That's rotate {demonstrates}
S1 Okay, I get it. {then to Kenny} Do you know how long it takes for the earth to spin itself once round? . . . {2 sec} One day.
S2 One day.

Denis:

Denis's partner was absent and so he was recorded the following day in the computer coordinator's office. During this computer lab session he worked with Jim the librarian, who played the role of tutee. Denis, therefore, was able to resolve issues about which he was uncertain before his recorded tutoring session.

Objective 2: The tutees learn

The tutoring task exposed the tutees to the contents of the Our World stack, which they learned but also, in varying degrees, forgot. They also became competent in navigating the HyperCard stack. The tutors explained and demonstrated the use of the various control
buttons and allowed the tutees to use the mouse and thus control operations. The tutees were familiar with HyperCard from previous work on typing and spellchecking programs and on some computer games. They quickly learned the uses of the control buttons in the Our World stack.

**Learning HyperCard Operations.**

**From Charley and Kenny:**

- S1 Click this one. See, it started a card.
- S1 And if you wanna go back to the first page click it this one.
- S2 Oh. *(and clicks)*
- S1 And then you want to go to next page, click this one.
- S2 This one. *(and clicks)*
- S1 And then can go "command-space" because you don't need all these things *(puts the standard HyperCard menu bar on screen for operations other than navigating the stack)*.
- S1 And this one goes forwards and this one goes backwards. Understand?
- S2 Yeah.
- S1 This one goes backwards.
- S2 And this one goes forward.

**From Hetty and Olly:**

- S1 See where you click the introduction. It clicks into the work. First of all, click the arrow.
- S2 Hey!
- S1 You got an arrow.

- S1 Oh no, you hold the mouse.
- S2 What?
- S1 You should hold the mouse and play around with it.

- S1 Click this one . . . Hurry up. It takes us to the solar systems and all the questions and answers *(the Question & Answer cards)*.

- S2 Find. *(wants to know about the "find" button)*
- S1 What you want to find? . . . If you want to find any word in this story and you, let's see, you want a planet, you just type "planet" and it'll find all the planets.
These exchanges illustrate the typical use in discourse around the computer of exophoric (situational) reference as distinct from endophoric (textual) reference (Halliday & Hassan, 1976). "This one" does not refer to a preceding or following reference in the discourse but refers outside of the discourse to the computer screen that both tutor and tutee are looking at. In the transcript word-count, the words "what" and "this" had the highest number of appearances except only for the definite article. Exophoric reference makes for fast communication because it depends on pointing rather than on language to convey meaning. The tutee sees what is pointed to, a non-textual icon, and by simply knowing what it is to click, can carry out the required operation and see directly the result.

**Learning Our World Stack Content.** The tutees learned a large part of the factual contents of the Our World stack. This learning, however, was language dependent and came slower than learning HyperCard operations. Oral evidence of what was learned is contained in the discourse extracts given under the next objective (Objective 3: Use of language). We will consider here written evidence of what was learned, as contained in written feedback and evaluation booklets the tutees produced in a day-long session in their homeroom after the tutorial sessions were over.

**Written evaluation booklets.** With the help of their partners, the tutees wrote down at least four sentences describing what they had learned about the three topics, The Solar System, What Causes Day and Night, and What's There on Our Earth. The following are examples:

**From Ollie:**

- Our Solar System part of our Universe.
• Our world spins around on its axis so one half faces the sun.

• There are continents and oceans on Earth. The continents divided into many countries.

From Kenny:

• There are nine planets. There are Saturn, Jupiter, Earth, Mercury, Venus, Mars, Neptune, Pluto, Uranus. The biggest planet is Jupiter, the smallest planet is Pluto.

• When our planet earth spins is self once it is 24 hours with mean one day.

• The earth is divided into continent and ocean.

From Lenny:

• We have nine planets in our solar system. They are (names follow).

• Our earth go around the sun.

• We have 5 continents and 5 oceans in our Earth.

From Nancy:

• Some planets have rings around them. They are Jupiter, Saturn, Uranus. The rings are made by ice, dust, and rocks.

• When one half of our world faces the sun it will be daytime and the other half is nighttime.

• There are fishes, whales, dolphins, seals, crabs, starfish, octopus, mussel, rocks, sand, shells, and mud in Ocean.

Because the tutees were helped by their partners in writing their feedback sentences, one cannot be certain just how much they understood independently. The tutors, however, took their job seriously and there is no reason to believe that, under Karen's supervision, they were not at pains to make sure that the tutees understood what they were writing down.
Objective 3a: Language generation

The tutoring task was an effective generator of language. Because the interaction between tutor and tutee was ongoing and intense, the peer tutoring sessions generated more language than the work sessions in the computer lab or the study sessions in the library. Our activity sampling analysis (Chapter 3) indicates \((56 \pm 7)\%\) speaking time for peer teaching (from the videotapes) compared with \((16 \pm 1.6)\%\) in the library and \((13 \pm 1.5)\%\) in the computer lab. The language was not generated equally: the tutors used nearly twice as much speaking time \((35\%)\) as the tutees \((20\%)\) and generated more than twice as many words (a detailed quantitative analysis is given in the next Chapter). A qualitative analysis shows that a number of well-formed sentences were produced with good evidence of conceptual understanding by both tutors and tutees, although more by tutors than tutees. The following extracts give examples:

**From Hetty and Olly** (June 4):

- S2 Bil... bi... bilography.  \(\text{reading "Bibliography" from screen}\)  
  S1 Never mind, that's all the books we using.

- S1 The biggest planet is which one?  \(\text{a successful transposition from the given question "Which is the biggest planet?"}\)

- S1 \(\text{to Teacher}\) Is the sun a star? Oh yeah, the sun is star because the star has its own heat. Okay Olly, what is Sun?

- S1 \(\text{reads question}\) What is the sun like?  
  S2 Sun circle?  
  S1 The sun like a fireball, a ball of fire.  
  S2 Fireball eh?

- S1 \(\text{restating after checking with the teacher}\) The planets are bodies made of rocks and they're in the solar system.

- S2 What be the name of this one?  \(\text{pointing to Jupiter's moons}\)
S1 Those are moons. Moons are like little planets. Go around the earth. The moons are like . . . {prompting tutee}
S2 Like little planet, go around the earth.
S1 Go around the planets. {correcting herself and tutee}

From Charlie and Kenny (June 4)

- S1 You know cave?
  S2 No.
  S1 A big hole on the mountain. You can go see this cave. {pointing to picture on screen}
  S2 Oh, I know.
  S1 You know that?
  S2 Yeah, the 'ole where in you die.
  S1 No, you wont die. Click again.

- S1 The earth is spinning all the time.
  S2 Ah.
  S1 And the earth's going around the sun.
  S2 Yeah?
  S1 And the moon is going around the earth.

- S1 Do you know the answer? {to "what is the sun like?")
  S2 No.
  S1 Like a burn planet.
  S2 Burn planet.
  S1 So very hot out there. You cannot go near it. It's burning all the time.

- S1 The sunlight keep the earth warm.
  S2 Keep the earth warm.
  S1 If we don't have the sun, we'll be cold all the time. And we don't have trees, plants, flowers, grass. Then we'll die.

- S1 Do you know why we all stay on earth? We don't tchooo! go up to space?
  S2 No.
  S1 Because the earth has gravity.
  S2 What?
  S1 Gravity.
  S2 Gravity.
  S1 Gravity hold us on the earth. So that's why we don't go up. When you go up to space you don't have gravity. You just float. You just fly.
  S2 Ah, you can fly, right?
S1 Yeah, if you on the moon you can fly right? There's no gravity. \{Charlie needs to understand that on the moon there is less, not no gravity\}
S2 No gravity.
S1 If you're on the earth you have gravity so you hold on the ground. Then you don't go fly into space. And there's no air, no oxygen on the moon. And we have oxygen, air, clouds, the trees on earth. Now why does all the planets go around the sun? Because the \ldots? \{prompting tutee\}
S2 The what's gravity you said.
S1 Gravity.
S2 Yep, gravity.
S1 Because of gravity. So all the planets go around the sun. Okay? So now say that sentences again.
S2 Because the gravity on the planet \ldots
S1 \{interrupting and correcting\} Because the gravity from the sun holds all the planet. Do you know these planets wants to go away? Right? But the sun use a gravity to hold them so they go around the sun. Understand that?
S2 Yes.
S1 Okay, then we know that question.

Charlie is excited by the notion of gravity. Although his ideas need some correction and refinement, they are in the right direction. His enthusiasm communicates itself to Olly, who begins to get the general idea.

From Gladys and Nancy (June 18):

- S1 These are layers \{referring to the layers of the atmosphere depicted on screen\}
  S2 But I want to know what that means.
  S1 Layers are blanket of air.
  S2 Blanket? blanket? of air?
  S1 Layers are something on top of something. \{Gladys's spontaneous and accurate definition\}
  S2 Layers are \ldots
  S1 Something \ldots This one is two layers. Something on top of something.

- S1 What are continents?
  S2 Ah, continents are \ldots
  S1 Continents are a big piece of land. \{Gladys has generalized this answer from the answer for oceans "An ocean is a big body of water"

- S1 What are planetary rings? \{Gladys has just checked with the teacher in Nancy's hearing\}
S2 Planetary rings are made by the ice, rocks and dirt combined. \(\{\textit{Nancy answers correctly}\}\)

- \(\{\textit{Nancy shows that she can, more than any other tutee, put her answers into well formed sentences. This is brought out in this exchange in which the questions are read by the tutor but the answers are composed by the tutee}\}\)
  S1 What is our solar system?
  S2 Our solar system has its sun and planets.
  S1 What does our solar system do?
  S2 Solar system . . planets go around the sun.
  S1 What is our solar system part of?
  S2 Solar system part of universe.
  S1 What is the sun?
  S2 The sun is a big star.
  S1 What is the sun like?
  S2 The sun like a big red . . no, a big fireball.
  S1 What does the sun do?
  S2 The sun go around with the planets. \(\{\textit{Nancy's meaning here is unclear as the students had not studied galaxies around whose centres suns with their planets revolve}\}\) The sun give us heat and sunlight. What too?
  S1 Day and night.
  S2 Yes, day and night.

- S3 \(\{\textit{a fellow tutor to Gladys}\}\) What causes the atmosphere to move?
  S1 What cause the atmosphere to move is the sun.
  S3 How do you know that?
  S1 The sun heat the air and the air move up and the cold air come down \(\{\textit{a fair operational definition of convection}\}\).

- S1 \(\{\textit{asks Nancy the same question a few minutes later}\}\) What causes the atmosphere to move?
  S2 \(\{\textit{extemporizing}\}\) The sun heat it up and warms it. And hot the air (er) rises to the atmosphere. And because of the atmosphere movement and cold and hot . . . and the wind . . . \(\{\textit{Nancy has heard this only once and has not quite got the notion of convection but is on her way to it}\}\).

- S1 Do you understand? \(\{\textit{the principle of ordering the subjects in the worksheet}\}\)
  S2 Yes. Because it order in the biggest and the smallest. \(\{\textit{meaning moving from the biggest (universe) to the smallest (features of the earth)}\}\)
  S1 Yeah.
• S1 *Nancy has expressed an interest in jungles*} The jungles are just like
forest but they are in the hot place. They always rain there. *Gladys worked
on forests and has correctly generalized from them to jungles*.

• S2 What's this all about? *the bibliography card*
S1 Ah, what book we use to find the informations.

• S1 *returning to day and night* What causes day and night?
S2 The sun cause day and night.
S1 But how?
S2 Just the earth go around the sun.
S1 No, the earth go around the sun and it spins when it go around the sun.
When one faces the sun it's daytime and the other half is at nighttime.
Understand that? Okay? *Gladys understands the difference between the
earth revolving on its axis and revolving around the sun*
S2 Ask me. *Nancy, always prepared for a challenge*
S1 Okay, you can explain it.
S2 The earth move . . . when the earth is spin this is spin . . . the one face
the sun is a day time *Nancy has probably "got it" but can't express it*.

Some of the exchanges between Gladys and Nancy show the need for further
conceptual guidance for understanding complex subjects like the causation of day and night
and the movement of the atmosphere. However, Gladys's conceptual grasp is good while
Nancy's probably exceeds her command of English with which to express it. Their exchanges
indicate a high level in both quantity and quality of language generation. Nancy fully earned
Gladys's accolade: "She smart woman tiger!"

**Objective 3b: Test usability of Our World stack**

The quoted extracts from the tutorial discourses indicate that the Our World stack was
used with effect with new learners in the tutorial sessions. Each pair was engaged with
interest and concentration during dialogues of an average length of 40 minutes with little or
no offtask time except for a few minutes of well-earned socialising at the end of the sessions.
The tutees showed both orally and in writing a reasonable understanding of the contents of
the Our World stack. However, we have noted some uncertainty about the tutees' grasp of the some concepts; and we also note in the section which follows some problems associated with the tutors' teaching style.

**Analysis by tutors' teaching style**

**Initiation-Response-Evaluation (I-R-E)**

The cycle of questioning, response and evaluation is well documented as the most common pattern of discourse between teachers and students. Mehan (1979) calls it the I-R-E sequence: *Initiation* by the teacher in the form of a question; *Response* by the student; and *Evaluation* by the teacher (is the answer right or wrong?). Cazden (1988) identifies this sequence as the default pattern of classroom discourse. The students, lacking the maturity and training of the professional teacher, practised their own version of the I-R-E sequence as a sort of competitive game.

Each topic card has two questions, displayed by clicking on a question button. If you don't know the answer you can click on the answer button and find out what it is. The tutors' teaching strategy was to have the tutees go through these questions and answers on each topic card and then later use the Checklist questions (Appendix 2) for review. Their goal was to get the tutee to remember the "right" answers. "Marks" were earned for the memorization of facts, with or without conceptual understanding.

The tutor, as in Charley's case, may berate the tutee for not remembering the right answers or, as in Denis's case, may play the "good guy" and feed the right answers to the tutee. The tutee, as in Lenny's case, may be defensive and anxious to be perceived as "being
right", preoccupied with marks and how they reflect on him, not with the understanding of content.

Two problems emerge: the tutees' forgetting and the tutors’ fatigue.

**The Tutees Forget**

**From Denis and Lenny:**

- **S1** Are sure you know all these things?
- **S2** Yep.
- **S1** Let's check your marks.
- **S2** Not all of them. Some. *{Lenny is backing down from knowing "all these things"}*
- **S1** Let's check your check marks. *{looks at the checklist}*
- **S2** Okay.

After a pause, Denis continues with the questions:

- **S1** *{reading} What is the solar system? ... {7 secs} Heh, heh, heh.*

Denis's stylised laugh after the pause is because Lenny doesn't know the answer. This is all part of the game. The laugh expresses: "You'd better look out, you're falling behind". A little later, after another pause with a review question, Denis says in a playful voice: "I teach you before" and then, laughing, "You hafta member!" Denis is not being mean. He is just temporarily an amused spectator of Lenny's performance in the memory game they all play. A little later, his amusement turns to frustration as he shouts at Lenny: "HAFTA MEMBER!"

Denis really wants Lenny to do well so he changes his strategy and starts to feed him answers in low whispers. Lenny's question is to name the smallest planet:

- **S1** Merchury ... no.
- **S2** *{whispers} Pluto ... {13 secs}*
- **S1** *{loudly} Pluto is smallest.*
- **S2** Yeah, I didn't say it. I know Pluto is the smallest. Yeah, Pluto is the smallest and the largest is Jupiter.
- **S1** Yeah! Good boy, good boy, good boy. So drive man *{in a funny voice}.*
S2  \textit{(whispers)} Shuddup.

Here we see the beginning of the negative aspects of the game. The student's ego is on the line, exposed to the cold winds of public failure and ridicule. Good teachers consciously protect the student from these hazards. The students have not yet the maturity, experience or training to do this. We see Lenny's defensiveness emerging. He makes out that he knew all along that Pluto was the smallest planet. So he does not respond to Denis's whispered cue and reacts with irritation to Denis's bantering praise. Lenny's defensiveness is heightened by the presence of the two girls, Gladys and Nancy, who are working immediately next to the two boys. The girls have already gone through the Our World stack and are doing their evaluation project. At the same time they keep their ears open to what's going on with the boys and contribute their own banter. This increases the negative spin of the game. The boys close ranks against the intervention of the girls and cry "foul" to the teacher-referee:

\begin{verbatim}
S1  Mr Gray, they always talk to us. And then make sound and laugh and laugh.
T   Oh, I don't . . . \textit{(interrupted)}
S1  They laughing at us.
S2  They laughing at us.
S1  And everything.
S2  Talk too much.
S1  She \textit{(Gladys)} says Nancy's better.
\end{verbatim}

In other words, the two girls claim how much better they are in the question and answer game than the two boys, and particularly how much better Nancy is than Lenny. A few minutes later they continue in the same vein:

\begin{verbatim}
S1  What is continents?
S2  Continents is continents. What sort of question is this? \textit{(indignantly)}
    \textit{(the girls laugh)}
S1  A big piece of land. See \textit{(to the teacher)} lookit, they laugh. He don't know it and they laugh.
\end{verbatim}
Mr Gray intervenes and the boys continue, with Lenny more intent than ever on defending his position:

S1 Continents is a big land.
S2 Yeah.
S1 Not just "continents is continents".
S2 Yeah, yeah. I knew that. No, no, just kidding.

Lenny covers up his claim to know when he didn't know with the "just kidding" remark. But when he does get a right answer he wants it well established for the record:

S1 Which is biggest ocean?
S2 Pacific Ocean.
S1 Yep and what's smallest?
S2 Arctic Ocean.
S1 Yeah.
S2 Yeah, see I was right.
S1 No, give your answer only. \textit{(Denis playing the strict instructor)}
S1 \textit{(reading the next question)} Which continents is the smallest and the biggest?
S2 Continent, the smallest is Australia and the biggest is Asia.
S1 Yeah man.
S2 See? \textit{(Lenny triumphant: he was right)}

Denis uses his whispered cue strategy more as the session proceeds, partly to help Lenny and partly to speed the session to its conclusion, which he announces with the statement: "I finish asking all the questions". Clearly, in his mind, the session was defined by the checklist questions and his tutee's success or failure was measured by whether or not he memorized the right answers.

\textbf{From Charley and Kenny:}

There was a two week gap between the first and second peer tutoring sessions. Frequently, the memorized answers had faded by that time. This is brought out well in the second discourse between Charley and Kenny. Charley was an energetic and thorough tutor.
In the first session he admonished Kenny: "You got to learn how to answer these questions".

In the second session he chides Kenny for his memory lapses:

S1 What does the sun do?
S2 The sun do make sunshine to the planets . . . right?
S1 Well what else? . . . {3secs} Think, think, what I taught you last time. Just think. . . . {5secs}
S1 You don't know? . . . {14secs}
S2 Um . . .
S1 The sun keep our earth warm. And then sun has gravity to hold all the planet go around. Do you remember what I tell you last time?
S2 Yeah, yeah I do.
S1 You don't know.
S2 Yeah, I, I know tha^
S1 You forgot. {reprovingly}
S2 Yeah.

The next topic produces a similar exchange:

S1 What is a continent? . . . {pause 3secs}
S1 Think.
S2 {under breath} Continent . . .
S1 Think! What is a continent? . . . {pause 4secs}
S1 Just one week you forget everything?
S2 Yeah.

By the end of the second tutorial session, the tutee in this discourse has learned something but the hard way by brute force questioning and repetition. How well he has grasped the underlying concepts is open to question.

The Tutors Tire

By the end of a 40-50 minute session the tutors were tired. There could be many reasons for this, e.g. a skipped breakfast, an incipient infection. Also they were under the strain of teaching and learning at the same time. In addition, there were the frustrations felt when the tutees didn't remember the right answers in reviews. It was sometimes these
frustrations that triggered the tutors' awareness of fatigue. No doubt the tutees also felt the strain but it was the tutors who expressed themselves.

**From Charley and Kenny:**

At the end of the second tutoring session, Charley doggedly reviews all the things that Kenny should have learned. He has established with Kenny that three of the planets have planetary rings:

S1 What's their name?
S2 Oh. *(surprised because he thought that just saying "three" was the answer)*
S1 You gotta check it out!
S1 *(hesitantly)* Jupiter . . . Siturn *(Saturn)* . . . and Uterus *(Uranus)*.
S2 Okay, then remember it. I'm going to ask you again. *(yawning and speaking to himself)* It's so hard to teach!

One can understand Charley's fatigue (not to mention Kenny's). Teaching the right answers as distinct from teaching understanding is an exhausting grind.

**From Hetty and Olly:**

Hetty shows a similar reaction to Charley. She has been teaching Olly the names of the planets. Olly has had difficulty pronouncing these new and unusual names. Whenever he mis-pronounces, Hetty chides him and makes him say the name ten times over. At the end of the first tutoring session she reviews:

S1 What are the names of the planets? You have to answer all the names of planets again. Too bad. Click and answer. *(Clicking on the planets drawn on the card pops up their names)*
S2 *(reading slowly, pronouncing each syllable)* Mer-cu-ry . . .
S1 *(overlapping)* Mercury. This sounds "Mercury".
S1 Mars! *(loudly with exasperation)*.
S2 Venus I forgot.
S1 Uhhhhh. *(sucks in her breath in exasperation)* Olly, I think one more. No, I don't think one. I'm so tired teaching one.
S1 *(to another student)* I'm teaching here, I'm so tired!
Hetty just wanted to quit. After the exchange with the other student she recouped and carried on but with yawns and an edge in her voice. "Say it niceeleeeeee" she says to Olly when not satisfied with his response, dragging out the final syllable to make her point.

**From Gladys and Nancy:**

It could be said that Charley and Hetty had no particular feeling for Kenny and Olly and therefore easily became impatient. However, the same phenomenon occurred with Gladys and Nancy, who were compatible with and liked each other. Gladys told me during one of the sessions, "I like working with Nancy". It was clear, watching them work, that the two girls enjoyed each other's company. By the end of the second tutoring session, however, nerves were wearing thin:

S1 Finish, Nancy. Nancy.
S2 Shut up.
S1 Finish up . . . {7secs}
S2 How about you?
S1 I won't help it. Are you any happier?
{after a brief indecipherable exchange}
S1 I so tired.
{a few minutes later}
S1 Oh Nancy, Nancy, I want to go home and sleep.
S2 Lazy girl.
S1 So? I will want lazier.
{Nancy makes a mistake with a HyperCard command}
S1 Hey, cannot click "Home". Oh Nancy.
S2 I know that.
S1 I kill you Nancy.
S2 No you will not.
{Gladys proceeds to "kill" Nancy}
S2 Eyah! You don't kill me Gladys . . . Don't kill me . . . Gladys! That's enough!

Because the girls were friends, the bantering was good humoured and the tension was discharged through joking. However, the fatigue, at least on Gladys's part, was real.
From Denis and Kenny:

Denis and Kenny also were well matched and got along together as friends but fatigue showed towards the end of the session. Denis responded with "Oh boy!" to the teacher's request to cover one more thing before the session ended. The last 3-minutes of their 40-minute session became desultory with long pauses, yawns, sighs and off task comments.

Qualitative summary

The qualitative analysis was governed by the following questions:

1. Did the tutors consolidate their understanding of the material they had worked on in the Our World stack?
2. Did they become familiar with the cards in the stack that they had not worked on?
3. Did the tutees become familiar with the content of the Our World stack;
4. Did they become familiar with HyperCard operations for navigating the stack?
5. Did the tutoring session promote use of language between tutors and tutees?
6. Did the tutoring sessions show the Our World stack as usable with new learners?

The tutors discovered that they were uncertain about the answers to some of the questions on their check list as they went through the Our World stack. These included questions on topics they had worked on in building the stack as well as topics they had not worked on. They resolved these questions by discussing with each other and with the teachers in the room. By these discussions and going through the stack with the tutees, they consolidated their knowledge of the whole stack. They frequently gave evidence of this by spontaneous multi-utterance explanations of topics.
The tutees showed that they learned required HyperCard operations by navigating the stack unaided. They learned the content of the stack by interacting with the tutors and from the tutors' discussions with each other and the teachers. Because the tutors helped the tutees in many of their answers and helped them later write a report of what they had learned, one cannot be certain of their grasp of all underlying concepts. Both tutors and tutees showed some confusion between the concepts of the earth rotating around the sun and around its own axis. It is of interest that one tutee, Manny, was a tutee on a new Tutorial stack for Our World some three months later (see Chapter 5) when his responses were clear and firm and he needed little assistance. If he is typical, then the tutees did learn substantial content.

The tutoring sessions were effective in promoting the use of English between the tutor/tutee pairs. Activity sampling shows (56 ± 7)% speaking time for peer teaching compared with (16 ± 1.6)% in the library and (13 ± 1.5)% in the computer lab. The tutors used nearly twice the speaking time (35%) of the tutees (20%) and generated more than twice as many words. Even so, the tutees' speaking time alone was higher than students' total speaking time in regular periods in the computer lab, library or homeroom.

The tutoring sessions held the interest of the tutees for periods averaging 40 minutes with minimal off-task time. Therefore the Our World stack proved an effective teaching medium for new learners. However, an analysis of the transcripts suggests that tutoring sessions will be more effective if the tutors change their teaching style from excessive use of unintroduced questions to providing the tutees with clear verbal introductions to the topics, allowing them to ask questions, and then encouraging them to attempt multi-utterance descriptions of their own.
QUANTITATIVE ANALYSIS

Methodology

The discourse audio tapes were transcribed and analyzed using the Systematic Analysis of Language Transcripts (SALT) system from the Language Analysis Laboratory of the University of Wisconsin-Madison (Miller & Chapman 1984-1991). The results of this analysis are presented with the aid of four charts:

1. Turns by Number of Utterances
2. Utterances by Number of Words
3. Words per Minute
4. Mean Length of Utterance (MLU)

For purposes of quantitative analysis, the transcripts were edited to exclude those parts where the tutor was discoursing with a teacher or with other tutors to raise questions and clarify understanding. The analyses therefore refer exclusively to tutor/tutee dialogues which, accordingly, are comparable among all pairs.

The data analyzed excludes all mazes (marked off by parentheses in the transcripts). Mazes are made up of false starts, repetitions, reformulations and hesitations ("um", "er" etc.). An example of a multiple-maze utterance is Nancy's attempt to formulate a difficult concept:

S2 (The sun hit, um the sun dry) the sun hits drying up and it hit the atmosphere and (it) it become dry and (its) it (um) cause the atmosphere move and the wind.

The approximate percentage of total words generated that appear in mazes is 4% for the tutors and 10% for the tutees.
Length of Turn by # Utterances

In the chart shown in Figure 4.1, the first two bars represent the teacher’s interaction with the whole class in the June 4 double period. This constituted a total of 5.5 minutes of discourse in three segments, one each at the beginning and end of the class and one part way through. It is shown in order to provide a comparison between the teacher/whole class profile and profiles of the individual tutor/tutee pairs. The last two bars represent the average of the tutor/tutee pairs against which each individual pair can be compared. The other pairs of bars represent the tutor/tutee pairs named on the period dates and for the number of discourse minutes shown. The tutor’s (and teacher’s) turns are expressed as 100% in total. The tutees’ turns are expressed as a percentage of the tutors’ total.

FIGURE 4.1: Length of Turn by # Utterances
Consistently across all pairs, the tutees' number of turns (96-98%) nearly equals the tutors' (100%). However, an average 88% of the tutees' turns are one utterance long and only 12% are two or more. In contrast, an average 60% of the tutors' turns are one utterance long and 40% are two or more. Of this 40%, nearly 10% are three utterances long compared with only 2% for the tutees; and just over 10% are four or more utterances long compared with none that long for the tutees. The teacher with the whole class has most turns of three or more utterances (44%) compared with the average for the tutors (20%).

Of the tutees, the easy talking Lenny (Len) shows most multi-utterance turns (20%). The tutee Kenny (Ken) shows an increase in multi-utterance turns from 4% (June 4) to 13% (June 18), possibly indicating on June 18 the benefit of practice in the preceding session.

**Length of utterances by # words**

The arrangement of the bars and the discourses represented are the same in Figure 4.2 which follows as in Figure 4.1 above. The subject of analysis is the length of utterances in words rather than the number of utterances in turns. Tutors' (and teacher's) total utterances are expressed as 100%. The tutees' utterances are expressed as a percentage of the tutors' total.

The tutees have a smaller number of utterances than the tutors. Expressed as a percentage of the tutors' or teacher's utterances, the smallest number is the whole-class (33% of teacher's utterances) compared with the average tutees (61% of tutors' utterances). The number of tutees' utterances improved from a 49% average in the June 4 sessions to a 70% average in the June 18/19 sessions, indicating, perhaps, the benefit of practice.
The tutees also produce a smaller number of words per utterance than the tutors. Most of their utterances are three words or less in length: 72% on average of their (the tutees') total utterances compared with the tutors' 45% on average of their (the tutors') total utterances. The converse of this is that the tutors produce more utterances of four words or more than the tutees: a 55% average of their total utterances compared with a 28% average for the tutees.

The tutees produce more utterances of four words or more in the June 18/19 sessions (35% average) than in the June 4 session (16% average). Again, this may indicate the benefit of practice in the first session.
The pattern of tutees' utterances in the June 4 sessions closely resembles the June 4 whole class pattern, although the June 4 ratio of total tutee to total tutor utterances is higher (49% average) than the June 4 ratio of whole class to teacher utterances (33%). In other words, the tutees talk more with the tutors than the whole class talks with the teacher but in both cases in mostly short utterances of three words or less.

The teacher has noticeably more long utterances than the tutors, as would be expected: 47% of the teacher's total utterances are made up of nine-plus words compared with 8% on average for the tutors. The reverse is true of short utterances: 15% of the teacher's total utterances are made up of three words or less compared with 47% for the tutors.

Charley stands out among tutors for long utterances: 12% of his total utterances are nine-plus words in length compared with a 4.3% average for the other tutors. Lenny stands out among tutees for quantity of utterances: his number of utterances in total on June 18/19 are 84% of his tutor's total utterances on those days compared with a 65% average for the other tutees relative to their tutors in the same period. His multi-word utterances (50%) are exceeded only by Nancy (53%).

Words per minute

The arrangement of bars and the discourses represented are the same in Figure 4.3 which follows as in Figures 4.1 and 4.2 above. The subject of analysis is words per minute. Unlike the previous two figures which show percentages, Figure 4.3 represents the actual number of words per minute, timed from the discourse recordings.
FIGURE 4.3: Words per Minute

Two things stands out: 1) the teacher’s production (128 wpm) is $\frac{3}{4}$ times the average of the tutors (57 wpm); 2) the tutors' average production (57 wpm) is $\frac{3}{2}$ times the average for the tutees (23 wpm).

The tutees' production for the two June 4 sessions (16 wpm) is somewhat higher than the whole class production (10 wpm) and improves in the June 18/19 session (28 wpm), reflecting, perhaps, the benefit of practice. At the same time the tutors' rates fall from 64 wpm on June 4 to 50 wpm on June 18/19, indicating that the tutees are claiming a greater share of talking time in the second sessions.
Charley stands out as the tutor producing most talk: his average (66 wpm) is well beyond that of the other tutors (48.4 wpm). Lenny is the tutee producing most talk (31.8 wpm) followed closely by Nancy (29.2 wpm).

**Mean length of utterance (MLU)**

The arrangement of bars and the discourses represented are the same in Figure 4.4 which follows as in Figure 4.3 above. Like Figure 4.3, Figure 4.4 shows an actual measure and not a percentage. The subject of analysis is mean length of utterance (MLU) measured by number of words.

**FIGURE 4.4: Mean Length of Utterance**
The teacher's MLU of 9 words is more than twice the tutors' average of 4.3 words. On June 4 the tutees' average of 2.2 words compare closely with the whole class's average of 2.0 words. The tutees' average improves in the second session to 3.4 words, again perhaps indicating the benefit of practice in the first session.

Charley stands out among the tutors with an MLU of 4.8, well beyond the average of the other tutors (3.9). Nancy stands out among the tutees: her MLU of 4.1 words is the highest of the tutees and exactly matches the MLU of her tutor Gladys. Lenny, who had most words per minute, falls behind Nancy in his MLU of 3.2.

**Quantitative summary**

The teacher has an understandably higher performance than the tutors in multi-utterance turns, multi-word utterances, words per minute and MLU. The tutors on average outproduce the tutees: more than three times as many multi-utterance turns, nearly three times as many three-plus-word utterances, two-and-a-half times as many words per minute, and one-and-a-half times the mean length of utterance. The tutees' performance in the first (June 4) session does not greatly exceed that of the whole class on the same date in any of the measures; but does show noticeable improvement on all measures in the second (June 18-19) session. This improvement may indicate the benefit of practice in the first session.

Of the tutors, Charlie stands out in his greater production of multi-utterance turns, long (nine-plus-word) utterances, words per minute and MLU. This indicates his oral English competence but does not indicate his tutoring skill which is revealed as overbearing by the discourse transcripts (see "The tutors' teaching style" in the next chapter under Introduction).
If tutoring success is judged by the tutee's rather than the tutor's language production, then Gladys and Denis are more successful tutors than Charley and Hetty.

Of the tutees, Lenny (Denis's tutee) and Nancy (Gladys's tutee) stand out particularly in multi-word utterances, words per minute and MLU. Nancy produces most multi-word utterances and produces the highest MLU (4.1), matching that of her tutor, Gladys.

A substantial amount of language was generated in these sessions. The average number of words produced per session is 2,068 for the tutors and 829 for the tutees. The average length of session is 36.5 minutes. The average words per minute is 57 for the tutors and 23 for the tutees. The average MLU is 4.3 for the tutors and 2.9 for the tutees.

The greatest beneficiaries of these sessions were the tutors who both consolidated their content learning and the language with which to express it. However, the tutees also benefited both in content knowledge and in language use. Although they produced less language than the tutors (40% of the tutors' number of words), they produced more than the average student production in regular sessions in the computer lab, library or homeroom and certainly more by far than student production in a typical 50-minute whole-class second language session (Long, 1975).
Chapter 5: PEER TUTORING (2) RESULTS

INTRODUCTION

Review of Peer Tutoring (1)

The tutors' teaching style

Both a quantitative and qualitative analysis of the discourse transcripts from Peer Tutoring (1) confirm an interesting trend. The teachers both in library and computer lab had used a predominantly explanatory and dialogic method of teaching, discussing concepts and elaborating detailed explanations with the aid of key visuals and practical demonstrations. Despite this, the tutoring students, when given the task of "teaching" the topics, did not emulate this model but followed instead their own version of the traditional I-R-E model, consisting of a continuous series of interrogations. They asked questions to which they knew (or thought they knew) the answers and demanded memorization of those answers by the tutees. They used the preset questions on the Question and Answer cards for this purpose and also the questions on the Tutor's Checklist (Appendix 2). The Checklist had not been given them for this purpose but rather to help them review later what they had covered to make sure they had not missed any items. Instead, they used the Checklist as an agenda and steadily worked their way through it. When they got to the end, they would cry out in triumph, "Done!"

They did not in general explain the topics to the tutees in terms of underlying concepts. They started straight out with questions. They used HyperCard visuals more for exophoric reference -- pointing to items or processes named -- rather than generating verbal descriptions and explanations of what the visuals depict.
Several reasons can be suggested to account for the tutors' teaching style:

1. The use of questions is the line of least resistance. The questions can be read out and the tutee left to the difficult job of working out answers while the tutor remains in control, playing the role of prompter.

2. The use of questions is sanctioned by the abiding power of the traditional I-R-E model of teaching (discussed in Chapter 2A under "The role of discourse analysis"). This is usually what students experience on their first exposure to schooling and was most probably the model to which these students were exposed in the traditional educational cultures from which they came (except the two who arrived in Canada illiterate, having received no previous education at all). The tutors interpreted this model according to their age, experience and level of maturity.

3. Students need orientation in the expository use of visuals: reading research shows that when expository text is well illustrated with visuals, students ignore them, convinced that what really counts is the text alone (Reinking 1986; Evans, et al. 1987; Tang 1989). Authority lies in the text, not the pictures, which are just a sugar coating to help the text go down.

4. Students need training and guidance in sustaining an explanatory dialogue based upon an understanding of underlying concepts. Without training, it is unreasonable to expect such a dialogue even of first language speakers, let alone second language speakers of the age and second language development level of our tutors.

   a. The teachers were not expecting dialogue at this level. As noted below under Evaluation, the results achieved in the tutoring were positive and considerable.
Perusing and discussing the transcripts, however, did cause the teachers and myself to raise the interesting question of whether, with some training and resource assists, such second language dialogue would be possible for our tutors. This question formed the basis for planning Peer Tutoring (2) as described in the next section in this chapter, "An Alternative Approach".

Evaluation

An experiment

The tutoring sessions were not originally a part of the Our World unit. Once the unit had taken shape, Karen had proposed the tutoring as an experiment to see whether:

1. the more experienced students who built the Our World stack would consolidate their understanding of its content by teaching it to their less experienced peers who did not take the unit;

2. the stack would be effective as a student-produced resource for teaching the less experienced peers and hence new learners in general.

3. peer tutoring would be effective in promoting language use.

An evaluation must take into account that this was an experiment and also that the students had limited exposure to the English language and Canadian culture. Karen made the point: "these are inner city kids who started at a zero level in English and have no more than 9-24 months of exposure to English learning".

Positive achievements

We have seen from the qualitative pedagogical analysis of the peer tutoring (1) results in chapter 4 that the peer tutoring (1) sessions were largely effective in achieving the
pedagogical objectives of the Our World unit which developed from Karen's original proposal:

- the tutors did consolidate their understanding of the Our World content;
- the tutees did become familiar with the overall topics on the Question and Answer cards and with at least some physical features of Earth covered by the Topic cards;
- the tutees did master HyperCard navigation;
- the students did generate a high level of second language (more than in any other activity in the computer lab, library or homeroom);
- the Our World stack did prove usable and effective as a teaching medium.

Karen commented on other positive aspects of the unit with which I concur: the wholehearted individual effort, participation and positive attitudes of all the students, both tutors and tutees; the success of the tutors in listening to, understanding and following their teachers' directions for this complex exercise; the efforts of the tutors to adjust to the level and needs of the tutees; and the enthusiasm of the tutors and receptiveness of the tutees that led to a profitable and productive sharing experience. Karen's comment is apposite: "Consider that our project is the first small step in launching our kids on the long, difficult journey of academic learning".

**Academic discourse**

Karen's comment brings into focus our prime research interest: did peer tutoring prove effective in leading the students into generating academic discourse? -- because this is a key to success on that "long, difficult journey of academic learning". The answer was not immediately apparent. Clearly, a great deal of language had been generated. But what was its
quality? How much of it was the more easily acquired and expressed conversational language proficiency, the language of social intercourse? How much of it was the less easily acquired academic language proficiency, the language of teaching and learning (Cummins, 1991)?

A perusal of the discourse transcripts revealed very little social intercourse. The tutors and tutees took their task seriously. Their pause time was minimal and they interacted continuously on the academic task in hand: for the tutors to teach and the tutees to learn the content of the Our World stack. Therefore it could be said that most of their verbal exchanges constituted academic discourse. A further question must then be asked: what was the quality of that academic discourse? To answer this question satisfactorily, a cognitive analysis procedure was devised, based on Halliday/Staab (1973, 1986) language functions, as described in the next chapter. However, it did not take formal analysis to perceive from a perusal of the transcripts that the discourses did not possess the continuity of dialogue and cognitive depth that one would expect of adequate academic discourse -- leaving until the next chapter the development of guidelines to answer the question "what does one look for in judging adequacy of academic discourse"?

In general, however, it seemed that the reason for a low quality of academic discourse lay in what we have already discussed: the tutor's teaching style, their own version of the traditional I-R-E teaching mode. The tutors' approach was question driven. This kept control of dialogue in their hands, resulted in a predominance of short one, two and three word utterances by the tutees, caused the tutors to talk more often and at greater length than the tutees (producing 2½ times more discourse), and placed emphasis on memorization and "right" answers rather than joint exploration of topics in cognitive depth.
An alternative approach

New tutoring sessions

A discussion of the transcripts from Peer Tutoring (1) led Harry, the computer coordinator, to propose new peer tutoring sessions, which we call Peer Tutoring (2). Harry observed that the Our World stack had proven usable and effective with new learners from Karen's class. Therefore it should be shown to ESL students in other classes as an example of a student-produced resource but with some tutoring assists added to raise the quality of academic discourse. Peer Tutoring (1) sessions had taken place at the end of the school year (June, 1992). Therefore Peer Tutoring (2) could be one of the first activities of the new school year in September or October, 1992. At that time four of the tutors, Albert, Denis, Gladys and Hetty, would still be in the school, transferred out of ESL into regular grade classes. (The other tutors would be transferred to other schools).

Therefore it was decided, based on the experience gained with the tutoring sessions, that the four tutors still remaining in the school should teach the stack on a "buddy system" to four new tutees. These would be recruited from Grade 5 classes but have come to those classes from ESL, making them reasonably compatible with the tutors on the basis of age and second language competence.

The essential features of the new approach would be:

1. Focus on a limited number of topics but cover them in greater depth. The topics agreed were two of the Overall Topics and topics which the tutors had either been uncertain about or had avoided in Peer Tutoring (1):
a. Universe and Solar System (Overall Topic)
b. Our Earth (Overall Topic)
c. Rotation, spinning and gravity (uncertainty in Peer Tutoring 1))
d. Volcanoes (avoided in Peer Tutoring 1))

2. Develop tutoring assists in the form of key visuals for these topics based on Mohan's (1986) Knowledge Framework. These will:
   a. identify the knowledge structure(s) (KS(s)) underlying each visual;
   b. represent the KS(s) diagrammatically in relation to each topic's context;
   c. show functional words and phrases to help express the KS(s) in context.

3. Build a new HyperCard stack called the Tutorial stack as a front end to the Our World stack.

4. Orient the tutors to the new Tutorial stack and to the objectives of the new tutoring sessions.

Key visuals

The purpose of the key visuals is to give the tutors a map of the cognitive content of the topic that has to be understood and enough vocabulary to be able to express this content in complete and coherent sentences. The visuals thus provide a scaffold to support tutors' explanations and facilitate tutees' discussions. The tutor, looking at the visual, can verbally and completely introduce the topic to the tutee rather than rely upon exophoric pointing and monosyllabic interjections or asking predetermined questions without prior explanations. The tutee can use the visual for asking questions and entering into a dialogue with the tutor rather
than being the passive target of preset questions. In other words, the tutor and tutee are given a tool to help them produce clear and simple academic discourse.

The Tutorial stack

Harry created a new HyperCard stack, which he called the Tutorial stack, and added it as a front end to the Our World stack for use in the new peer teaching sessions. It introduces eight topics under the following headings which appear on the opening Menu Card:

   The Universe: Classification
   The Solar System: Classification
   The Solar System: Description
   Two Ways of Rotating: Description
   Gravity: Description
   Our Earth: Classification
   Continents and Oceans: Classification
   Volcanic Eruption: Sequence

The new stack was designed so that the first card in each group presents a structure without words except for key functional phrases. The student clicks on provided buttons to bring up the content words. Appendix 4 shows representative cards from each group. The purpose is first to introduce students to the abstract structure and then have them discover the content of that structure by clicking and bringing up the content words. The descriptive flow on the classification cards can be reversed so that the classification can be described from top down or bottom up. The eight topics thus yield some 30 different cards for exhibiting the themes on screen.
The presentation of whole sentences was avoided as far as possible so that the students would have to generate their own sentences by combining the content words and functional phrases that appear in different places on the screen. For example, the first card of the Solar System: Classification group appears with three levels of classification boxes joined by downward arrows labelled with the functional phrase "is made up of". Successive clicks bring up, first the heading "The Solar System", and then the content words "The Sun" (level 1), "The Planets" (level 2), and "Moons" (level 3). At this point the student can make up the sentence "The solar system is made up of the sun, the planets and moons" (see Appendix 4).

By clicking on a directional icon (a pointing hand) at the bottom of the screen, the student brings up the same structure but with upward instead of downward arrows labelled with the functional phrases "belong to" and "which are all part of". From this the student can make up the sentences: "The moons belong to the planets. The planets belong to the sun. The sun, moon and planets are all part of the solar system". From the various cards the students can learn not only specific content words but also some of the universal functional phrases of knowledge structures (classification, description and sequence in the Tutorial stack).

**The pedagogical objectives**

The object of the Tutorial stack is to help the tutors move beyond treating the tutees as the passive targets of unintroduced "guess what?" questions, which characterized the earlier peer tutoring sessions. In the training sessions, Harry had explained to them the meaning of the structures of the visuals. He had asked them to use these structures to help formulate explanations to the tutees in the form of clear sentences of what the structures represent; and then to have the tutees, in turn, use the structures to formulate their own explanations to show
that they had understood. He had also emphasised the need to treat the tutees with courtesy and respect (recalling some of the more heavy I-R-E exchanges). Therefore the discourse objectives of the new peer tutoring sessions may be expressed in question form as follows:

1. Did the tutors show that they understood the structures of the visuals?
2. Did they describe topics in coherent sentences matching the structures?
3. Did the tutees show through their language that they understood the structures?
4. Did the tutors treat the tutees with courtesy and respect?
5. Did the tutors avoid excessive "guess what" questioning? (used as the "I" in I-R-E).

We will look at qualitative and quantitative evidence in answering these questions. We will use the transcripts of Gladys, Hetty and Denis because their earlier peer tutoring sessions were recorded and provide a basis for comparison.

**Tutors' Training**

The tutors were the four students of Karen's last year's ESL class who still remained in the school: Gladys, Hetty, Denis and Albert. They had been "mainstreamed" and assigned to different classes. Harry arranged for two periods in the computer lab on September 15 and 16 to introduce them to the new Tutorial stack and to discuss teaching strategies based on the experience of the peer teaching sessions at the end of the previous year; and then a double period on September 21 to complete training and run the first of the new peer tutoring sessions.

**First training session**

Harry asked them what they thought were the main problems and received the following responses, made with some vigour:
1. The tutees didn't listen.

2. Their English was inadequate.

3. They were not up to speed on the computer.

4. They didn't understand why they were learning the material.

Very humanly, the tutors thought in terms of the tutees rather than themselves being responsible to do something about problems 1, 2 and 3. They would, perhaps, be entitled to regard Problem 4 as a matter resting between the tutees and the teachers of the unit.

Harry also asked them whether anything helped the sessions. They identified particularly the voice labels and the Find button. These had proved popular features in the peer teaching sessions.

Harry then told them that he would be finding some more tutees for them from grade five, and spoke to them about teaching style. He pointed out that in their Home Room last year (when they all shared the same teacher), Karen did not give them a hard time if they didn't know the answer to a question but would help them find an answer. He asked the tutors how they might help a tutee find an answer and received the general response "give clues". Then he asked them how they would give the clues, what expressions they would have on their faces and what tone of voice they would use. The responses were "be nice" and "speak clearly". Harry summed up that the important thing was to show the tutees courtesy and respect, something the Principal had spoken to the whole school about in Assembly that very day.

Having dealt at length with the matter of style, Harry turned to substance and got all the tutors around one computer and showed them the Tutorial stack, beginning with the Solar
System: Classification cards. Once the content words had been clicked into place, the students did well in forming appropriate descriptive sentences for both the "top down" and "bottom up" orientations. Harry took them quickly through the other cards, pointing out the difference between them and the original stack. The new cards, rather than showing literal pictures of the subject matter, show instead schematic pictures of subject matter organization: as a classification hierarchy, or in sequences of steps, or in descriptive patterns. Because the new tutees would not have had previous exposure to the Our World stack, Harry pointed out that the tutors may need to help them by switching between the Our World cards with their pictures and descriptions and the schematic Tutorial cards. He had provided buttons to make this switching easy. The purpose of the Tutorial cards is to help the tutors organize their discourse and help the tutees organize their responses to show that they have understood what has been presented.

Second training session

The next day Harry confirmed the arrangements for two peer tutoring sessions so that each tutor would go through the stack with two tutees in two successive weeks. He stressed that the tutees could not be expected to know what an empty box or circle in a visual represents. It was up to the tutors to tell the tutees what each visual was about and then to ask them questions to be sure that they understood. He again stressed that, if necessary, they should switch between the Tutorial visuals and the Our World picture-text cards. He then had the tutors pair up and go through the Tutorial, making up sentences to each other, while he moved around and checked their progress.
Third training session

The third and last training session was on the morning of September 21, the day of the first of the new peer teaching sessions. The computer lab had been booked for a double session. The first half was for training and the second half for peer teaching. Harry did a last review of how the various control buttons work. He then had the tutors work through the Tutorial on individual computers while he moved from one to the other challenging them and dealing with their questions. The girls complained about the "hard English" on the Volcanic Eruption card in the Tutorial stack. This card, indeed, turned out to be a problem for all the tutors in the peer tutoring sessions. Only Albert of the four tutors had worked on the volcano cards in the Our World stack. The last thing stressed was that the tutors should not worry about finding exactly the right words. This was not a test. They should use the visuals and words on screen to help them talk in their own words about what, by now, they knew well.

A final reminder

A further few minutes was spent before the second of the new peer teaching sessions on September 30. This was held in the Computer Coordinator's office, not the computer lab, with the tutor-tutee pairs coming in one pair at a time at scheduled times throughout the day. Before each session, the tutor was reminded to explain each structure to the tutee before expecting him or her to answer questions. It was suggested that the tutor treat each of the Tutorial cards like a story: to tell the story to the tutee, to give the tutee the opportunity to ask questions, and then to have the tutee tell the story back to the tutor.
The students

Tutor/tutee pairs

The pairs reported on in this section are (tutors named first, tutees second):

1. **Albert** from China, age 12, in Canada 4 years, paired with
   a. **Tommy** from Vietnam, 11¼, in Canada 5 years.
   b. **Manny** from Vietnam, age 12¼, in Canada 2½ years.

2. **Hetty** from China, age 12, in Canada 3 years, paired with
   a. **Roxy**, Canadian born Chinese, age 10¼;
   b. **Win** from Vietnam, age 10, in Canada 3 years.

3. **Denis** from Hong Kong, age 12¼, in Canada 2½ years, paired with
   a. **Sam**, Canadian born Chinese, age 10, last year in Learning Assistance Centre for cognition problems and low confidence;
   b. **Vic**, Canadian born Chinese, age 9¾, has cognition problems and low confidence, thought to have learning disability, below grade 5 norm.

4. **Gladys** from China, age 13, in Canada 3 years, paired with
   a. **Patty** from China, age 10¼, in Canada 4 years, recommended to Learning Assistance Centre for cognition problems and low confidence.
   b. **Ursula** Canadian born Chinese, age 10¼ years, above average student but still "fairly ESL".

---

1 Albert's tape recording with Tommy was faulty: no transcript was produced.

2 Manny and Win were from Karen's last year ESL class. They were the only tutees who had been previous classmates with their tutors.

3 Sam, Vic and Patty had unusual learning problems which have been noted from information provided by their teachers.
Transcript conventions and interpretation

Transcript conventions

The same conventions are used in the extracts from discourse transcripts as are used in the extracts from Peer Tutoring (1):

<table>
<thead>
<tr>
<th></th>
<th>Explanation</th>
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<tbody>
<tr>
<td>{italics}</td>
<td>Explanatory or interpretive comments</td>
</tr>
<tr>
<td>...</td>
<td>Pause in middle or at end of utterance</td>
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<td>... (#secs)</td>
<td>Pause measured by seconds</td>
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<td>^</td>
<td>Utterance interrupted</td>
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<tr>
<td>&gt;</td>
<td>Utterance left uncompleted</td>
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</tbody>
</table>

S1 = Tutor; S2 = Tutee; T = Teacher

Transcript interpretations

The interpretation of the discourse transcripts in the Qualitative Analysis which follows is based upon judgments of the students' understanding and attitudes. These judgments are based upon: the evidence of the transcripts themselves; observations of and conversations with the tutors in various environments over a three-month period; and observations of the tutees during the recording sessions and conversations with them after the sessions before they went back to their classrooms.
PEDAGOGICAL ANALYSIS

Qualitative analysis of discourse by pedagogical objective

The tutor/tutee discourses are analyzed by the pedagogical objectives stated in the form of questions in the previous section:

1. Did the tutors show that they understood the structures of the visuals?
2. Did they describe topics in coherent sentences matching the structures?
3. Did the tutees show through their language that they understood the structures?
4. Did the tutors treat the tutees with courtesy and respect?
5. Did the tutors avoid excessive "guess what" questioning? (used as the "I" in I-R-E).

Objective 1: Understanding the visual structures

The tutors showed a sound grasp of the structures of the visuals. These cover Classification, Description and Sequence. The simplest structure is Description because the visuals are not completely abstract: they include, at least, a diagrammatic representation of their subject matter. Sequence is abstract but at least presents a well understood principle, that one thing comes after another in a causal and/or temporal sense. The most complex of the structures is Classification because it is completely abstract, with no representational component and no overt indication of the classification principle. The following examples cover discourse centred on the Classification and Sequence visuals.

Our Earth: Classification

Gladys and Patty:

Gladys has just gone over with Patty the "downwards" classification: "Earth is made up of Land and Water; Land is divided into Continents and Islands; Water is divided into
Oceans, Seas, Rivers and Lakes". She then reverses the direction of the arrows and introduces to Patty the "upwards" classification with a briskness that alarms Patty.

S1 What is made up of what and what's made up of what that's made of what?
{Gladys confuses "made up of" with "make up" but gets it right when she makes up her own sentence}
S2 You can't say that {with some alarm}.
S1 The same as the last one . . . This one just did.
S2 {nervously} hee hee hee.
S1 {under her breath} Oh boy! . . . Okay now, let me try this one. This one's sea, river, lake, ocean. They making the water.

This brief exchange reveals a great deal. Gladys is a bright student who grasps concepts quickly. Her quickness of understanding is matched by her quickness of speech in expressing it. The "What is made up of what . . . that's made up of what" line pours out like water from an open tap and indicates clearly that she understands the principle of classification before her. Patty on the other hand has learning problems and lacks confidence and has been recommended to her school's Learning Assistance Centre. Gladys intuitively picks up from Patty's nervous laugh that she is not going to catch on quickly (unlike Gladys's previous tutee, Nancy, who matched Gladys in wit and speed). Hence the "Oh boy!" which the microphone picked up but which Patty probably did not hear. Loosely translated, Gladys is saying "Oh boy! What have I been saddled with"? Being an outgoing and courteous girl, and also remembering how courtesy was urged in the training sessions, Gladys catches herself and after a 3-second pause says "Okay now, let me try this one" by which she means that she will take the load off Patty and show how to describe the "upward" classification. This she proceeds to do.
Hetty and Roxy.

Hetty, like Gladys, shows her understanding of the structure of Our Earth:

Classification in the way she introduces it. Her tutee, Roxy, is a confident student who can challenge Hetty and follow along with her.

S1 Okay . . . this one . . . what is made up of what and what.
S2 How'd'y'know it?
S1 Okay, the earth is made up of continents and oceans. Now you press this one {clicks up the words} . . . Ooh! land and water {Hetty realizes that the chart follows the high-level classification "land and water" rather than "continents and oceans"}. Now land is divided into continents and . . . now just press this, see? . . . islands and continents. Water is divided into oceans, lakes, seas and river. Press this, see?

Hetty is not fazed by her mistake and shows that she realizes that choices can be made in classification schemes. She understands the scheme the card is following and is competent and comfortable in describing it.

Denis and Sam.

Denis shows clear understanding of the principles underlying Our Earth: Classification and of the mechanics of the chart.

S1 See next one. What is this? Our earth was made of . . . This our earth, eh?
S2 Yeah.
S1 This box is our earth {one of the boxes on the classification chart}. What's both made of? {the two boxes making up "Earth"}. Last time we learn it {when they named the continents and oceans from the map of the world in the "Our World" stack}.

Denis proceeds to go through the chart without even clicking up the words, showing that he understands the principles of its construction. However, he should have clicked up the words the first time through for Sam's benefit. He leads Sam through various clues to construct the sentence "Our earth is made up of land and water". Like Gladys and Hetty, he also shows his
understanding of the classification principle by the generalizing use of the pronoun "whatever". He reverses the direction of the chart:

S1  Press the next one \emph{(the reversing hand icon)}. See this one. What does this do?
S2  Huh?
S1  What things have we got to whatever? What things make up to the earth?

He helps Sam to follow the chart in its reversing direction, again without clicking up the words. He is still playing a guessing game. Sam enters into the spirit of this, saying "Ah no, don't tell me". Denis gives him a series of elaborate clues until he leads him to the required sentence "Islands and continents make up the land".

**Solar System: Classification**

An understanding of a principle sometimes shows through misinterpretation of its application. Solar System: Classification was misinterpreted by all three tutors because they did not appreciate the difference between the application of the phrase "made up of" in the contexts of the Solar System and Our Earth. In Our Earth: Classification, which they had studied earlier, the classification scheme describes what each entity is "made up of" or "divided into" or simply "is", in a hierarchical breakdown of part/whole relations: Earth is made up of land and water, the land is divided into continents and islands . . . and etc.

Following Werner and Schoepfle (1987) we group "part/whole" and "taxonomy" as two types of classification. The students have difficulty in consistently using the part/whole relation as shown in the three extracts which follow.
Gladys and Patty.

Gladys shows ambiguity in interpreting Solar System: Classification. She knows the right sentence to compose but misreads the chart's intention and so misleads (and fails to correct) Patty:

S1 The solar system is made up of the sun and the sun is made up of what?
S2 The rocks?
S1 No.
S2 The planet.
S1 Right and?
S2 The stars?
S1 No. How about this little thing \{pointing to the small "moon" circles\}. This one are the planets \{pointing to the "planet" circles\}. How about this one \{pointing back to the "moon" circles\}.
S2 This one moons.
S1 Click it \{which brings up the words\}. Okay, how about that one \{the "moon" circles\}? Okay, now read it in the sentences.
S2 The solar system is made up of the sun. (Um) the sun is made up of the planets . . . and the moon.
S1 Okay. The solar system is made up of the sun, the planets and the moons, that's all \{Gladys does not catch Patty's error yet states the sentence correctly\}.

Gladys and Patty had earlier done Our Earth: Classification and were following that model for the Solar System. One can state correctly from the Our Earth card that "Earth is made up of Land and Water; Land is divided into ("is made up of" would also fit) Islands and Continents; Water is divided into Oceans, Seas, Rivers and Lakes". However, it is not correct to say: "The Sun is made up of the Planets" and "The Planets are made up of Moons". The visual could remove the ambiguity by putting the word "and" after "The Sun" and "The Planets". Gladys knew this and produced the right sentence but did not spot the inconsistency between it and Patty's interpretation of the visual structure.
Hetty and Win.

Hetty had the same problem as Gladys. In her session with Win, the teacher happened to be by. Hetty realized that her interpretation was not making sense and checked it out:

S1 Oh Mr Gray how you say this one? The solar system is made up of sun, the sun is made up of planets?
T It doesn't say that.
S1 Yeah . . . it . . . oops!
T The solar system is made up of the sun?
S1 Yeah . . . the planets and the moon. Ahhh! oh, like that.
T See, there's only one "made up".
S1 Oh, oh, yeah, oh yeah, okay. The solar system is made up of the sun, the planets and the moon {Hetty gets this out fast with great certainty and then clicks on the hand icon to reverse the arrows and carries on with equal certainty} The moon, the planets and the sun is all part of the solar system.

Denis and Sam.

The first time through, Denis has Sam click up the words after he has incorrectly guessed what the symbols represent (e.g. he guesses "stars" for the second line of circles instead of "planets"). However, once the words are on screen, Sam makes up the correct sentence "The solar system is made up of the sun, the planets, moons". The second time through, reviewing, Denis and Sam misinterpret the chart in the same way as Gladys and Hetty and their partners:

S1 Make a sentence.
S2 The moon is made up of the planets.
S1 The planets? {This is to prompt the next sentence, not to question Sam's mistake}.
S2 Um, the stars^  
S1 The planets is . . . {Denis corrects the word "stars" but does not question the pattern of the sentence}.
S2 Made up of . . .
S1 The sun {Denis continues Sam's error pattern}.  
{a few moments later when all the content words are displayed}  
S1 Read it again.
S2 The solar system is made up of the sun, the planets^
Si And?
S2 The moons.

Both students correctly interpret the visual as a whole without seeing the inconsistency of their previous interpretation of the parts.

**Volcanic Eruption: Sequence**

All the tutors had problems with the Volcano Eruption: Sequence cards but understanding the structure was not one of them.

**Gladys and Patty** (September 21):

S1 Okay now, first is the earthquake.
S2 Okay
S1 Now maja {her reading of "magma" from the label "disturbs the magma"} then what? Then there's a rock on the earth {the earthquake rocks the earth}, I don't know. Come up volcano {refers to label "magma forced up"}. Then maja change to lava.

This exchange was produced after, on the teacher's advice, they had looked at the Volcano cards in the Our World stack. They read in unison the information they found there:

S1,S2 {together} A volcano is a special sort of mountain because they explode. Earthquakes are one causes of volcano. The earthquake cause the maja {misreading "magma"} to rumble and roar. Then the maja comes out the top of the volcano. The top of the volcano is called a crat . . oh yeah, crater. Maja is hot melted rocks that comes from inside the earth. Then the maja flows down the side of the volcano. When the maja is outside the volcano it is called lava. Lava is a black rock. Maja becomes lava when the maja comes out of the volcano. When the maja cools it will change to lava.

Gladys understands perfectly the notion of sequence, that one thing comes after another. Her problem is understanding conceptually the different things that happen when a volcano erupts.

What they had read together provided enough information to turn the clue words on the Tutorial card into sentences, despite some ambiguity in the Our World cards between flowing lava and lava being a black rock. The inadequacy of Gladys's Tutorial description indicates
that they had read but not understood. They read together in a sing-song mechanical way.

Although what they read was accompanied by a drawing with clear labels describing the whole process, they made no attempt to link their reading with the drawing. They also made no attempt to follow the drawing provided on the Tutorial card, which was a reduced copy of the original in the Our World stack. Their problem, therefore, seems twofold: 1) a difficulty in linking new content vocabulary to new concepts and 2) unfamiliarity in using a labelled drawing to help understand the text.

**Hetty (tutor)** (September 30):

In the second tutorial session (September 30) in the computer coordinator's office, the teacher explained to each pair in turn how to read the "volcano eruption story" and how to relate it to the provided picture of the process. With this additional coaching, they all did much better. Here is Hetty's version:

S1  Okay I'll say it again *(Hetty had had a trial run with the teacher and now voluntarily repeats)*. The earthquake is . . . start a earthquake. And it disturbs the magma. And it force the magma come up from the crater. And it blows out the steam and ash. The magma becomes lava and flows down . . . *(prompted by teacher)* Oh, down the side of the mountain. And the lava solidfies into rock.

**Gladys (tutor)** (September 30):

Gladys pays more attention to the functional sequence words and phrases on the card:

S1  First there is a earthquake. As a result it destruct *(disturbs)* the magma. And force magma up into the crater. Then blow out steam and ashes. At the same time, magma's become lava and flows down the volcano. Finally, the lava solidfies into rock.
Vic (tutee) (September 30):

Because the tutors did better, the tutees also did well in this second session. Denis's tutee, Vic, was particularly fluent and well organized:

S2 First, there was an earthquake. Second, as a result, disturb magma. Third, and forces magma up. And fourth, blows out steam and ash. At the same time, five, magma becomes lava and flows down. Sixth, lastly, lava solidifies into . . .

S1 Rocks.

S2 Rocks, hot rocks, whatever.

Summary of Objective 1 realization

All tutors dealt confidently with the Description visuals (Solar System, Two Ways of Rotating, Gravity). If anything, they were all too familiar with these visuals and expected the tutees to guess what they meant without the help of text labels (discussed under Objective 5). However, they also asked helpful prompting questions. Gladys is typical of the other tutors: e.g. on Gravity: Description she asks: "What is held in place by what?"; and on Two Ways of Rotating: Description she asks: "The earth goes around what?". She understands how the structures work and seeks to help her tutee understand the visual abstractions by partly supplying and partly drawing out from her the labels that contextualize them.

All tutors also dealt confidently with the three Classification visuals for The Universe, Our Earth, and Continents and Oceans; but showed ambiguity in dealing with the one for the Solar System. Only Hetty showed evidence that she knew there was a problem. This was the difficulty of working with part/whole relationships at different levels of abstraction: e.g. on the one hand, the earth is made up of land and water, land is made up of continents and
islands, and etc. while on the other hand, the solar system (an abstraction) is made up of the sun, the planets and the moons.

The tutees showed an understanding of the structures after the tutors had explained them. Sometimes they needed help in generating their descriptions. Sometimes they generated descriptions spontaneously, particularly with the Description cards for Two Ways of Rotating and Gravity.

All had problems with Volcanic Eruption: Sequence but not because of a problem with the Sequence structure but rather because they lacked content concepts and vocabulary and did not make use of the provided drawing of the process. They did better with this theme after additional coaching from the teacher.

Objectives 2 & 3: Production of Language to Match Structures

The tutors produced clear and coherent sentences to match the structures, particularly in the second (September 30) sessions when they were reminded to start off in this way rather than have the tutees guess what the visuals represented. The tutees, on the whole, needed the tutors' help in structuring their response sentences although in some cases they produced substantial statements unaided. These points are illustrated in the following examples:

Our Earth: Classification

Gladys and Ursula (September 30):

S1  Okay, now this one is our earth. It is divided into land and water 
   {acceptably substituting "divided into" for "made up of"). And land is 
   divided into islands and continents, see? And the water is divided into rivers, oceans, seas and lakes, see? If you don't understand, ask me, okay? . . . And 
   these ones reverse. And these ones, islands, continents is made up of the 
   {incorrectly using "made up of" instead of "make up")^
S2  Land {Ursula interrupts to correctly complete the statement}. 
Gladys starts off with a full set of statements. As Ursula spontaneously joins in to jointly construct the second set of statements, Gladys lapses into partial statements, relying on exophoric pointing to supply the meaning. Ursula, when asked by Gladys to make up her own description, starts uncertainly but, with corrections and prompts from Gladys, completes her statement in a series of sentence fragments:

S2 The land is (er) continents and . . . water?
S1 No, land is where you stand on {a good extemporaneous definition}.
S2 Land and continents? No, continents.
S1 Right.
S2 Um . . . isl^{*}
S1 Island. Now d'y'remember this one?
S2 Yeah.
S1 Okay, what does this divide to?
S2 Lakes, oceans, sea . . . {then repeated whisper} lakes, ocean, sea, {then full voice} river.
S1 Right . . . Now, d'y'know how to do this one backwards?
S2 Like, you mean what?
S1 Like this one, Land . . .
S2 Oh, er islands and continents {correct, but omitting the formal "Land is divided into"}
S1 And this one's divided into?
S2 Er lakes, sea, ocean, river {again omitting the formal "Water is divided into"}
S1 You got it right.

Solar System: Description

Gladys and Ursula (September 30):

The first card for Solar System: Description is designed to elicit a simple high level description of the two major components of the solar system: the sun in the middle and the
planets going around the sun. After dealing with this but before going to the next card which contains prompts for a more detailed description, Gladys launches immediately into that description:

S1 There are nine planets in the solar system and there is a sun. The sun is a star. And there are many moons around some of those planets. The closest one to the sun is Mercury and the farthest is Pluto. And some of the planets have rings around them. Can you see that? \{the diagram of the planets revolving around the sun remains the same in the two "Solar System" cards so it is possible to "see" what Gladys refers to\}

S2 Can you say it one more time? \{Ursula is somewhat overwhelmed\}

T Go on to the other card that shows that information.

Gladys goes to the other card and runs through the description more slowly. The teacher reminds her to click as she goes to bring up the content labels and visual connecting lines.

When Ursula is asked to give her description, she starts with some complete statements of what is immediately in her head and then carries on with prompts and assists from Gladys.

They switch between the two Description cards:

S2 And some of them has moons. Some of them has rings around it. And there's nine planets. The (er) the sun is where, a star?

S1 Yeah. Okay, here's your question \{Gladys clicks to the preceding card\}.

S2 \{reading prompt in a whisper\} We have the^ S1 Read it louder.

S2 We have on the one hand in the centre, middle of the^ S1 This one.

S2 Sun.

S1 See, and this one.

S2 We have on the other hand on the other side \{should be "outside"\} going around the sun . . .

S1 What are this?

S2 I dunno.

S1 This one, this black thing.

S2 Oh, planets.

S1 Right. Planets are going around the sun. \{then clicks to the next card\} Now I just sayed that. Number of planets?

S2 Nine.

S1 D'y''know what are their names? D'y''know how to read them?
S2 Yep, Mercury, Venus, Earth, Mars, Saturn, Jupiter, Uranus?
S1 Uranus.
S2 I don't know that one.
S1 Neptune.
S2 Neptune, Pluto.
S1 Okay, and biggest?
S2 The biggest is Jupiter.
S1 Right, and smallest?
S2 Planet's Mercury \{joins to preceding words to complete a joint sentence\}.
S1 Mercury, right. And nearest?
S2 And nearest to the sun?
S1 Yeah.
S2 Is (er) Mercury \{completes a joint sentence\}.
S1 And the farest?
S2 Is Pluto \{completes a joint sentence\}.
S1 Right.
S2 And some have?
S1 Moons around it \{completes joint sentence\}. And some has rings around it.
S2 And some have both . . .
S1 Both (er) rings and moon \{completes a joint sentence\}.

Gladys has run through these two cards without clicking up the content words. Ursula is a bright student who has studied the solar system in previous classes and remembers her facts. She therefore provides a smooth succession of answers that complete the sentences that Gladys has started.

**Denis and Vic (September 30):**

Denis and Vic proceed in a somewhat similar way except that Vic is a less confident student with problems, according to his teacher, in internal cognitive processing and external language production. He therefore needs a clearly stated spoken model before answering the questions. Denis inappropriately lapses into the "guessing game" with him. An extract from their discourse is quoted under Objective 5: Moving Away from the "Questioning Mode". Denis does, however, insist that Vic produce whole sentences at the end of each segment.
Hetty and Win (September 30):

Hetty provides full and accurate descriptive statements, like Gladys. She also clicks as she goes so that Win can see the content words and visual connecting lines that come up on the screen. However, a different type of problem arises in her interaction with Win:

S1 We have, on the one hand in the centre, the sun. Okay, the sun? We have, on the other hand on the outside, the planets going around the sun.
{whispering} Okay now this one. Ah! that's better {the next screen comes up}. There're nine planets in the solar system. {in a whisper} Hurry up! {the computer takes time to respond to her click}. The biggest planet is Jupiter.
{in a soft voice} D'y'wanna hold the mouse?
S2 {in a tiny whisper} No, that's okay.
S1 The smallest planet is Pluto too.
S2 {whispers} Tha's what Flo {a classmate} call me.
S1 The nearest planet to the sun is Mercury.
S2 {whispers} This one put over there.
S1 The furthest from the sun is Pluto too.
S2 {whispers} How come you know?
S1 Yeah, I know. It's easy. Some have rings. Other have moons. {whispers to herself} Check it {i.e. click up the words and connecting lines}. Whoops! Oh yeah. {sighs and whispers} Rings. Oh tcha! . . . {whispers} Moon . . . Okay, now you answer. We have . . .
S2 We have . . .
S1 Just read it {the clue words}.
S2 On the one^.
S1 Hand.
S2 In the^.
S1 {whispers} Centre.
S2 Centre.
S1 The . . .
S2 The . . .
S1 The sun.
S2 Sun.
S1 You're right. You don't need to see it {Hetty stops clicking and carries on giving Win cues which Win may or may not answer. If she doesn't answer, Hetty supplies the answer which Win mechanically repeats}.
{a little later}
S2 {whispers} Tomorrow we are going ice skating. Great okay?
Hetty and Win are ESL classmates from the previous year. Hetty has been "mainstreamed" while Win, who is younger, remains in the ESL class. The two know each other well. The above exchange shows that Hetty is able to describe a card with fluent, consecutive sentences. It also indicates an unspoken agenda that emerges between the two girls after a number of Win's irrelevant whispered *sub voce* remarks. This agenda is simply to get through each card in the fastest possible time by Hetty providing answers to the questions in rapid sequences of two and three word sentence fragments which Win mechanically repeats. Each exchange concludes with Hetty triumphantly exclaiming "Finished!" This pattern recurs throughout their discourse. Both girls' objective is clearly to "get finished" so that they can indulge in social chit chat or, as Hetty would put it, "have fun". In Win, Hetty has a cheerful co-conspirator.

**Two Ways of Rotating: Description**

The tutees all showed greater independence in generating their own sentences in Two Ways of Rotating: Description. Even Hetty and Win briefly broke off from their mechanical question and answer routine.

**Gladys and Ursula (September 30):**

- S1 You put "earth goes around the sun" in three sentences. And you says goes around, rotates around and revolves around. (I'll) do the first one. The earth goes around the sun. The earth ro-tates *{equal emphasis on both syllables}* around the sun. The earth revolves around the sun.
  S2 Oh!
  S1 Now you say that one *{referring to the earth-moon instead of sun-earth circle}*). That one the earth, this one's the moon, this what I just said, the same.
  S2 Oh, you want me to say the same thing that you said, right?
  S1 But I don't want you to use the earth and the sun. I want you to use the moon and the earth.
  S2 Is it the same thing?
  S1 Yeah, use three . . .
  S2 The moon goes around the earth.
S1 Right.
S2 The moon 'tates around the earth?
S1 Yeah.
S2 The moon remove^.
S1 Revolves.
S2 Revolves around the earth.

- S1 The earth's axit. The earth spin around the axit. You just say now. You're saying the same thing. Say that.
S2 Huh?
S1 This one's the earth's axit [the line drawn through the circle representing the earth's axis]. Spin around the earth's axit. Then put it in new sentences.
  Earth . . .
S2 Earth goes around the axit.
S1 Earth's axit.
S2 Earth's axit. Earth 'tates around the earth axit. Earth removes^.
S1 Revolves.
S2 Revolves around the axit.
S1 Earth's axit.
S2 Earth's axit.
S1 You say that again. Spin around you saying.
S2 Earth spin around the earth's axit.

Denis and Vic (September 30):

Denis adopts the same strategy as Gladys in making up first the sun-earth sentence as a model and then having Vic make up the earth-moon sentence:

S1 You can make a sentence. You can use those words. I teach you one first, okay? The earth goes around the sun . . . See earth goes around or rotate . . . See you make a sentence.
S2 Like that?
S1 Uhhuh. There's the earth, there's the moon. The moon . . .
S2 The moon goes around the earth.
S1 Yeah, that's right. Let's see this one . . . The earth . . .
S2 The earth spins around earth {earth's} . . .
S1 Axis.
S2 Axis.

Hetty and Win (September 30):

Win spontaneously makes up her earth-moon sentence after Hetty's sun-earth example:
Okay, you say the earth.
The earth...
Goes around the sun.
The sun.

The earth go around the sun.
The moon go around the earth {Win breaks the mechanical answering routine}.

Gravity, Description

Ursula with Gladys and Vic with Denis follow the same pattern with Gravity as they have with Two Ways of Rotating:

Gladys and Ursula

Okay, gravity is a force.
If there's no gravity, people will fly off {Ursula knows something about gravity}.
Now, okay... put this earth and sun into the sentences.
Huh?
Oh, don't worry. {beneath breath Gladys works on composing a sentence} The (sen) sun is held... er the... see the... {she continues out loud} Okay? Now I'll help you. Earth is held in place by... Earth is held in place by sun's gravity. See? Now you read that one {referring to the earth-moon circle}.

Earth is held in place by sun's gravity.

Now use this one {the earth-moon circle}.
Earth...

No.
No, moon is held in place by earth gravity.
Right. Now nothing more. It'll do.

Denis and Vic.

I make my sentence while you obey. Earth is held in place by sun gravity...
Okay, see you make one.

Moon is held in place by earth gravity.

Yep.
Volcanic Eruption: Sequence

The particular difficulties with this card have been explained above under Objective 1: Understanding the Visual Structures.

Summary of Objectives 2 & 3 realization

The tutors adequately matched the cognitive structures with appropriate language except for some confusion between the functional phrases "make up" and "is made up of", noted under Solar System: Classification in the preceding section. Gladys and Denis tended to give their descriptions without clicking up the content words on screen. Gladys assisted her tutee by asking leading questions so that much of the tutee's response was in the form of joint sentences with her. Denis also did this but additionally insisted on his tutee producing whole sentence descriptions. Hetty gave her descriptions as she clicked up the content words but over-assisted her tutee by feeding her replies to questions in the form of sentence fragments which the tutee mechanically repeated. The tutees' greatest success with unassisted whole-sentence descriptions was with the Two Ways of Rotating and Gravity. Volcanic Eruption: Sequence presented special difficulties with unfamiliar concepts and content words.

Objective 4: Courteous Treatment of Tutees

In the first peer tutoring sessions on June 4, 18 and 19, the tutors had played out their interpretation of the I-R-E teaching model: they had the answers and their task was to get the tutees to guess what those answers were. Charley, in particular, on several occasions chided his tutee for his "forgetfulness". In all cases the tutors emphasised the need for the tutees to remember the "right" answers and to be able to produce those answers on cue. The tutors did not explain first what the subject matter was about but led straight in with questions. This
tended to make the tutees apprehensive and sometimes defensive. Harry Green, in the training periods before the second set of peer tutoring sessions, discussed these problems with the tutors. They readily agreed on the need for a gentle approach that would reassure the tutees. Harry also emphasised that the peer tutoring sessions were not a test. The tutors took all this to heart and were exemplarily courteous in the new peer tutoring sessions.

**Gladys:**

Gladys had a problem with Patty, who was not such an able learner as Gladys's previous tutee, Betty. Gladys was confronted with this problem early in her discourse with Patty (see the first discourse segment under Objective 1: Understanding the Visual Structures). As soon as Gladys realized that Patty was having a problem following her, she immediately responded with positive assistance:

S1 Okay, I told you this one's land. And this too is divided into what?
S2 Umm *expressing great doubt*.
S1 I just told you *in a playful tone of voice*.
S2 *in a whisper* Land, river . . .
S1 Okay I'm going to give you a hand.

Upon this Gladys proceeds to walk Patty through this particular part of Our Earth: Classification. Later, Patty has a problem with Gravity: Description. Gladys asks her to make up a sentence but gives her encouragement and reassurance:

S1 What is held in place by what? . . . Get it? You guess it. Don't need to be right. Now you click that one.
S2 Okay.
S1 Just guess it.

Again, Gladys patiently helps Patty to make her sentence correctly.

In both of her sessions, Gladys shows her consideration with such comments and questions as, "If you don't understand, ask me", "Do you remember this one?", "Do you
understand that one?", "Do you want to say it again?", "Don't worry", "You don't need to be right", "Now I'll help you", "I'm going to give you a hand".

**Denis:**

Dennis was more inclined than the other tutors to adhere to the questioning technique without first providing examples. He did this extensively in his September 21 session with Sam and, to a lesser extent, in his September 30 session with Vic. However, he was at all times encouraging, even in his questioning mode. He would end an exchange with positive comments like "Perfect!", "You got it right!", "You got it right again!" and, as superlatives, "What a dazz!", "Ah, you're so good!", "You know everything, almost!".

**Hetty:**

Hetty's main objective was to "have fun" which, for her, meant browsing through the Our World stack rather than the Tutorial. She was a congenial companion in both stacks. She simply found more to be congenial about in the Our World stack. As she said to Roxy after the teacher had directed her back to the Tutorial: "We'll play later". In the Tutorial with Roxy, she produced good explanations of each card but tended to keep up a running commentary which limited Roxy's opportunities for response. In the Tutorial with Win, she followed a mechanical question and answer routine which increased Win's production of language over Roxy. This was, however, largely through Win mechanically repeating sentences and sentence fragments fed to her by Hetty. Hetty no doubt considered that she was helping her tutees in sometimes providing a continuous stream of information and other times feeding them answers to questions. What she actually did, however, was overshadow them and limit their responses.
Objective 5: Moving Away from the "Questioning Mode"

By the "questioning mode" is meant the practice, prevalent in the first peer teaching sessions, of making each tutorial a continuous interrogation of the tutee with no introduction of subject matter and no modelling of the sort of responses required. In the new peer teaching sessions, the tutors did move away from this mode, but not entirely. In the first of the new sessions (September 21) it persisted noticeably; in the second session (September 30), after a reminder just before the session to "tell the story" first, it lessened greatly but did not entirely disappear.

Gladys

Gladys illustrates the general tendency. In her session on September 21 with Patty, she starts out with Our Earth Classification. Rather than clicking up the words and going through it in a straightforward way, she describes the first level of the visual with the classification boxes blank on the screen. Only then does she click and bring up the words. She then moves on to the next section of the chart and asks Patty to guess how it goes. Only then does she tell her to click up the words.

S1 This is our earth.
S2 Yep.
S1 The earth is made up of . . . earth, land, water. Guess, then you click
{Gladys brings up the confirming words}. . . Land like? {Patty is confronted with blank boxes}
S2 Have country {a reasonable guess with no prior knowledge of the classification scheme}.
S1 No, is divide into continents and islands. Now, do you know how water divide?
S2 Oh . . . lake?
S1 Yeah {a good guess}. And?
S2 And . . . {Patty's run out of ideas}
S1 There're three more.
S2 Um . . . river.
This was Patty's first exposure to the Tutorial and the Our World stack. It would have made sense simply to go through it first with all the content words in place. There are many ways of classifying "our Earth" or any other entity. There is no one "correct way" and therefore no way in which one can be expected to guess the particular breakdown that has been chosen. Speaking to a blank chart may be reasonable in a review or even when clicking the reversing icon and going through the same chart from bottom up instead of top down, but not before the method of classification has been explained,

Gladys broke with this pattern in the September 30 session with Ursula. Only once did she engage in a "guessing game" routine:

S1  Now, did you remember the continents? *Gladys had earlier gone over them*
S2  Er . . . maybe.
S1  Okay, try all think of.
S2  Australia, Asia, North America, South America, Europe . . . I can't remember all of it.
S1  "A" *sounds the "A" of Africa*, begin with "A".
S2  Australia?
S1  No, you said that before.
S2  Oh.
S1  Another "A" . . . under Europe.
S2  Huh?
S1  Under Europe.
S2  Europe?
S1  Under Europe . . . Africa.
This was an isolated diversion. When Ursula did not connect with Gladys's clues, she simply
told her the answer without prolonging the agony.

**Denis**

Denis employed the questioning mode extensively in his session on September 21 with
Sam. The following is one brief example from their dialogue on Solar System: Classification:

S1 What is this? *{Sam has clicked up the first card which has the visual
schematic but no content words}.*

S2 It's circles *{a completely accurate reply: only unlabelled circles were to be
seen}*.

S1 The universe! *{how could Sam have known?} Up here you can click it and
it works.*

S2 Anywhere?

S1 Mmm.

S2 Do you know where it is? Make up of what? What is those circles? *{only
the "Universe" label has appeared so far}*

S1 Small little planets. *{Sam has not the idea of schematic representation: he perceives the circles as "little"; therefore whatever they represent must be
"little"}*

S2 Mmm. *{Denis assents to Sam's incorrect answer}*

S1 Um . . . stars *{Denis corrects himself}. Press it. See "Stars" *{the written
label: this clicking should have been done at the beginning on a first
viewing}*

Denis used the questioning mode less in his session on September 30 with Vic, after
being reminded just before the session to click with the mouse to help tell the story on the
screen. He also encouraged Vic to use the mouse: "If you don't know, just click".

There were, however, lapses. When they got to Solar System: Description, Denis
forgot to give his introductory "story" and reverted to a series of questions. Because Vic had
some knowledge of the solar system he was able to answer most of them: the number of
planets, the biggest and the smallest planets, and the planets nearest and furthest from the sun.

Then they got to the prompt words "Some have . . .", "Others have . . .", "Some have both . .
The words required to fill in the blanks are not obvious without clicking. The clicking brings up the content words not in the blanks but on the schematic diagram of the solar system. The student can then make up appropriate sentences and become familiar with the usage of the functional phrases of description on screen. Denis, however, continues with the guessing game:

S1  Let's see, some have and . . . ?
S2  Some has like ice around it?
S1  No, little balls, what those little balls? {little black dots (moons) around small circles (planets)}
S2  Clocks?
S1  What we see alight at night?
S2  Sun?
S1  At night, nighttime sleeping and the yellow thing?
S2  Stars.
S1  Yellow thing, big one.
S2  Moon.
S1  Yeah, that's moon. Click on it. Some have . . . moon. Ah, see this one {the word "moons" and pointers to the planets with moons appear on screen}. There, now's your moon.
S2  Moons.
S1  Some both have . . . {Denis inverts the word order of "have both"}
S2  Some both have . . .
S1  Just two words. Moon and?
S2  Sun?
S1  No, what those have?
S2  Rings.

Vic had no idea of what was required. After his first wild guesses of "ice" and "clocks" he realized it had to be something to do with the solar system. So he came up with anything he could think of that would fit, like "sun" and "stars". It would have been better simply to click at the outset and make up the sentences to complete the overall description of the Solar System. Deferring the clicking may be appropriate when reviewing the material.
After this they moved to Two Ways of Rotating: Description. The screen shows three sets of circles with no labels. Without previous knowledge of the stack, there is no way of knowing what those circles represent. Denis briefly relapses into the guessing game:

S1 Do you know what's this?
S2 No.
S1 Sun \textit{(Denis is direct and does not go through a long list of clues).} What's this?
S2 Planets.
S1 No, our Earth.

Denis goes on to explain the first set of circles and then tells Vic directly about the next set:

"There's the earth, there's the moon".

\textbf{Summary of Objective 5 realization}

The use of the "questioning mode" persisted in the first sessions (September 21) but lessened in the second (September 30) when it came into play only occasionally, like an old habit. The tutors by then realized that they needed to actively model descriptions for the tutees rather than drag answers out of them by a series of unintroduced questions and elaborate clues.

\textbf{Qualitative Summary}

The PT (2) sessions (September 21-30) differed from PT (1) sessions (June 4-19) in the use of the Tutorial stack with its key visuals and functional language clues. These were provided to help the tutors generate academic discourse, i.e. complete and coherent utterances to describe each topic, using appropriate cognitive structures. The main cognitive structures in the Tutorial are description, classification and sequence. The visuals provide a graphic structure, content words and functional phrases. The tutors' task is to integrate these elements
into utterances for communication to the tutees and then have the tutees, with help from the tutors, describe each topic as it has been described to them.

In pre-discourse training sessions, the computer coordination teacher oriented the tutors to the Tutorial structures, asked them to introduce each topic before questioning the tutees, and stressed the need for sensitivity and courtesy in interactions with the tutees. The qualitative analysis was, therefore, governed by the following questions:

1. Did the tutors show that they understood the structures of the visuals?
2. Did they describe topics in coherent sentences matching the structures?
3. Did the tutees show through their language that they understood the structures?
4. Did the tutors treat the tutees with courtesy and respect?
5. Did the tutors avoid excessive "guess what" questioning?

The tutors, through their language and tutoring strategies, showed that they understood the structures of the visuals but, in connection with Solar System: Classification, did not understand the correct use of some functional phrases. They produced clear descriptions of the topics but, in connection with Volcanic Eruption: Sequence, did not always use the functional phrases provided. The tutees, through their language and responses, showed that they also understood the structures and could emulate, with some help from the tutors, the topic descriptions. They shared the tutors' problems with the Solar System: Classification and Volcanic Eruption: Sequence charts.

The tutors were uniformly courteous and considerate in their interactions with the tutees and made them feel at ease. The tutors in the September 21 sessions still tended to use
their unintroduced questioning technique but in the September 30 final sessions moved away from this and only occasionally used guessing strategies to elicit answers from tutees.
QUANTITATIVE ANALYSIS

Background

Methodology

The Systematic Analysis of Language Transcripts (SALT) system (Miller & Chapman 1984-1991, University of Wisconsin-Madison.) was used to prepare and analyze transcripts for Peer Tutoring (2), September 23 and 30 as for Peer Tutoring (1), June 4-19. Results are presented with the aid of four charts:

1. Turns by Number of Utterances
2. Utterances by Number of Words
3. Words per Minute (WPM)
4. Mean Length of Utterance (MLU)

All mazes are excluded from the data analyzed.

The transcripts for (PT1) were edited to exclude discourse with teachers. The transcripts for (PT2) were edited to exclude discourse on the Our World stack, as distinct from the Tutorial, as well as discourse with teachers. This was done to facilitate a comparison between discourses on the Our World stack in PT(1) and discourses on the Tutorial stack in PT(2).

Tutor/tutee comparability

The tutors have different personalities, temperaments and ranges of ability. They are, however, fairly evenly matched in their ability to undertake the tutor role. Hetty stands out from Gladys and Denis as more likely to follow her own agenda (see her profile in Chapter 1), which contributes to differences between her and the other two tutors' quantitative results.
The tutees vary more widely and range from the well adjusted and confident Nancy (PT1) and Ursula (PT2) to the less well adjusted and unconfident Vic, Sam and Patty (PT2), who all had learning problems. In between is Lenny (PT1), low academically but good at talking and Roxy and Manny (PT2), rated as average. In a class by themselves are Olly (PT1) and Win (PT2) who arrived in Canada from refugee camps illiterate and therefore started from further back than the other tutees.

Hypothesized results of PT(1) and PT(2) comparison

The training sessions had emphasised the need for the tutors to clearly explain to the tutees what each of the Tutorial visuals was about and to have them "tell the story" back. One would hypothesize an increase in PT(2) over PT(1) on all the reported measurements with the tutors' move away from unintroduced questioning and the production of more continuous descriptions by both tutors and tutees. This hypothesized increase was not, in fact, realised for reasons that will become clear in the comparisons we make in Chapter 8.

First, we will look at individual and average results for PT(2) and compare with average results for PT(1) as shown in Figures 4.1-4.4 in the previous chapter. In the next chapter we will compare average results of PT(1) and PT(2) in greater detail.

Length of turn by # utterances

In the chart shown in Figure 5.1, the last two bars represent the average of the tutor/tutee pairs against which each individual pair can be compared. The other pairs of bars represent the tutor/tutee pairs named on the period dates and for the number of discourse minutes shown. The tutors' turns are expressed as 100% in total. The tutees' turns are expressed as a percentage of the tutors' totals.
As in Peer Tutoring (1) (shown in Figure 4.1) so in PT(2) the tutees' number of turns nearly equals that of the tutors'. In PT(1) the spread is from 96% to 98%; in PT(2) it is from 93% to 100%, the 93% being for Patty, one of the weaker students in PT(2). Also as in PT(1), most of the tutees' turns are on average one utterance long [PT(1) 88%, PT(2) 87%]. The small number of tutees' turns of two or more utterances long on average [PT(1) 12%, PT(2) 13%] contrast with a much higher average for the tutors [PT(1) 40%, PT(2) 36%]. The drop from 40% to 36% indicates a small trend towards more equal turn-sharing by the tutors.
in PT(2). The number of tutors' turns three and four-plus utterances long is much the same on average in PT(2) [10% and 9%] as in PT(1) [10% and 10%].

Of the tutees in PT(2), Ursula shows the greatest number of multi-utterance turns (21% against the average of 11%) as Lenny did in PT(1) (20% against the average of 12%).

Of the tutors in PT(2), Gladys stands out as the most diligent in terms of productive time spent on the Tutorial stack (26-28 minutes). Denis did well in his first session (23 minutes). The rest of the sessions (11-16 minutes) average out at about half of Gladys's time. These observations hold good for all the charts as they are all different perspectives of the same sessions with the same times. When not on the Tutorial stack, the tutors were browsing with their tutees through the more familiar, less demanding Our World stack.

The tutor Hetty in PT(2) stands out as an anomaly, which she was not in PT(1). As she is equally an anomaly in the three PT(2) charts that follow, some explanatory comments will be given here and only briefly referred to in comments on the other charts. Hetty made it clear in the September 21 session that she preferred the Our World stack to the Tutorial because it was "more fun". At the end of the September 30 session, when Win was telling the teacher what she had found most interesting in the Tutorial, Hetty stated gratuitously "I don't like anything, oh so boring". She said this with a smile but her meaning was in her words. She simply did not like the Tutorial and intended to have as little as possible to do with it.

In her September 21 session with Roxy, a shy student lacking in confidence, the sometimes over-confident and highly talkative Hetty dominated the discourse with a running commentary on the cards, often supplying answers to questions when Roxy hesitated. She had the habit of "thinking aloud" so that her discourse was continuous. As a result, Roxy,
although rated an "average" student who would when encouraged take risks and talk, actually contributed less to the discourse (11 words per minute) than the tutees with learning problems (22-25 wpm). Hetty's September 30 session with Win showed a different distortion. Hetty knew Win well because they were classmates together in Karen's class in the previous year. The two girls fell into a mechanical question and answer routine in which Hetty rapidly fed Win answers to questions in sentence fragments which Win repeated, as on the solar system:

H  Okay now you answer. We have . . .
W  We have . . .
H  Just read it.
W  On the one . . . <hand>^<
H  <Hand.>
W  In the . . .
H  Centre.
W  Centre . . .
H  The . . .
W  The . . .
H  The sun.
W  Sun
H  You're right.

The object was to get through the Tutorial in the shortest time possible. Hetty, highly talkative by nature, shows uncharacteristic decreases in all measures because of the artificial sharing of discourse caused by this routine. Win shows increases on all measures but these increases are of questionable validity to the extent they are the result of the routine.

The effect of Hetty's distortions can be seen in the charts for PT(2). With Roxy, Hetty has many more multi-utterance turns (77%) than any other tutor (30-40%) and more words per minute (79) than any other tutor (42-64), an indication of her running commentary style. With Win, she has more single-utterance turns (76%) - uncharacteristic for Hetty - than any other tutor (55-69%), an indication of their "mechanical question and answer routine."
Length of utterances by # words

The arrangement of the bars and the discourses represented in Figure 5.2 are the same as in Figure 5.1 above. The subject of analysis is the length rather than the number of utterances. Again, tutors' total utterances are expressed as 100% and tutees' utterances are expressed as a percentage of the tutors' total utterances.

Figure 5.2: Utterances by # Words

As in PT(1), the tutees in PT(2) have a smaller number of utterances than the tutors, the average in both cases being 61% of the tutors' utterances. Also, as in PT(1), the tutees produce a smaller number of words than the tutors. Most of their utterances are three words
or less in length which, measured as a percentage of their total utterances amount to 72% for PT(1) and 69% for PT(2). Therefore PT(2) shows a slight corresponding increase in the tutees' four-plus-word utterances from 28% of their total utterances in PT(1) to 31% in PT(2).

Conversely, the tutors produce more utterances of four words or more than the tutees, but less in PT(2) at 52% than in PT(1) at 55%. This together with the tutees' modest increase in utterances of four-plus words may indicate some yielding of discourse by the tutors to the tutees in PT(2).

Individually, Hetty and Roxy stand out from the other pairs: Hetty's running commentary (see comments under Figure 5.1) testifies to her oral fluency with 76% utterances of four words or more compared with the tutors' average of 55%; on the other hand her tutee, Roxy, has the lowest number of total utterances at 30% of her tutor's total compared with 57-70% for the other tutees. It seems that Roxy, rated an average student, was drowned out. Apart from Hetty with Roxy, Gladys is the tutor with most utterances of four-plus words at 58% for her two sessions compared with a range from 34-53% for the other tutors. Also, Gladys has more multi-word utterances with her weaker student, Patty, (83%) than with her stronger student, Ursula (73%).

Words per minute (wpm)

The arrangement of bars and the discourses represented are the same in Figure 5.3 which follows as in Figures 5.1 and 5.2 above except that the bars are laid out horizontally rather than vertically. The subject of analysis is words per minute. Unlike the previous two figures which show percentages, Figure 5.3 represents the actual number of words per minute, timed from the discourse recordings.
The tutors speak more than the tutees although to a slightly lesser extent in PT(2) at 2¼ times than in PT(1) at 2½ times. Hetty and Roxy stand out as anomalous for reasons already explained under Figure 5.1. Hetty's decrease in wpm with Win is uncharacteristic and arises largely from their mechanical question and answer routine. Except for Hetty, Gladys speaks more than the other tutors: 61 wpm average for her two sessions compared with the other tutors' range (excluding Hetty/Roxy) from 42 to 54 wpm. She also speaks more relatively to the weaker student Patty (64 wpm) than to the stronger student Ursula (57 wpm). Ursula stands out as the tutee producing most speech at 35 wpm compared with the tutee
average of 25 wpm. Her ratio of speech to her tutor, Gladys, is also the highest at 38% compared with the average of 31%.

Mean Length of Utterance (MLU)

The arrangement of bars and the discourses represented are the same in Figure 5.4 which follows as in Figure 5.3 above. The subject of analysis is mean length of utterance (MLU) measured by number of words.

Figure 5.4: Mean Length of Utterance

The tutors' MLUs are longer on average than the tutees' in PT(2) as they were in PT(1). While the tutors' average remains almost the same in PT(2) at 4.2 as in PT(1) at 4.1,
the tutees average rises slightly from 2.8 in PT(1) to 3.0 in PT(2). Once more, Hetty in relation to Roxy stands out, Hetty's utterances being continuous and, on average, long (5.6 words) while in relation to Win they drop sharply (3.4) because of the fragmentation of utterances in the mechanical question and answer routine. Gladys's MLU is higher (4.6) in relation to her weaker tutee, Patty, and lower (4.2) in relation to her stronger tutee, Ursula. Ursula's MLU (3.7) is higher than the tutees' average (3.0) and, surprisingly, is matched by Vic, one of the tutees identified as having a learning problem. The other weaker students, Patty and Sam have lower MLU's, both at 2.7.

Quantitative summary

As in Peer Tutoring (1), the tutors in Peer Tutoring (2) outproduce the tutees substantially on all measures except total number of turns and by similar amounts (for a detailed comparison, see Figure 6.1 in the next Chapter). The tutees' performances vary. The students identified as having learning problems, Patty, Sam and Vic, generally produce lower measurements than the rest, identified as average or better-than-average students.

Gladys spent more time on the Tutorial stack with both of her tutees (average 27 mins) than did the other tutors (average 16 mins). Gladys and Ursula stand out as the most successful tutor/tutee pair in terms of the tutee's performance. Ursula produces the highest of the tutees' scores for amount of talking (35 wpm) and length of utterance (3.7 MLU) compared with the tutees' averages of 25 wpm and 3.0 MLU. Gladys's scores are higher on all measurements in relation to her weaker student, Patty, than they are in relation to her stronger student, Ursula. Patty's scores, conversely, are lower than Ursula's. The contrasts are: wpm, Gladys/Ursula 57/35 against Gladys/Patty 64/22; MLU, Gladys/ Ursula 4.2/3.7 against
Gladys/Patty 4.6/2.7. The tendency seems to be for tutors to speak more in longer utterances when tutees are weak or lack confidence than when they are strong. It is, of course, not easy to get reluctant talkers to talk as any language teacher can attest. The teacher then tends to fill the silent gaps.

Hetty stands out as an aberration with both of her tutees, Roxy and Win. In both cases her goal was to get through the Tutorial stack in the shortest possible time so that she could "play" with the Our World stack. She did this with the shy Roxy by a strategy of dominating the discourse with a running commentary and supplying answers; she did it with Win, a previous classmate, by a mechanical question and answer routine in which Win collaborated by repeating Hetty's answer prompts. Hetty's time on the Tutorial stack with Roxy was the lowest (11 mins). With Win it was the average of the other tutors except Gladys (16 mins).

The tutors were asked to use a strategy of explanation and discussion based on key visuals in PT(2) instead of the question-driven I-R-E strategy they used in PT(1). It was hypothesized that the new strategy would increase the tutees' measurements relative to the tutors'. PT(2) produced a small and inconclusive move in this direction. It is necessary to compare PT(1) and PT(2) more closely, both quantitatively and qualitatively, to answer the question why this movement was not greater.

It is also necessary to ask: how much academic as distinct from social discourse is there in PT(2) compared with PT(1)? And what is its quality? These questions are addressed in the following two chapters.
CHAPTER 6: COMPARISON OF PT(1) AND PT(2) RESULTS

Introduction

Different settings

The PT(2) sessions differed from those in PT(1) in several respects: the tutors had moved out of ESL into Grade 7 classes; their numbers had been reduced from ten to four (six had gone to classes in other schools); and the tutees were not fellow ESL classmates of the tutors but were ex-ESL students from regular Grade 5 classes. The first of the PT(2) sessions was held in the Computer Lab like the first of the PT(1) sessions. The dynamics were different: the first PT(2) session, with only four pairs and the tutors and tutees coming from different classes, lacked the "gala event" excitement of the first PT(1) session with ten tutor/tutee pairs, all from the same class. The dynamics of the sessions held in the Computer Coordinator's office were similar in PT(1) and PT(2). The main difference was that none of the PT(2) tutees were classmates of the PT(2) tutors. Two, however, (Win and Manny) had been classmates the previous year.

Positive aspects

The same positive aspects of PT(1), noted under Review of Peer Tutoring (1) in Chapter 5, continued on the whole in PT(2): the wholehearted individual effort and positive attitudes of all the students, both tutors and tutees; the tutors' listening to, understanding and following directions for a complex exercise; and the tutors' enthusiasm and the tutees' receptiveness that led to a productive sharing experience.

The four tutors came to the training sessions for PT(2) with positive motivation. They realized that they had been selected for the new task because of their previous experience.
They provided valuable feedback on problems encountered in PT(1) from their point of view. They took to heart the request to move away from the "questioning mode" of the first sessions although this would prove a difficult habit to break. They also took to heart the request to be sensitive to the needs of the tutees and provide them with whatever support they needed. And they were unfailingly courteous and supportive.

**Purpose of comparison**

The main difference between the PT(2) and PT(1) sessions, apart from differences in tutee characteristics, was the provision in PT(2) of knowledge-structure-based key visuals in the Tutorial stack to facilitate topic explanation and discussion. The purpose of our comparison is to determine whether using the Tutorial stack succeeded in:

1. raising the ratio of tutee-to-tutor participation in PT(2) over PT(1);
2. raising the absolute scores of tutees in PT(2) over PT(1);
3. moving the tutors away from the I-R-E teaching model;
4. improving the quantity and quality of academic discourse in PT(2) over PT(1).

We will defer the study of item 4 above to the following chapter because it turns on a cognitive analysis of the discourse transcripts which we have not yet presented. We will also defer the detailed analysis of item 3 (I-R-E) until the next chapter because it turns on a consideration of tutoring modes that arise out of our cognitive analysis. The remainder of this chapter will, therefore, deal with items 2 and 3 above and generally introduce some qualitative issues relating to item 3.
Discussion headings

We will discuss items 1 and 2 and introduce item 3 under the following headings:

1. Overall quantitative comparison.
   a. Problems of quantitative comparability
   b. Analytical strategy

2. Overall qualitative comparison
   a. Persistence of I-R-E
   b. Analytical strategy

3. Quantitative comparison of selected tutor/tutee pairs

4. Summary.

5. Focus on academic discourse.

Overall quantitative comparison

Figure 6.1 brings together into one chart the key quantitative factors for the totals of all tutor/tutee pairs recorded in both PT(1) and PT(2). The data is listed in Table 6.1.

Table 6.1: Data for comparative analysis of total PT(1) and PT(2) tutor/tutee pairs

<table>
<thead>
<tr>
<th>Measurement Percent</th>
<th>PT(1)</th>
<th>PT(2)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T&quot;ors</td>
<td>T&quot;ees</td>
<td>T&quot;ees % T&quot;ors</td>
</tr>
<tr>
<td>% Turns: total</td>
<td>50.7</td>
<td>49.3</td>
<td>97.2</td>
</tr>
<tr>
<td>% Turns: 2+utt'ces</td>
<td>77.4</td>
<td>22.6</td>
<td>29.2</td>
</tr>
<tr>
<td>% Utt'ces: total</td>
<td>62.2</td>
<td>37.8</td>
<td>60.8</td>
</tr>
<tr>
<td>% Utt'ces: 5+wds</td>
<td>77.6</td>
<td>22.4</td>
<td>28.9</td>
</tr>
<tr>
<td>% Words per Min</td>
<td>71.4</td>
<td>28.6</td>
<td>40.1</td>
</tr>
<tr>
<td>% MLU</td>
<td>60.0</td>
<td>40.0</td>
<td>66.7</td>
</tr>
<tr>
<td>Measure Absolute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Words per Min</td>
<td>56.8</td>
<td>22.8</td>
<td>40.1</td>
</tr>
<tr>
<td>MLU</td>
<td>4.2</td>
<td>2.8</td>
<td>66.7</td>
</tr>
</tbody>
</table>
The top part of Table 7.1 records the six measurements for tutors and tutees as percentages of the combined totals for both tutors and tutees. In this way it is possible in columns © and (f) to show how much of each measurement was achieved by the tutees relative to the tutors in PT(1) and PT(2). This makes it possible to answer the question: did the PT(2) tutees achieve a greater or lesser share of the tutor/tutee dialogue than the PT(1) tutees? Column (g) expresses this answer. Column (h) expresses it as a percentage of the PT(1) tutees' scores to tell us by how much more or less the PT(2) tutees increased (or decreased) their share of total discourse time compared with the PT(1) tutees.

In the first three measurements the PT(2) tutees maintained the same ratio to their tutors as the PT(1) tutees. For the next measurement, "5+ word utterances", the PT(2) tutees scored 3.9% more than the PT(1) tutees relative to their tutors. This means that the PT(2) tutees achieved 17.4% more 5+word utterances than the PT(1) tutees ((3.9 x 100) / 22.4). In the same way, relative to their tutors, the PT(2) tutees scored 7.7% more words per minute and a 5.8% longer MLU than the PT(1) tutees.

The bottom part of the table records the absolute (actual) scores for words per minute and MLU. Words per minute reflect in word counts the vocabulary content of the turns and utterances that are measured relatively. MLU expresses the average length of those words. The final absolute and relative differences in column (h) for words per minute and MLU differ because the tutors' scores enter into the relative differences but do not enter into the absolute differences. The latter are derived directly and solely from the tutees scores.

These results are presented visually in the chart shown as Figure 6.1 which follows.
Figure 6.1: Comparison of total PT(1) and PT(2) tutors/tutees on selected measurements

The PT(2) tutor and tutee bars lie beneath the PT(1) tutor and tutee bars. The purpose of the chart is to compare tutor/tutee patterns throughout all measurements and the PT(1) and PT(2) results within each measurement. Note that the first six measurements from the top down are percentages, i.e. they compare tutees relative to tutors in PT(1) and PT(2). The last two measurements, Words per Minute and MLU, are absolute measures that directly compare the actual PT(1) and PT(2) tutor and tutee scores.
Throughout, the tutors' measurements exceed the tutees'. In only one measure, "% total turns", is the difference insignificant, the tutors and tutees being approximately equal. In all other measures the tutors exceed the tutees substantially by approximately: 2½ times in "% 2+utterance turns"; 60% in "% total utterances"; 2+ times in "% 5+word utterances"; 2+ times in "% words per minute"; and 50% in "% MLU". These results are the same in PT(1) and PT(2) for the first three relative measures: "% total turns", "% 2+ utterance turns", and "% total utterances". In the last three relative measures, "5+ word utterances", "wpm" and "MLU", the tutees show a small increase in PT(2) over PT(1) while the tutors show a corresponding decrease.

In absolute terms, comparing the actual tutee PT(1) and PT(2) scores independently of their relationship to the tutors' scores, the PT(2) tutees' show an increase in words per minute of 7.5% and a 7% increase in MLU over the PT(1) tutees.

The results therefore show a slight movement in the direction hypothesized: that the tutees will improve their performance relative to the tutors because of the tutors changing from a question-driven I-R-E strategy in PT(1) to a strategy of explanation and discussion based on key visuals and knowledge structures in PT(2). The movement, however, is too small to be conclusive and belies the expectations raised by observations of the tutoring sessions in progress and a qualitative inspection of the discourse transcripts.
Problems of quantitative comparability

A more detailed comparison of PT(1) and PT(2) indicates two factors that could distort results in favour of PT(1) and account for the less than hypothesized increase of quantitative measurements in PT(2):

1. Differences between PT(1) and PT(2) tutors and tutees;
2. Contribution of reading to PT(1) discourses.

Tutor/Tutee differences

One of the criticisms of the process-product stream of research springing from the application of behavioural psychology to education in the 1960s and 70s was that its reliance on aggregated data and average scores concealed individual teacher and student differences (Rosenshine and Furst, 1971; Rosenshine, 1979). Certainly in this present study we have found that wide individual variations are concealed in the average trends. Nuthall and Alton-Lee (1990) speak of the doubts brought about by these criticisms as a crisis of confidence in research on teaching. They suggest a new direction for research with a focus on learning rather than teaching and on individual students rather than aggregated data. This is the direction we have taken although we believe that aggregated data can usefully indicate general trends when proper selection criteria are applied to the subjects measured. These criteria would include the following for different tutees with a common tutor:

1. Tutees assigned to a common tutor should be evenly matched in temperament, academic standards, levels of confidence, and previous exposure to L2 and content.
2. The common tutor should be positively motivated and stable in applying his or her tutoring strategies to the different tutees.
A quantitative comparison is not valid between Denis and Lenny in PT(1) and Denis and Vic in PT(2). Lenny, although not highly rated academically, was confident and performed well orally. Vic, on the other hand, lacked confidence, had low language skills and was suspected by his teacher of having learning disabilities. Denis was a highly consistent tutor but the wide differences between the two tutees distort a quantitative comparison.

A quantitative comparison is not valid between Hetty and Olly in PT(1) and Hetty and Win in PT(2) because 1) Hetty was positively motivated to the Our World stack in PT(1) and negatively motivated to the Tutorial stack in PT(2); and 2) she materially changed her tutoring strategy from Olly to Win by extensively feeding Win answers to questions in short sentences and sentence fragments which Win mechanically repeated. Although Olly and Win were well matched as tutees, Hetty's change in strategy distorts a quantitative comparison.

**Contribution of reading to PT(1)**

A quantitative comparison between PT(1) and PT(2) is distorted by the greater written language support present in PT(1). This was in the form of preset questions read by the tutors from their checklist (Appendix 2) and preset questions and answers which were read by tutors and tutees from the Question and Answer cards (Appendix 1). PT(2) had some written language support; but this was restricted to content words and functional phrases, appearing in different parts of the visuals, that tutors and tutees had to put together into sentences. Lacking in PT(2) was the whole-sentence written language support in PT(1) which tended to increase the amount of language spoken (words per minute) and the mean length of utterances (MLU). Some 20% of words generated in PT(1) came from this support.
Analytical Strategy

The distortion of PT(1) and PT(2) comparisons arising from differences between PT(1) and PT(2) tutoring strategies and tutee profiles can be largely corrected if results are compared only for tutor/tutee pairs which have similar strategies and profiles. Only one tutor, Gladys, satisfied this requirement: her PT(1) tutee, Nancy, and her PT(2) tutee, Ursula, had very similar profiles while Gladys showed herself to be a consistent and stable tutor. Therefore we selected for further analysis the discourse transcripts of these two pairs.

Quantitative comparison of selected tutor/tutee pairs

The comparison of the quantitative measures presented in Figure 6.1 for all tutor/tutee pairs is shown for Gladys and her tutees in Figure 6.2 for which the data is as follows:

Table 6.2: Data for comparative analysis of selected PT(1) and PT(2) tutor/tutee pairs

<table>
<thead>
<tr>
<th>Measurement Percent</th>
<th>PT(1)</th>
<th>PT(2)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gladys</td>
<td>Nancy</td>
<td>Tutee% Tutor</td>
</tr>
<tr>
<td>%Turns total</td>
<td>50.8</td>
<td>49.2</td>
<td>96.9</td>
</tr>
<tr>
<td>%Turns 2+utts</td>
<td>72.5</td>
<td>27.5</td>
<td>37.9</td>
</tr>
<tr>
<td>%Utts'ces total</td>
<td>60.2</td>
<td>39.8</td>
<td>37.9</td>
</tr>
<tr>
<td>%Utts 5+ws</td>
<td>62.7</td>
<td>37.3</td>
<td>39.5</td>
</tr>
<tr>
<td>%Wds per Min</td>
<td>60.7</td>
<td>39.3</td>
<td>64.7</td>
</tr>
<tr>
<td>% MLU</td>
<td>50.0</td>
<td>50.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Measure Absolute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Words per Min</td>
<td>45.1</td>
<td>29.2</td>
<td>64.7</td>
</tr>
<tr>
<td>MLU</td>
<td>4.1</td>
<td>4.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>
A comparison of Figures 6.1 and 6.2 shows that Gladys's tutees produced more on all measures than the average of all tutees in both PT(1) and PT(2). As both Gladys and her two tutees were "top" students, outgoing, positive, confident, with good classroom records, this is not surprising. However, when we look at the relative performance of Gladys's PT(1) and PT(2) tutees, the picture is somewhat mixed.

Figure 6.2: Comparison of Gladys & her PT(1) & PT(2) tutees on selected measurements

Only one measure shows a decisive difference: on % 2+ utterance turns, Ursula in PT(2) outperforms Nancy by 9.9%, scoring 37.4% in relation to Gladys compared with Nancy's 27.5%. This represents an increase over Nancy of 36% ((9.9 x 100 / 27.5). The other
relative differences are marginal with Nancy in PT(1) actually exceeding Ursula in the last three relative measures. The absolute measures are more significant but also mixed: Ursula in PT(2) exceeds Nancy's Words per Minute by 19%; but Nancy in PT(1) exceeds Ursula's MLU by 10%, i.e. Ursula produced more talk but Nancy produced longer utterances.

As Nancy was materially assisted by the number of read sentences in PT(1), particularly in her MLU, we could regard the overall results as indicating better quantitative results in PT(2) over PT(1) but not conclusively.

**Overall qualitative comparison**

**Persistence of I-R-E**

**The "Questioning Mode"**

"Questioning mode" refers to the tutors' strategy in PT(1) of making each tutorial a continuous interrogation of the tutee with no introduction of subject matter and no modelling of the sort of responses required. The reason for the tutors adopting this strategy is not difficult to understand. Their experience had taught them that asking questions is central to teaching. Teachers may use rhetorical questions to focus the students' minds on the topic under discussion or real questions to find out how much the students know. In either case the same cycle is followed: the teacher's initiatory question (I), the student's response (R) and the teacher's evaluation (E) of that response. However, teachers also introduce their subject matter and give periodic recapitulations as the class proceeds. This the tutors cannot easily do because they lack command of language and subject matter expertise. They are therefore long on questioning and short on evaluation.
They quickly discovered that questioning as a strategy has rewards: it puts the pressure in the dialogue on the tutee rather than the tutor. The tutor is the one who knows. The tutee is the one who must find out. The tutor initiates a gambit simply by asking a question. The tutee has to produce the best response he or she can. The tutor's contribution then takes the form of saying simply whether the tutee's response is "right" or "wrong". If the tutee is "wrong" or cannot produce an answer at all, then the tutor either states the answer or provides elaborate clues to tease it out, all the while remaining comfortably in control. The tutors do not appear to initiate this strategy consciously but rather take the line of least resistance by following their own version of a teaching model to which they have been extensively exposed.

The "Guessing Game".

The "guessing game" refers to a new strategy the tutors sometimes used in PT(2), which led them back into the questioning mode and hence into a continuation of the I-R-E model. Harry Green, in the last of the training sessions immediately preceding the second set of tutorials, urged the tutors to move away from the "questioning mode". He explained that the Tutorial visuals provide structures to help them introduce each topic to the tutees before asking them questions. In the first PT(2) sessions (September 21), the tutors still tended to start off with questions but in the second PT(2) sessions (September 30) they conscientiously followed the request to first "tell the story". However, they replaced the "questioning mode" with the "guessing game". The challenge of the "guessing game" is to describe what the structure of the visual represents without clicking up any of the content words. The tutors, who by this time knew the subject matter well, did this with ease. They then challenged the tutees, to whom the subject material was new, to do the same. When, inevitably, the tutees
had difficulties, the tutors would re-enter the questioning mode by providing clues with a series of questions to elicit the required descriptions. In this way the tutors defeated one of the purposes of the visuals which was, by providing content words and functional phrases, to help the beginner construct accurate descriptive sentences. It is reasonable to defer the appearance of the content words when reviewing material. The tutors, however, did not discriminate between a first presentation and a subsequent review.

Again this is understandable. It is all too human to think that what is obvious to me, after many repetitions, must be equally obvious to you, coming to the material for the first time. I may know, intellectually, that this is not the case but in practice I frequently act as though it is. This is why teenagers should learn to drive from a professional instructor and not from a parent. The PT(1) sessions provide an interesting application of the same principle. The tutors would find themselves without an answer to a question. They would find out the answer from a fellow student or the teacher. All at once the answer was obvious. They would then ask the same question to the tutees and wait for an answer as though it was the most natural thing in the world that the tutees should know it. When inevitably the tutees did not know the answer, the tutors would then provide elaborate clues to elicit it.

Analytical strategy

For the reasons explained above under "quantitative comparability" we selected Gladys and her tutees for comparing amount and quality of academic discourse in PT(2) and PT(1). This comparison, our particular concern, requires a cognitive analysis of Gladys's transcripts. We present this analysis in the following chapter and derive more conclusive results from it than from the quantitative analysis that we have just considered.
Summary

Peer Tutoring (2) continued with the same positive aspects as Peer Tutoring (1): the tutors and tutees worked with diligence and positive motivation (except for some lapse on the part of Hetty and Win), and produced the same amount of language between them (average 80 wpm for tutors and tutees combined). Beyond this, the tutors in PT(2), by the second session, had moved away some distance from the questioning mode even though it persisted somewhat. Additionally, they were more supportive of the tutees and sensitive to their needs. Quantitatively the PT(2) tutees compared with the PT(1) tutees improved, relative to their tutors, their output of: long utterances (5+words) by 17%; words per minute (wpm) by 8%; and mean length of utterance (MLU) by 6%. They also increased their absolute output of words per minute by 7.5% and their MLU by 7%.

However, comparisons between PT(1) and PT(2) for individual pairs were frequently distorted by marked differences in two sets of variables:

1. in tutee confidence, literacy and learning skills: in PT(1) one (Olly) out of four (25%) tutees had learning problems owing to deficits in these factors; in PT(2) the number was three (Patty, Sam and Victor) out of seven (43%);

2. in the number of words read directly from formed sentences in the Tutors' Checklist and in the questions and answers on screen, thus making an easy contribution towards wpm and MLU: in PT(1) 20% of total words spoken were read in this way compared with none in PT(2).

Because both of these factors favoured PT(1), it could be claimed that the quantitative improvements in PT(2) for long utterances (relative to tutors) of 17%, and for wpm (absolute)
of 7.5% and MLU (absolute) of 7% are more significant than they appear to be and that therefore there is quantitative evidence for benefits provided by the change in tutoring strategy in PT(2). Moreover, as we have seen, this change -- moving from the question-driven I-R-E model of teaching to explanation and discussion supported by knowledge-structure-based key visuals -- was not completely implemented by the tutors in PT(2). This factor also adds to the significance of the modest improvements achieved in PT(2).

However these results cannot be regarded as conclusive, particularly as the wide differences of profile between the PT(1) and PT(2) tutees make overall comparisons questionable. Neither do we get conclusive quantitative results when we compare Gladys and her two comparable tutees with similar profiles, Nancy in PT(1) and Ursula in PT(2): on the absolute measures, Ursula exceeds Nancy by 19% on words per minute but Nancy exceeds Ursula by 10% on MLU. It is necessary, therefore, to focus on a new cognitive analysis to identify the presence of and differences between academic discourse in the PT(1) and PT(2) sessions to support our belief, based on observation of the tutoring sessions and a pedagogical qualitative analysis of the discourse transcripts, that the quality of discourse is higher in the PT(2) than in the PT(1) sessions.

**Focus on academic discourse**

We have seen that Peer Tutoring (1) and Peer Tutoring (2) mostly achieved their pedagogical objectives by the end of their respective sessions. It may be helpful at this point to repeat what the objectives were in Table 6.3 below.

Addressing PT(2) objective 4, the tutors did not altogether avoid "guess what" questioning but did by the second sessions go a long way towards that end. We could also
say that we have reached a generally positive answer to our focal research question: "Is peer tutoring, using a computer-based hypermedia resource, an effective means to help ESL students generate academic discourse?" We have seen that the peer tutoring sessions were conspicuously successful in generating language. We have seen that the pedagogical objectives were largely achieved. Therefore much of the language used had to be academic as distinct from social discourse in order to accomplish this result.

Table 6.3: PT(1) and PT(2) Pedagogical Objectives

<table>
<thead>
<tr>
<th>PT(1) OBJECTIVES</th>
<th>PT(2) OBJECTIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Consolidate tutors' understanding of content.</td>
<td>1. Tutors to show understanding of structures of key visuals.</td>
</tr>
<tr>
<td>2. Make tutors familiar with cards they had not worked on.</td>
<td>2. Tutors to describe topics in coherent sentences matching key visual structures.</td>
</tr>
<tr>
<td>3. Expose tutees to content of Our World stack.</td>
<td>3. Tutors to treat tutees with courtesy and respect.</td>
</tr>
<tr>
<td>4. Make tutees familiar with HyperCard operations.</td>
<td>4. Tutors to avoid excessive &quot;guess what&quot; questioning.</td>
</tr>
<tr>
<td>5. Promote use of language between peers.</td>
<td>5. Tutees to show understanding of content through language</td>
</tr>
<tr>
<td>6. Test usability of Our World stack with new learners.</td>
<td></td>
</tr>
</tbody>
</table>

Something, however, is missing. We have inferred, in claiming some success for the accomplishment of the PT(2) pedagogical objectives, particularly through our qualitative analysis, that more academic discourse or a higher quality of academic discourse was used. This must have been the case for the tutors to move some way from simple question-and-short-answer discourse to explanatory discourse and discussion. To this point, however, neither our pedagogical nor our quantitative analysis has given us any measures of difference in the academic discourse of PT(2) over PT(1). In other words, we have said that peer tutoring, using a computer-based hypermedia resource, has been effective in helping ESL
students generate academic discourse but we have not said how effective. To this problem we turn in the chapter which follows.
CHAPTER 7: COGNITIVE ANALYSIS OF PT(1) AND PT(2)

Introduction

We take as points of departure Cummins (1984) model of communicative activity and Mohan's (1986) Knowledge Framework which are reproduced for convenience in Figures 7.1 and 7.2. For macro cognitive analysis we link Mohan's Knowledge Structures (KSs) with Smith, Meux, Coombs et al (1967) Ventures. For micro cognitive analysis we use Staab's (1986) language functions which fall under Halliday's (1970) dichotomy, interpersonal/ideational. These sources are discussed in Chapter 2A, Selected Review of Literature.

Cummins' model of communicative activity

Figure 7.1: Range of Contextual Support and Degree of Cognitive Involvement in Communicative Activities (Cummins, 1984)

Discourse in both the Our World and Tutorial stacks was mostly context embedded. The tutors, with a fair knowledge of what the stacks contained, embedded context for the tutees, interacting with them and providing feedback, corrections and clues. The visual clues and labels on screen also embed context: tutors and tutees could point to these to help get
their meaning across. Most computer-based discourses abound with this type of exophoric reference, a ready indicator of context embeddedness. To the extent that tutors and tutees dealt with questions on the content of the stacks, their discourse fell in the "B" quadrant: context embedded and cognitively demanding. It was cognitively demanding for the tutees because the content was new and for the tutors because they had to work out how to get the information across, correct errors and think up strategies. These activities embodied predominantly ideational exchanges.

However, part of the discourse in the Our World stack fell in quadrant "A": context embedded and cognitively undemanding. This included those parts of the discourse where the tutors helped tutees explore the HyperCard Voice and Find buttons and where they talked about the authorship of the various cards. These activities embodied interpersonal exchanges.

We would expect discourse in the Tutorial stack to be more cognitively demanding than discourse in the Our World stack: the purpose of the Tutorial stack was to help the students talk about the concepts underlying the Our World themes. Therefore we would expect more of PT(2) than of PT(1) discourse to fall in quadrant "B" (context embedded and cognitively demanding) where the ideational component predominates and less in quadrant "A" (context embedded and cognitively undemanding) where the interpersonal component predominates.

**Mohan's Knowledge Framework model**

A further step is required once we have separated academic from social discourse: some further breakdown of academic discourse according to its level of difficulty or cognitive challenge. Mohan's (1986) Knowledge Framework helps make this distinction.
Discourse in the Our World stack engaged primarily the KSs of practical action and experience while the Tutorial stack was designed to engage additionally the more demanding KSs of theoretical understanding. In the Our World stack, the tutors and tutees between them exercised Choice of what cards to look at and in what Sequence they would look at them. The cards themselves were the subjects of Description and, sometimes, Sequence. However, the tutors did not speak about the types of Classification underlying the descriptions nor the Principles underlying the sequences. Thus, going through the Our World stack was an "action" experience, using the HyperCard buttons and controls, looking at the pictures, reading the descriptions, and answering preset questions about the descriptions.

On the other hand, the Tutorial stack deals primarily with the types of Classification underlying the Descriptions and the Principles underlying the Sequences. Our World describes Earth and the Solar System; the Tutorial more formally describes them and also presents explicitly the classification principles on which the descriptions are based. Our World describes a volcanic eruption; the Tutorial formally presents the sequence of events in the eruption and makes explicit the cause-effect principle that underlies it. Hence, we would
expect to find more cognitively demanding academic discourse in the PT(2) discourses, based on the Tutorial stack, than in the PT(1) discourses, based on the Our World stack.

These two models set out the broad principles of our cognitive analysis. For the analysis itself we turn to Smith, Meux et al (1967) Ventures and Halliday (1970)/Staab (1986) language functions.

Methodology

Tutor/tutee selection for comparison

We have seen that a major problem in comparing PT(1) results with PT(2), even if the tutor is the same in each case, is variability in the tutees. The tutor's performance is likely to be different with a tutee who is a top student than with a tutee with learning disabilities. Obviously, the tutees' performances in such a case will also vary. Even with the same tutee, a tutor may unpredictably vary his or her strategy from one session to the next, leading to different performance results as we saw in the case of Hetty. However, if a tutor is stable between one session and the next and the tutees are well matched, then a broad comparison between two different sessions seems reasonable.

Therefore we have selected Gladys and Nancy from PT(1) and Gladys and Ursula from PT(2). Gladys was a steady, competent and sensitive tutor not given to unpredictable changes in approach. Nancy and Ursula were both rated "top" students by their teachers, were confident and eager to learn, and ranked first overall in performance among their fellow tutees, Nancy in PT(1) and Ursula in PT(2). Moreover, they were both in the last of the PT(1) and PT(2) sessions respectively so that Gladys, their tutor, was equally prepared in both cases.
Macro analysis by Venture

A Venture is the largest unit of analysis used by Smith, Meux et al (1967) in breaking down a classroom discourse (see discussion in chapter 2A). Ventures are classified according to their "overarching objectives". These objectives are cognitive objectives and hence relate broadly to knowledge structures as shown in Table 7.1.

Table 7.1: Ventures relate to Knowledge Structures (KSs)

<table>
<thead>
<tr>
<th>VENTURES</th>
<th>Overarching Objectives</th>
<th>ASSOCIATED KSs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARTICULAR</td>
<td>A body of information which clarifies or amplifies a specific topic or group of related topics.</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>CONCEPTUAL</td>
<td>A set of conditions governing or implied by use of a term and constituting criteria for determining membership in the class of things referred to by the term.</td>
<td>CLASSIFICATION</td>
</tr>
<tr>
<td>INTERPRETIVE</td>
<td>The meaning or significance of a set of words or symbols</td>
<td>CLASSIFICATION</td>
</tr>
<tr>
<td>PROCEDURAL</td>
<td>A sequence of actions by which an end may be achieved.</td>
<td>SEQUENCE</td>
</tr>
<tr>
<td>CAUSAL</td>
<td>A cause-effect relationship between particular events and classes of events.</td>
<td>PRINCIPLES</td>
</tr>
<tr>
<td>RULE</td>
<td>A rule or several related rules for conventional ways of doing things or for analytic relations to guide actions.</td>
<td>PRINCIPLES</td>
</tr>
<tr>
<td>REASON</td>
<td>Reasons for an action, decision, policy or practice.</td>
<td>CHOICE</td>
</tr>
<tr>
<td>EVALUATIVE</td>
<td>A rating of an action, object, event, policy or practice.</td>
<td>EVALUATION</td>
</tr>
</tbody>
</table>

Micro analysis by language function

Once the selected discourses were broken down into ventures, each utterance was classified by Halliday/Staab language functions. Staab (1986) collapses Tough's (1979) seven functions of language into five and separates them under Halliday's (1970) dichotomy, interpersonal/ideational. These language functions are described in Table 7.2.
Table 7.2: Halliday/Staab Language Functions

<table>
<thead>
<tr>
<th>INTERPERSONAL</th>
<th>SOCIAL NEEDS</th>
<th>CONTROLLING</th>
<th>PROJECTING</th>
<th>IDEATIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Asserting personal rights and/or needs.</td>
<td>- Controlling actions of self and others.</td>
<td>- Projecting into the feelings and reactions of others, e.g. &quot;He's feeling sad&quot;.</td>
<td>INFORMING</td>
</tr>
<tr>
<td></td>
<td>- Asserting negative expressions: criticizing, arguing, threatening, and giving negative opinions.</td>
<td>- Requesting directions.</td>
<td>- Projecting into the experience of others, e.g. &quot;His parents are fighting and he's caught in the middle.</td>
<td>(KSs Description, Sequence)</td>
</tr>
<tr>
<td></td>
<td>- Asserting positive expressions.</td>
<td>- Requesting another's attention.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Requesting an opinion.</td>
<td></td>
<td></td>
<td>FORECASTING/REASONING</td>
</tr>
<tr>
<td></td>
<td>- Incidental expressions.</td>
<td></td>
<td></td>
<td>(KSs Classification, Principles, Choice/Evaluation)</td>
</tr>
<tr>
<td>Asserting</td>
<td>- Asserting personal rights and/or needs.</td>
<td>- Controlling actions of self and others.</td>
<td>- Projecting into the feelings and reactions of others, e.g. &quot;He's feeling sad&quot;.</td>
<td>- Explaining a process</td>
</tr>
<tr>
<td>personal</td>
<td>- Asserting negative expressions: criticizing, arguing, threatening, and giving negative opinions.</td>
<td>- Requesting directions.</td>
<td>- Projecting into the experience of others, e.g. &quot;His parents are fighting and he's caught in the middle.</td>
<td>- Recognizing causal and dependent relations.</td>
</tr>
<tr>
<td>rights</td>
<td>- Asserting positive expressions.</td>
<td>- Requesting another's attention.</td>
<td></td>
<td>- Recognizing problems and their solutions.</td>
</tr>
<tr>
<td>and/or</td>
<td>- Requesting an opinion.</td>
<td></td>
<td></td>
<td>- Justifying judgements and actions.</td>
</tr>
<tr>
<td>needs.</td>
<td>- Incidental expressions.</td>
<td></td>
<td></td>
<td>- Drawing conclusions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Recognizing principles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Requesting a reason.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Anticipating/forecasting (in terms of anticipating problems, possible solutions, alternative courses of action when problem is spotted, and predicting consequences.</td>
</tr>
</tbody>
</table>

These language functions are assigned in two stages:

1. First the transcript text is blocked out by Move, another unit of analysis borrowed from Smith, Meux et al (1967) and modified to suit our needs. Smith, Meux established Moves as the basic element of instruction strategy reflecting the discourse schemas through which a Venture's "overarching objective" is achieved. However, the detail to which the Smith, Meux teams went -- over 100 Moves were defined and the teams were wanting to
establish even more -- makes analysis difficult and interpretation problematic (see discussion in Chapter 2A). Instead we identify only five Moves, corresponding to Staab's five language functions. For this study, the number is four -- Social Needs, Controlling, Informing, Reasoning -- because we did not encounter instances of Projecting.

2. The second stage is to analyze each utterance by these four language functions. An Informing or Reasoning Move may embody some Controlling or Social Needs utterances or a Controlling Move may give rise to some Informing or Social Needs utterances. As the final objective is to analyze each utterance by language function, the question arises: why not do this right away and skip the intermediate analysis by Move? The answer is one of practicality. For intelligent analysis one needs a feeling for the discourse as a whole. This is easier achieved by a top-down analysis -- Venture, Move, Utterance -- than a bottom-up analysis by utterance alone.

Assigning the Staab language functions to each utterance enables us to:

1. Separate the interpersonal from the ideational discourse functions.
2. Distinguish between the easier ideational function of informing, using the KSs of Description and Sequence, from the more difficult ideational function of forecast/reasoning, using the KSs of Classification, Principles and Evaluation.
3. Perform a word count by language function. A word count provides a more accurate analysis than an utterance count because of variability in utterance length.

Table 7.3 shows an example of the analysis process just described.
Table 7.3: Analysis of a Venture
S = Social Needs; C = Controlling; I = Informing; R = Reasoning

<table>
<thead>
<tr>
<th>Moves</th>
<th>Utterance Words</th>
<th>Gravity: Causal Venture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>C</td>
</tr>
<tr>
<td>Reason</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>8</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Needs</td>
<td>3</td>
<td>4</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Reason</td>
<td>5</td>
<td>7</td>
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<td>Control</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Social Needs</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>24</td>
<td>29</td>
</tr>
</tbody>
</table>
Tutoring modes

In the course of analysis it became clear that the tutor and tutee moved from one pattern of tutoring to another depending upon the objective (e.g. browse or pursue in depth), the nature of the instruction (e.g. hands-on or conceptual) and the ability of either tutor or tutee to cope with a particular topic. These tutoring modes are of interest because they show different patterns of language functions, e.g. the ratio of interpersonal to or the ratio of informing to reasoning. They form a subset of discourse genres (Halliday 1978) which we can call tutoring genres. We identified the following:

From the Our World stack:

1. **Unstructured**: tutor and tutee browsing through stack at will without an agenda.
2. **Hands-on**: tutor instructing tutee in an operating skill by first demonstrating and then letting the tutee perform the operations, e.g. various features of HyperCard.
3. **Set questions**: tutor taking tutee through stack following a checklist of questions.
4. **Review**: tutor going through stack a second time following the question checklist.

From the Tutorial stack:

5. **Tutor explanation**: tutor taking tutee through a key visual with a consecutive explanation ("telling the story").
6. **Tutee emulation**: tutee following the tutor's expository example with as much help from the tutor as required.
7. **Joint construction**: tutor and tutee going through a key visual together without the tutor giving an introductory explanation.
Selected features

In addition to language functions and tutoring modes, the following special features of the discourses were tracked:

1. **I-R-E**: most but not all I-R-E instruction occurred in the Structured Exploration and Review tutoring modes. The ideational portion of these two modes was predominantly but not exclusively I-R-E as occasionally the tutee would seize the initiative and break the pattern. I-R-E also occurred in the Tutee Emulation mode when the tutee had difficulties and the tutor helped out.

2. **Words read**: these were words read directly from the Tutor's Checklist or from the Question and Answer cards in the Our World stack.

3. **Exophoric references**: personal and demonstrative references to situations outside rather than inside (endophoric) the text, e.g. "This (on screen) is Day & Night".

Cognitive analysis results

We will look at cognitive analysis results under the following headings:

1. Analysis by language function.
2. Analysis by language function and tutoring mode (with discourse examples).
3. A special look at Hands-On tutoring mode (with discourse examples).
4. Tutor/tutee analysis by language function and tutoring mode.
5. Analysis by selected features and tutoring mode (with discourse examples).

Two doctoral student-teachers independently coded by language function randomly selected extracts from the discourse transcripts. These extracts amounted to approximately
15% of the total discourse. The levels of agreement with the coding results reported in this section are: for Peer Tutoring (1) extracts, 86%; for Peer Tutoring (2) extracts, 93%; and for PT(1) and (2) combined, 90%.

**Analysis by language function**

The Our World discourse of Gladys and Nancy in PT(1) and the Tutorial discourse of Gladys and Ursula in PT(2) are compared in total in Figure 7.3.

**FIGURE 7.3: Tutor/tutee analysis by Language Function**

Most striking in this comparison is the jump in reasoning from 22% in PT(1) to 39% in PT(2), an increase of 77%. Overall the ideational component remains much the same: 87%
in PT(1) and 86% in PT(2). What changes is the ratio of Reasoning to Informing, increasing from .34 (22:65%) in PT(1) to .83 (39:47%) in PT(2). Thus Reasoning increases by 77% Informing decreases by 28% and the ratio of Reasoning to Informing more than doubles. Social Needs is the same in both PT(1) and PT(2) at 3.5%. Controlling increases from 9% in PT(1) to 11% in PT(2). Figure 7.4 shows how these differences vary by tutoring mode.

Analysis by language function and tutoring mode

In Figure 7.4, the readings for the four language functions are shown in four rows with Social Needs in front, followed by Controlling, Reasoning and Informing. The pattern of language functions varies significantly in the different tutoring modes. We will examine each language function in turn, first for PT(1), then for PT(2), and note significant comparisons.

PT(1)

Social Needs. Social Needs is highest for Hands-On (15%). There is a reason for this: Gladys had gone through the operational commands for HyperCard, the Hands-On topic in this discourse, in the first session of PT(1) on June 4. In that session the voice buttons were not working. Therefore, in this second PT(1) session on June 18 she went through the voice buttons again. This time they were working but not properly, the activated voices being very hard to hear. This caused frustration and speculation, giving rise to more Social Needs dialogue than usual, e.g. the complaint, "It's so hard to hear it". Even when the buttons were working properly this particular activity tended to generate more than usual Social Needs dialogue because of the students' fascination with hearing their own voices. Social Needs dialogue in the other PT(1) tutoring modes is insignificant.
**Controlling**. Controlling is high for Hands-On (25%) and somewhat high for Unstructured (16%), which is to be expected. In Hands-On, the tutor is telling the tutee what to do and monitoring his or her progress as in the following:

S1   Let's click on that one.
S2   What has this one?
S2   Huh?
S1   Hold that here.

In Unstructured there is no guiding agenda, which leads to exchanges like the following:

S1   This one. Oh. Then more.
S2   *Reads under breath*
S1   Oh see this question. We asked this question already.
S2  How about this?
S1  You can see another topic.

Control is less where there is an agenda as in Set Questions (8%) and Review (4%).

**Reasoning.** The absence of Reasoning from the Hands-On mode is not characteristic (see discussion under Figure 7.5 below of instances of Hands-On instruction for all tutor/tutee pairs). It can be attributed to the more passive nature of this particular discourse in connection with the faulty sound buttons (discussed under Social Needs above). If we put into this chart the Hands-On average from Figure 7.5, then reasoning would be lowest in Unstructured (9%), higher in Hands-On (20%) and highest in the Set Questions and Review modes (27% each). Examples of Reasoning discourse are given under a separate topic heading which follows the analyses in this section.

**Informing.** Informing is highest in Unstructured (75%) where Reasoning is lowest (9%) and less high in Set Questions (62%) and Review (69%) where Reasoning is less low (27% for both modes). Informing is lower in Set Questions (62%) than Review (69%) because of the greater amount of interpersonal discourse in Set Questions (11%) compared with Review (4%).

**Overall.** Review is most productive of ideational discourse (96%), followed by Set Questions (89%), Unstructured (84%) and Hands-On (73% average from Figure 7.5). Unstructured is least productive of Reasoning discourse (9%) compared with Hands-On (20% from Figure 7.5), Set Questions (27%) and Review (27%). Note that the lowest Reasoning discourse in PT(2), 34% for Tutee Emulation, exceeds the highest Reasoning Discourse in PT(1), 27% for Set Questions and Review. We will now turn our attention to PT(2).
PT(2)

Social Needs. Social Needs is a minimal 2% for Tutor Exposition and Tutee Emulation. It is higher at 8% for Joint Construction mainly because of one incident: the tutee's headset slipped and pinched her ear which gave rise to a whole sequence of interpersonal dialogue accounting for one half of the Social Needs component in Joint Construction.

Controlling. Controlling is highest in Joint Construction (15%) for the same reason that it is high in Unstructured in PT(1): tutor and tutee are working without an agenda which creates the need for more controlling dialogue as together they decide what topic they will move to next. The two modes with an agenda are lower: Tutor Explanation at 9% and Tutee Emulation at 11%. The two modes with an agenda in PT(1) are even lower in Controlling: Review at 4% and Set Questions at 8%. This is because their agendas are more tightly controlled by written questions, thus reducing the need for controlling dialogue.

Reasoning. The most striking feature in Figure 7.4 is the increase in Reasoning and of the ratio of Reasoning to Informing in PT(2) over PT(1). The lowest level of Reasoning in PT(2), Tutee Emulation at 34%, is higher than the highest level of Reasoning in PT(1), Set Questions and Review both at 27%. Then in PT(2) Reasoning increases to 38% in Joint Construction and to 46% in Tutor Exposition. The high level of reasoning in Tutor Exposition is achieved with the help of key visuals based on knowledge structures. These prompt the tutor with key functional phrases and help her with the flow of exposition. The key visuals also help both tutor and tutee in the Joint Construction ventures. Examples of Reasoning discourse are given under a separate topic heading following the analyses in this section.
Informing. Informing is less in PT(2) than in PT(1) only because Reasoning is more. The highest ratio of Reasoning to Informing in PT(1) is .43 (27/63) for Set Questions. The lowest ratio in PT(2) is half as much again at .64 (34/53) for Tutee Emulation and rises to 1.00 (38/38) for Joint Construction) and to 1.07 (46/43) for Tutor Explanation where Reasoning exceeds Informing.

A special look at Hands-On

Figure 7.5 shows the PT(1) Hands-On tutoring for the four pairs recorded: Charley and Kenny on June 4, Hetty and Olly on June 4, Gladys and Nancy on June 18 and Denis and Lenny on June 19. Most of the Hands-On instructing was done in the first June 4 session. The subject of instruction was the various HyperCard operations. Charley covered them most thoroughly.

Gladys and Nancy's exceptionally high Social Needs (15%) and zero Reasoning stand out clearly and have already been explained as due to the atypical venture on the poorly functioning HyperCard voice labels. Hands-On instruction is understandably high in Controlling (Average 23%) because of the need for the tutee to periodically ask for and receive controlling instructions to keep on track with the physical operations. The ratio of Reasoning to Informing is higher for Charley and Kenny (.45, 25/55) than for the Hands-On Average (.38, 20/53).
There is a tendency to think of hands-on instruction as cognitively simple compared with verbal only instruction. There can, however, be as much of explaining processes, recognizing relationships and problems, and testing solutions as in purely theoretical discourse. What distinguishes hands-on instruction is the higher interpersonal controlling dialogue that is necessary. The following are some Reasoning samples from Teddy and Kenny:

- Exploring which buttons to click to advance to next card or go back to previous one. Note high incidence of exophoric reference, "these things" and "this one".
  
  S1 And then can go command space because you don't need all these things.  
  S2 Oh.  
  S1 No, this one goes forwards and this one goes backwards. Understand?
S2 Yeah... {6 secs}
S1 This one goes backwards.
S2 And this one go forward.
S1 This one goes forward.
S2 Yeah... {6 secs} Okay.

- Instructing in the use of the HyperCard "Find" function.
S1 If you want to find . . . let's say "rock". You want to find the word "rock".
S2 Yeah.

- Informing interlude: S1 checks that S2 understands "rock" and then continues.
S1 This is a computer book.
S2 Yep.
S1 If you want find the words in the computer book you click "Find".
S2 "Find" yeah?
S1 Let's see? Here. You just type whatever the words you want . . . "rock".

- Controlling interlude: S1 helps S2 spell "rock" and pick out right keys.
S2 You click.
S1 Okay.

- Controlling interlude: S1 takes S2 through series of clicks bringing up "rock".
S1 See, it help you to find all the same words in the whole book.
S2 Ohhh.

Examples of Reasoning discourse for tutoring modes other than Hands-On are given under a separate topic heading following the analyses in this section.

Analysis of tutor/tutee % total words by tutoring mode

Figure 7.6 shows comparatively percent of total words for tutor and tutee both in total and by tutoring mode for PT(1) and PT(2). In total the tutee spoke more relative to the tutor in PT(1) with a ratio of 40:60 than in PT(2) with a ratio of 36:64. However, the breakdowns by tutoring mode provide a more meaningful comparison.

The tutee speaks more in the tutee emulation mode in PT(2) than in any other mode in PT(1) or PT(2) and actually speaks more than the tutor with a tutee/tutor ratio of 55:45. Similarly, the tutor speaks more in the tutor explanation mode in PT(2) than in any other mode.
The tutee speaks correspondingly less with a tutee/tutor ratio of 11:89. These two modes in PT(2), therefore, show the tutor in Tutor Explanation and tutee in Tutee Emulation speaking more extensively than anywhere else. The tutee's performance in Tutee Emulation is particularly significant as this mode accounts for 48% of the dialogue in PT(2).

Figure 7.7 shows the same data as in Figure 7.6 with the additional analysis by language function. Both tutor and tutee have more reasoning discourse in total in PT(2) than in PT(1): the tutor has 9% in PT(1) and 23% in PT(2); the tutee has 13% in PT(1) and 16% in PT(2).
The contrast is more striking in the individual tutoring modes. The tutor has a higher proportion of Reasoning in the PT(2) Tutor Explanation mode (43%) than in any tutor measurement elsewhere (the highest Tutor Reasoning measurement in PT(1) is 12% for Review); and the tutee has a higher proportion of Reasoning in the PT(2) Tutee Emulation mode (24%) than in any tutee measurement elsewhere (the highest Tutee Reasoning measurement in PT(1) is 16% for Set Questions). This speaks in favour of the explanation/emulation strategy used in PT(2) in place of the question-driven I-R-E strategy in Set Questions and Review in PT(1).
Analysis by selected features and tutoring mode

See Figure 7.8 above.

1. **I-R-E discourse** (last row in chart), is shown because one of the objectives of PT(2) was to move away from that mode;

2. **Words read** (middle row in chart), is shown because this was a factor in artificially raising the cognitive level of PT(1) discourse.

3. **Exophoric references** (front row in chart), is shown because they are particularly expected in discourse around a computer.
**Exophoric references**

These are highest (16%) in the PT(1) Hands-On tutoring mode because of the frequency of pointing to the screen or to the keyboard both in giving directions and asking questions. They are next highest but noticeably less (5%) in the PT(2) Tutor Explanation and Joint Construction modes, again because of pointing to the screen to easily convey meaning. They are lower (3%) in the Tutee Emulation and Set Questions modes: in Tutee Emulation, perhaps because this mode always follows the tutor's exposition in which meanings are established; and in Set Questions because this mode emulates traditional classroom discourse where the tutee, if knowing the answer, expresses it in words not normally requiring exophoric reference. This is also true of Review in which there are no exophoric references.

**Words read**

These appeared entirely in PT(1) in the Set Questions (20%) and Review (31%) because the words appeared in set questions and answers in the Question and Answer cards on screen or in set questions in the Tutor's Checklist (Appendix 2). They were, therefore, a significant factor in the PT(1) quantitative scores for length of utterance and mean length of utterance (MLU).

**I-R-E**

It is interesting that I-R-E discourse does not appear in the Hands-On and Unstructured modes in PT(1) nor in the Tutor Explanation and Joint Construction modes in PT(2). It appears predominantly in PT(1) Set Questions (76%) and Review (92%) modes, which closely follow traditional classroom practice. It appears to a lesser extent in PT(2) Tutee Emulation mode (34%). That it appears at all in this mode is because Gladys on some
occasions would give her explanation without calling up the content words in the key visual to which she was speaking. Consequently, Ursula would get into difficulties trying to emulate Gladys's exposition, leading Gladys to fall back on I-R-E to coax appropriate descriptions from her. For example, when Ursula starts to emulate Gladys's description of the solar system (without the benefit of content words in the key visual) she takes the initiative, asking Gladys questions, but gradually peters out causing Gladys to take the initiative and then move from helping to full I-R-E control. This is illustrated in the following dialogue:

_Ursula takes the initiative:
S2  What is that word over there?
S1  That one?
S2  Yeah.
S1  Mercury? Yeah, this one's Mercury.
S2  Huh. And this? . . . and that one is?
S1  That one Pluto.
S2  Yeah, Pluto . . . But I was thinking . . .
S1  Oh don't worry.
S2  And some of them has moons. Some of them has rings around it.
   And there's nine planets. The sun is where a star?
S1  Yeah. Okay here's your question

At this point Gladys takes the initiative but still helps Ursula generate discourse:

S2  {reading prompt} We have . . . we have the . . .
S1  Read it louder.
S2  We have on the one hand in the centre, middle of the . . .
S1  This one.
S2  Sun . . . {4 secs}
S1  See, and this one.

At this point Gladys takes control and moves into full I-R-E discourse:

S1  What are this?
S2  I dunno.
S1  This one, this black thing.
S2  Oh, planets.
S1  Right. Planets are going around the sun . . . {5 secs} now I just sayed that.

S2  Okay.
S1  Number of planets?
S2  Nine
(Gladys asks Ursula to name the planets which, with some help, she does)
S1 Okay and biggest?
S2 The biggest is Jupiter.
S1 Right. And smallest? (dialogue concludes with a series of short I-R-E exchanges like this one)
Examples of Reasoning discourse

Peer Tutoring (1): Our World stack

Gladys/Nancy from Atmosphere, a Concept venture
Sequence starts with three Informing turns. Tutee moves into Reasoning by challenging tutor twice. Tutor responds with two original definitions.
S1 These are layers {looking at screen where atmospheric layers drawn}.
S2 Oh, so they're here?
S1 Yeah.
S2 But I want to know what that means.
S1 Layers are blanket of air.
S2 Blanket? of air? { . . . 5 secs}
S1 Layers are something on top of something.
S2 Layers are . . .
S1 This one is two layers. Something on top of something.

Gladys's description of the atmosphere is checked and challenged by Nancy who insists on knowing what "layers" means. Gladys provides her own original definition of "layers": "blanket of air", and then again, at Nancy's insistence, her definition of "blanket": "something on top of something". Tutor and tutee share control.

Gladys/Teacher/Nancy from Planetary Rings, a Concept venture
Tutor doesn't know and asks teacher. Tutee listens and learns at the same time.
S1 {to teacher with tutee listening} What are planetary rings? I know what they are but how do they live? {i.e what is their function?}.
T They're made up of rocks and ice and they condense in what looks like a very thin ring. But it's actually lots of little rocks and dust and ice revolving around the planet.
S1 {to tutee} What are planetary rings?
S2 Planetary rings are made by the ice, rocks and dirt combined {substitutes "dirt" for "dust"; then concludes with two Social Needs utterances}.
Did you get that? {assertion of pride}.
S1 Very good.

Here the reasoning sequence takes place between Gladys and the teacher with Nancy silently listening and then providing the evidence that she had understood. Exchanges with the teacher were excluded from quantitative analyses.
Gladys/S3: Another tutor comes over to get information from Gladys

Two informing followed by two Reasoning utterances.

S3  What causes the atmosphere to move?
S1  What causes the atmosphere to move is the sun.
S3  How do you know that? {move to Reasoning}.
S1  The sun heat the air and the air move up and the cold air come down.

A simple Informing exchange moves into Reasoning with the fellow tutor's challenge "How do you know that?". Tutors will challenge fellow tutors and tutees will challenge tutors when neither are likely to challenge the teacher.

Gladys/Nancy from Day and Night, a Causal venture

Sequence starts with two Informing utterances, then moves into Reasoning.

S1  What causes day and night?
S2  The sun cause day and night.
S1  But how? {move to Reasoning}.
S2  Just the sun . . . the earth go around the sun.
S1  No, the earth go around the sun and it spins when it go around the sun. When one faces the sun it's day time and the other half is at night time.

Understand that? Okay {ends with Controlling utterance}.

Here Gladys challenges Nancy to move beyond a simple information answer by showing a relationship between cause and effect. Nancy gets stuck and Gladys supplies the answer. Nancy is confused between the earth spinning on its own axis and going around the sun. Gladys understands the difference but does not sufficiently elaborate on it. The Tutorial stack addresses this confusion with the "Two Ways of Rotating" and "Gravity" cards.

Gladys/Nancy from "Our Earth" (Classification), a Concept venture

Tutor teaches "Our Earth" classification principle.

S1  What are this ordering?
S2  Ordering what?
S1  Like dictionary A-Z or what?
S2  A-Z.
S1  No, no, no. Lookit here and you will know {pointing to Classification Work Sheet}.
S2  {pause 10 secs} ordering . . . about? Tell me.
S1  From biggest to smallest. Universe the biggest, and that's {points} solar system.
Gladys is asking Nancy about the classification principle on which the Our World stack is organized. She directs Nancy to the work sheet they had to complete (Appendix 3) and points out that it is from the biggest to the smallest.

Peer Tutoring (2) Tutorial Stack

Gladys/Ursula from Our Earth: Classification, a Concept venture

Tutor Explanation

Tutor introduces "Our Earth" classification with descriptive part-whole taxonomy.

S1 Okay, now this one is our earth. It is divided into land and water. And land is divided into islands and continents, see?

And the water is divided into the rivers, oceans, seas and lakes, see? {then a Controlling utterance} If you don't understand, ask me. Okay? . . . {9 secs}

S1 And these ones reverse.

And these ones, islands, continents is made up of the land.

S2 Land.

S1 Land, yes. And this water. And this one is rivers, sea^.

S2 Sea, oceans, river, lakes.

S1 Right.

Tutee Emulation

S2 The land is, er, continents and . . . er . . . water?

S1 No, land is where you can stand on.

S2 Land and continents? No, continents.

S1 Right . . . Okay

S2 Isl . . . ^

S1 Island.

S2 Now d'you remember this one? {Gladys moves into I-R-E}.

S1 Yeah.

S2 Okay, what does this divide to?

S1 Er, lakes, oceans, sea {repeats in whisper} river.

S2 Right . . . Okay.

Gladys starts her explanation with a part-whole taxonomy in a 6-utterance turn which produces 58 uninterrupted words, an MLU of 9.7, a longest utterance of 13 words, and one 7-word Controlling utterance. Ursula shows that she is following along by repeating the last word of the turn, "land". She then shows her active participation by interrupting Gladys's next turn by correctly completing Gladys' sentence for her with the words "sea, oceans, river,
lakes". When it comes to Ursula's emulation of Gladys's example she starts out uncertainly because Gladys has not clicked up the content words for the key visual classification chart on screen. Gladys corrects her query of "water" as a part of what "land is" with a well reasoned definition, "No, land is where you stand on" (implied: so how can it be water?). Ursula continues uncertainly until Gladys takes control of the dialogue with the utterance "Now d'you remember this one?" and completes it in I-R-E mode.

Gladys/Ursula from Rotation: Principles, a Causal venture

Tutor Explanation

S1 This one the sun and this one the earth and the earth moon \{identifying components of visual in Informing utterance\}. Now earth goes around, rotates, rotates around the <sun>

S2 <Moon and the x takes x> \{Ursula perceives relationship\}.

S1 And the earth revolves around the sun. And they take what? The earth goes around the sun in one . . . takes one years, only one years. \{Then follow four Informing utterances, including the tutee's "Oh".\} Now, do you understand that? You put "earth goes around the sun", you put it in three sentences. And you say, goes around, rotates around and revolves around the sun.

S2 Oh.

Tutee Emulation \{begins with five Informing turns\}

S1 Now you say that one \{the earth-moon instead of the sun-earth model\} That one \{circle\} the earth, this one's the moon, and this what I just said, the same.

S2 Oh, you want me to say the same thing that you said, right?

S1 But I don't want you to use the earth and the sun. I want you to use the moon and the earth.

S2 Er, is it the same thing?

S1 Yeah, use three, three sent^ \{then follows the Reasoning turns\}.

S2 The moon goes around the earth.

S1 Right.

S2 And the moon 'tates around the earth?

S1 Yeah.

S2 The moon remove around^

S1 Revolves.

S2 Revolves around the earth.

S1 Okay.
Here, Gladys starts her exposition with an 8-utterance turn which produces 77 words, an MLU of 9.6, and a longest utterance of 13 words of which three are Informing utterances. Ursula attempts to cut in with an observation she makes from the key visual, indecipherable because both girls are talking at once. Gladys keeps going. The overlapping dialogue is indicated by the <> symbols. Then Gladys gives Ursula the Informing instructions for her turn but tells her to talk about earth and moon instead of sun and earth as Gladys had done. Ursula checks Gladys's meaning and rises to the challenge, producing three Reasoning sentences of relationship using the alternative synonyms "go around", "rotate" and "revolve". Gladys gives Ursula confirming or correcting feedback but allows her to remain in control.

**Gladys/Ursula from The Solar System: Classification, a Concepts venture.**

*from Tutor Explanation*

Tutee incredulous and challenges authority of tutor's description.

S1 And the moons here {points to graphical depiction of moons with some planets having several moons}.

S2 So many moons?

S1 Yeah see, planets and moons.

S2 Oh, I don't know that there has so many moons {tone of incredulity}.

S1 This one has the most, see? . . . Moons is belong to the planets and (planets) belong to the sun. Now d'y'understand that?

Here we have another example of the tutee challenging the tutor. Gladys remains firm and emphasises the moons' place in the classification system.

**Gladys/Ursula from The Solar System: Classification, a Concepts venture**

*from Tutee Emulation*

Tutee produces both "top down" and "bottom up" part-whole taxonomy with minimal help from tutor.

S2 The solar system is made up of the sun, the planets and moons.

S1 Okay {clicks the directional icon to reverse direction of visual}.

S2 {following the changed direction} The moons belong to the planets, the planets belong to the sun, the sun^?

S1 No. Belong to the sun . . . {to prompt tutee to correct herself}.

S2 Which are (all) part of the solar system.

S1 Right.
Gladys/Ursula from Gravity: Principle, a Causal venture, from Joint Construction
Tutor guides tutee in applying process-principle in two contexts.
S1 Okay, gravity is a force.
S2 If there's no gravity the people will fly off . . .
S1 Now put this earth and sun into the sentences.
S2 Huh?
S1 Oh don't worry . . . {Social Needs utterance}
   Now I'll help you. Earth is held in place by the sun gravity, see? {points to visual} Now you read that one.
S2 Earth is held in place by sun's gravity.
S1 Now use this one.
S2 Earth^.
S1 No.
S2 No, moon is held in place by earth gravity.
S1 Right.

Gladys does not give an expository introduction to this venture but figures it out as
she steers Ursula through it.

Gladys/Ursula from Volcanic Eruption: Cause-Effect Sequence, a Procedural venture, Tutee Emulation
Tutor, after demonstrating, helps motivated tutee relate causal sequence. Begins with two control utterances and then moves into Reasoning.
S2 Oh now can I say it?
S1 Yes.
S2 First, it caused earthquake. As the result the disrup magma up^.
S1 No, it is the earthquake distrubs {disturbs} magma.
S2 Magma. Then force magma up the volcano. Then blow the steam and ash . . . crater, is it?
S1 No, crater's this one.
S2 Oh, then blow out steam and ash out of volcano.
   At the same time, magma becomes lava and flowns r . . r . . running down the^.
S1 Flows down.
S2 Flows down the . . volcano.
S1 You know that's the^.
S2 And finally lava solidifies into rocks.'
S1 Yeah.
This is one extract from a prolonged Volcanic Eruption venture which was a problem to all of the tutors because of unfamiliar vocabulary. Gladys was helped by the teacher after which she was able to go through it. Ursula had followed along and is eager to take her turn.

_Gladys/Teacher in exchange after completing the Tutorial stack._

_Tutee explains choice to teacher in terms of evaluation criteria._

T Do you think that it's best on HyperCard {i.e. "Tutorial" presentation} or do you think it would be best just to have straight sheets and explain it from the sheets?

S2 I think I would have it in HyperCard.

T Why do you like it in HyperCard?

S2 Because if you... it doesn't have the answers. When you want to have the answer you click on and if you don't want to have the answer you click it off.

T Yes, that's a good point. So you test yourself.

S2 Yeah.

Because this exchange is with a teacher, it is not included in quantitative analyses.

Ursula here explains why she and the other tutors would click up a key visual and use it without clicking up the content words. They wanted to see how far they could get without that assist. This is a good technique for review but not good as a first introduction of a topic to the tutee.

**Summary of results**

Overall, PT(2) results compared with PT(1) show very little quantitative difference between inter-personal and ideational discourse: PT(1) is 13% inter-personal and 87% ideational; PT(2) is 15% inter-personal and 86% ideational. The significant difference lies in the split of ideational discourse between Informing and Reasoning: PT(1) has 65% Informing to 22% Reasoning while PT(2) has 47% Informing to 39% Reasoning. In other words PT(2) shows a 77% increase in Reasoning (from 22% to 39%) and a more than doubling of the ratio.
of Reasoning to Informing from .34 to .83, indicating a higher quality of academic discourse in PT(2).

When results are broken down by Tutoring Mode, Reasoning in PT(1) is lowest in Unstructured (tutor and tutee browsing without an agenda) at 9%, higher in Hands-On at 20% (taking the average Hands-On figure from Figure 7.5) and highest in the Set Questions and Review modes at 27%. In PT(2), Tutee Emulation shows the lowest level of Reasoning. However, at 34% this is one quarter higher than the highest level of Reasoning (27%) in PT(1). Reasoning then increases in PT(2) to 38% in Joint Construction and to 46% in Tutor Exposition. The tutee's performance is particularly significant in the PT(2) Tutee Emulation mode (about half the total discourse) where the tutee exceeds the tutor in her share of the total Emulation discourse (55% compared with 45%) and in her share of the Reasoning component (71% compared with 29%)

In PT(2) the Joint Construction mode is highest in Controlling (15%) for the same reason as in PT(1) the Unstructured mode is high in this function (16%): the lack of a tutor-led agenda. This is not necessarily a bad thing but it does entail more Controlling discourse.

I-R-E discourse predominates in PT(1) but in Set Questions (75%) and Review (81%), not in Unstructured or Hands-On where it does not appear at all. It drops away sharply in PT(2): it does not appear at all in the Tutor Exposition mode, appears minimally in the Joint Construction mode (3%) and to a reduced extent in the Tutee Emulation mode (34%). I-R-E persists in the Tutee Emulation mode because it is the natural default mode for the tutor when the tutee gets into difficulty. The tutee experienced particular difficulty when the tutor spoke to a key visual empty of content words and then asked her to do the same.
Words read directly from the Question and Answer cards and the Tutor's Checklist amount to 20% of all words in PT(1) and so contribute materially to PT(1) sentence length and MLU measurements.

Exophoric references predominate in the Hands-On mode (10%) in PT(1); are next highest in Tutor Exposition and Joint Construction in PT(2), both at 6%; and are least in the highly structured Set Questions (3%) and Review (0%) modes in PT(1).

The Cognitive analysis results therefore suggest that the use of key visuals embodying knowledge structures, together with some tutor training, made possible:

1. a much higher ratio of Reasoning to Informing discourse in PT(2) over PT(1): .81 (39:47%) compared with .34 (22:65%);
2. a move away from tutor-dominated, question-driven I-R-E discourse in PT(1) of 62% to a more equal sharing of control between tutor and tutee in PT(2) where I-R-E, although persisting, dropped to 13%;
3. a significant performance by the tutee in the PT(2) Tutee Emulation mode (48% of the discourse) where the tutee actually spoke more than the tutor both in total (55:45%) and in Reasoning discourse (71:29%)

This analysis is based on a comparison of only two tutor/tutee pairs. It cannot therefore be generalized. The results, however, seem convincing enough to believe that something similar may be achieved with other tutor/tutee pairs where the tutors are common and the tutees have similar educational, cultural and personality profiles.

We turn now in our final chapter to a discussion of these results and conclusions which may be drawn from them.
CHAPTER 8: CONCLUSION, SUMMARY AND DISCUSSION

Conclusion

The research question answered

Our research question asks: Is peer tutoring, using a computer-based hypermedia resource, an effective means of helping ESL students generate academic discourse? We can answer "yes" in varying degrees, based on results achieved in PT(1) and PT(2). These results are recapitulated in the summary which follows.

Summary

Peer Tutoring 1

Overall Quantitative results

1. In PT(1), more student talk was generated by peer tutoring, (56% ± 7% of activity time), than by any other student activity in library, computer lab or homeroom (11-16% ± 1.5% of activity time).

2. Our question then is: how much of the 56% student talk from peer tutoring is academic (ideational) as distinct from conversational (interpersonal) discourse? The answer is approximately 48% or seven eighths of it. These measurements derive from PT(1) in which some 87% of total peer tutoring discourse was academic and 13% was conversational.

Reservations

3. Although we judged PT(1) successful in terms of the quantity of student talk generated by peer tutoring and the high proportion of that talk which was academic, we had reservations about the results, based upon our observation of the tutoring sessions and
scrutiny of the discourse transcripts. The tutors had adopted a whole-class I-R-E model of teaching (familiar to them from their previous schooling) although they were teaching a "class" of only one - the tutee. Accordingly, they maintained discourse control by a continuous flow of initiating questions (whether or not they knew the answers themselves) which they put to the tutees.

Quantitative and qualitative effects of I-R-E

4. I-R-E accounted for 62% of the total PT(1) tutoring discourse. This had certain consequences:

a. The tutors (some more than others) tended to adopt an authoritarian attitude which caused some interpersonal tensions.

b. The question-driven control inherent in the I-R-E approach inhibited spontaneous dialogue between tutor and tutee.

c. The above factors are reflected in the tutees' utterance and wordcount analyses.

i. Tutee utterances were mostly short reply attempts: 40% were of one word only and 72% were of three words or less.

ii. In contrast, the tutors' had fewer short utterances: 17% of one word and 45% of three words or less; and more longer utterances: 55% of four words or more (tutees 28%), 25% of seven words or more (tutees 11%).

iii. Accordingly, the tutors produced 2.5 times as much talk, measured by wordcount, as the tutees.

d. The tutors took as their agenda the questions on the Checklist (Appendix 2), intended for review, most of which called for factual rather than explanatory
answers. The tutors emphasised to the tutees the importance of **memorization**. Consequently there was little consecutive dialogue between tutors and tutees, success being judged by the tutees' prompt response to factual questions with memorized factual answers. This tutoring strategy resulted not only in short utterances, as we have seen above, but also in relatively low quality of academic discourse, measured by the amount of "Reasoning" compared with "Informing" (Staab's (1986) language functions). The results were: Informing 65%, Reasoning 22%, a ratio of 3:1 in favour of Informing.

**Differentiation by tutoring mode**

5. Four tutoring modes were identified in PT(1):

   a. **Unstructured**: Tutor and tutee browse through stack without agenda;

   b. **Hands-On**: Tutor engages tutee in physically operating HyperCard.

   c. **Set Questions**: Tutor takes tutee through stack following question checklist.

   d. **Review**: Tutor follows question checklist in asking tutee review questions.

Analysis by these modes brings out differences concealed in the average results:

   i. **I-R-E** instruction is confined entirely to Set Questions (75%) and Review (81%) and does not appear at all in the Unstructured and Hands-On modes. Set Questions and Review account for 81% of the PT(1) discourse. Therefore The I-R-E average for these two modes, the bulk of the PT(1) discourse, is 77%.

   ii. **Reasoning** is the same in the Set Questions and Review modes (27%), much lower in the Unstructured mode (9%) but only slightly lower in the Hands-On mode (20%).
iii. **Unstructured** (browsing) is essentially exploring What? not Why? and therefore produces a small amount of Reasoning discourse (9%). Unstructured is also high in Conversational discourse (16%) compared with Set Questions and Review (9%). Most of the Conversational discourse is Control (15.5%) because of the need for tutor and tutee between them to agree an exploration sequence.

iv. The **Hands-On** mode is even higher than Unstructured in conversational discourse (27%) because of the need for Controlling discourse (23%) to guide the Hands-On sequences. However, Hands-On produces more Reasoning (20%) than Unstructured (9%) and the same ratio of Reasoning to Informing (20/53 = .4) as Set Questions and Review (27/65 = .4).

**Overall qualitative (pedagogical) results**

6. PT(1) had positive qualitative results in terms of meeting the pedagogic objectives for the peer tutoring sessions as supported by the discourse extracts quoted in Chapter 4:

a. The tutors consolidated their understanding of the material they had worked on in the Our World stack and became familiar with material they had not worked on. They resolved uncertainties by discussions with each other or with the teachers in the computer lab; and showed the understanding gained by multi-utterance explanations of the topics in question, as recorded in the discourse transcripts.

b. The tutees became familiar with the contents of the Our World stack, which they demonstrated through interactions with the tutors and by the preparation of a
booklet in their homeroom in which they answered questions focusing on the question and answer cards.

c. The tutees also learned the required HyperCard operations, which they demonstrated by navigating the Our World stack unaided.

d. The peer tutoring sessions also proved that the format of tutoring around the computer using multimedia HyperCard software was an effective teaching medium for new learners: the tutees' interest was sustained in periods averaging 40 minutes without a break, with minimal offtask time.

7. However, certain factors detract from these positive results:

a. The I-R-E approach had certain qualitative effects as noted in point 4 above: in particular, tensions induced by the authoritarian attitude adopted in varying degrees by the tutors; and inhibition of spontaneous dialogue by question-driven control.

b. Most tutees were confused about certain concepts, particularly the difference between the earth rotating around the sun and spinning around its own axis, and the phenomena of day and night. This was largely because the tutors asked questions about these phenomena without explaining the underlying concepts. In some cases the tutors were unsure themselves.

Therefore the success of PT(1) lay in quantity rather than quality of language and in a focus on factual information about our world and the solar system rather than on underlying classificatory and causal concepts.
Peer Tutoring (2)

The computer coordinating teacher felt that the tutors could achieve a higher quality of discourse if they were steered away from the I-R-E question-driven approach and provided with key visuals to help an explanatory dialogue with the tutees. He therefore planned a second series of peer tutoring sessions, PT(2), in the following new school year, using four of the same tutors with new tutees.

**Differences between PT(2) and PT(1)**

1. The tutors were provided with a Tutorial HyperCard stack with knowledge-structure-based key visuals as a front end to the Our World stack to help them teach the Our World Q&A cards (see Appendix 4).

2. They attended three orientation sessions to become familiar with and use the Tutorial stack, practising on each other. In practising, they were asked to change their mode of instruction. Instead of asking a continuous flow of initiating questions (I-R-E), they were asked instead, to explain each card with the help of the corresponding key visual on screen, and then to ask the tutees to repeat each explanation in their own words, also with the help of the key visual. The new mode of instruction was summed up:

"First, you tell the story; then you ask the tutee to tell it back to you".

3. The tutoring modes identified in PT(2) were different from those in PT(1):
   a. **Tutor explanation**: the tutor's initial multi-utterance explanation of a topic.
   b. **Tutee Emulation**: the tutee's attempt to emulate the tutor's explanation.
   c. **Joint Construction**: the tutor and tutee working together to explicate a topic.
PT(2) Objective

4. The object of PT(2) was to compare results with PT(1) to determine the effectiveness of the new PT(2) tutoring strategy in:
   a. maintaining or increasing the quantity of language produced;
   b. improving the quality of academic discourse produced by both tutors and tutees, as measured by an increase in the ratio of Reasoning to Informing discourse;
   c. reducing the amount of I-R-E discourse.
   d. meeting the qualitative pedagogical objectives.

Basis of PT(1) and PT(2) comparison

5. Of the four new tutor/tuttee pairs, only one, Gladys and Ursula, had a comparable joint profile to a pair in PT(1), Gladys and Nancy. The other PT(2) pairs had major differences from PT(1), mainly due to the PT(2) classroom teachers' selection of students with identified or suspected learning problems. Comparisons were therefore based on the Gladys/Nancy and Gladys/Ursula pairs.

Quantitative results

6. The amount of language generated in PT(2) was greater than in PT(1). The comparison, as measured by Words per Minute (wpm), is:
   a. Tutor: PT(1) 45.1 wpm, PT(2) 57.3 wpm, an increase of 12.2 wpm or 27%.
   b. Tutee: PT(1) 29.2 wpm, PT(2) 34.8 wpm, an increase of 5.6 wpm or 19%.

Nancy, the tuttee in PT(1), had one of the two highest scores for tutees' wpm in PT(1), which ranged from 15.3 to 31.8 with an average of 22.8. Therefore Ursula, the tuttee in PT(2), achieved her 19% increase over a high, not average base.
7. However, Gladys, the tutor in both PT(1) and PT(2) in this comparison, increased her amount of talk in PT(2) by even more than the tutee (by 27% compared with 19%) thus maintaining the same proportional excess over her tutees' talk (1 1/2 times) in PT(2) as in PT(1). On average all tutors exceeded all tutees' talk in both PT(1) and PT(2) by approximately 2 1/2 times. Gladys and her tutees' more even sharing of discourse time, and their higher than average scores on all measures, indicate that these partnerships were more efficient than the others.

Academic discourse results

8. Ideational discourse was approximately the same in PT(2) at 86% as in PT(1) at 87%. However, the breakdown between Reasoning and Informing shows a marked difference:

a. Informing: 65% in PT(1), 47% in PT(2), a decrease of 28%;

b. Reasoning: 22% in PT(1), 39% in PT(2), an increase of 77%.

Thus, Reasoning, the marker of academic discourse quality, almost doubled (1.8 times) in PT(2) over PT(1).

9. The breakdown of Informing and Reasoning by Tutoring Mode is instructive:

<table>
<thead>
<tr>
<th>Tutoring Mode</th>
<th>PT(1)</th>
<th></th>
<th></th>
<th>PT(2)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reas %</td>
<td>Inf'm %</td>
<td>R/I</td>
<td>Reas %</td>
<td>Inf'm %</td>
<td>R/I</td>
</tr>
<tr>
<td>Set Qs / Review</td>
<td>27</td>
<td>65</td>
<td>.4</td>
<td>Tutor Explanation</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>Hands-On</td>
<td>20</td>
<td>53</td>
<td>.4</td>
<td>Joint Construction</td>
<td>38</td>
<td>39</td>
</tr>
<tr>
<td>Unstructured</td>
<td>9</td>
<td>75</td>
<td>.1</td>
<td>Tutee Emulation</td>
<td>34</td>
<td>53</td>
</tr>
</tbody>
</table>

Reading "Reasoning %" from the left hand side, bottom up, we see that it rises in PT(1) from a low of 9% for "Unstructured" to a high of 27% for "Set Questions &
Review”; and then in PT(2) starts at 34% for "Tutee Emulation", and rises to 46% for Tutor Explanation. Thus the lowest Reasoning score in PT(2) is higher than the highest Reasoning score in PT(1). Similarly, the ratio of Reasoning to Informing (R/I) starts at a low in PT(1) of .1 for Unstructured and rises to .4 for both Hands-On and Set Questions & Review”. In PT(2) it starts at .6 for Tutee Emulation and rises to 1.0 for Joint Construction and to 1.1 for Tutor Explanation. Thus Reasoning never amounts to more than .4 (two fifths) of Informing in PT(1) but rises to parity with Informing for Joint Construction and above parity for Tutor Explanation.

I-R-E results

10. The amount of I-R-E discourse in PT(2) at 13% is substantially lower than in PT(1) at 62%, reflecting the efficacy of the tutor explanation/tutee emulation strategy which the tutors used following their orientation sessions before the PT(2) tutorials started.

a. As with academic discourse, the breakdown by tutoring mode is instructive:

Tutor Explanation 0%; Joint Construction 3%; Tutee Emulation 25%.

- The highest amount of I-R-E in PT(2), 25% for Tutee Emulation, is still substantially lower than the average I-R-E for PT(1) of 62% and lower still than the average (77%) for PT(1) Set Questions and Review with which it should more properly be compared.

b. A study of the discourse transcripts shows that I-R-E came back into PT(2) in the Tutee Emulation mode when the tutee got stuck and heavily relied on the tutor for continuing. The tutor then reverted to I-R-E questioning to get the tutee back on track. An I-R-E strategy in these circumstances was not necessarily inappropriate.
Qualitative pedagogical results

11. PT(2) satisfactorily met the pedagogic objectives for the peer tutoring sessions, which were set at a more demanding level than for PT(1). They called for the tutors to:
   a. show understanding of the key visuals and their underlying cognitive structures;
   b. describe the content represented by the visuals in coherent sentences matching the cognitive structures;
   c. show tact and sensitivity in their relations to their tutees;
   d. move away from a controlling-question-dominated (I-R-E) approach.

12. The tutors showed through their language that on the whole they understood the structures of the visuals and produced clear explanations of the content represented in multi-word utterances and multi-utterance turns, as supported by the discourse extracts quoted in Chapter 5.

13. These extracts also show that they had problems with two of the topics: in "Solar System Classification" they misapplied some of the functional phrases and in "Volcanic Eruption" they had problems with the content vocabulary and sometimes did not use the functional phrases provided.

14. The tutees, through their language and responses, showed that they followed the tutors in understanding the visual structures and that they could emulate the tutors' explanations of the content with some help. They shared the problems which the tutors had with the two topics described in above.

15. The tutors were courteous and helpful in their interactions with the tutees.
a. One of the tutors (Hetty) was the exception in going off-task with her tutee in one episode in one session and not following the recommended tutoring procedure with another tutee in another session. Otherwise neither tutors nor tutees were off-task at any time and the tutors responded positively to their tutoring challenge.

16. The tutors were, on the whole, successful in using the "tutor explanation/tutee emulation" approach. Their move away from I-R-E was significant: from 62% of total discourse in PT(1) to 13% in PT(2), a 79% drop (see I-R-E above). The tutors fell back on I-R-E as "default" mode when tutees got stuck in their emulation responses.

Discussion

The issues

PT(2) holds the key to success in enabling students, both tutors and tutees, to generate reasoning discourse. In PT(1), academic discourse is dominated by Informing which, in the predominantly I-R-E Set Questions and Review modes (81% of total discourse), is 2½ times greater than Reasoning. In PT(2) this ratio is reduced to 1½ times in the Tutee Emulation mode, is approximately even in the Joint Construction mode and, in the Tutor Explanation mode, is actually reversed by a small margin (2%). The Joint Construction and Tutor Explanation modes together make up 52% of total discourse. Two factors contribute to these results

1. Moving away from the traditional I-R-E default teaching style to alternative tutoring: modes, suitable to small group settings: i.e. in PT(2), moving to the Tutor Explanation and Tutee Emulation modes (the tutor explains a topic and the tutee emulates the
tutor's explanation) or the Joint Construction mode in which tutor and tutee work on a topic in more or less equal partnership.

2. The addition to the Our World HyperCard stack of a Tutorial front end with knowledge-structure based computer-graphics (key visuals).

These factors give rise to three levels of discussion relating to peer tutoring in our case study:

1. A remedy for traditional teacher-dominated language in the classroom;
2. The grounding in technology of the traditional classroom paradigm;
3. The role of the electronic technologies in changing the classroom paradigm.

**Strategy for lessening discourse domination by tutors**

**The tutors' version of I-R-E**

In PT(1), the tutors mimicked the traditional model of teaching to which they had been exposed in their previous school years but without the skill and sensitivity of the trained teacher. The goal was to transmit the knowledge in the Our World stack to the tutees. The method was the tutors' less sensitive version of the I-R-E style. They would ask the tutees questions but without introducing the subject matter; they would then prompt, coax or hector them until they got the answer; and when the tutees did not get the answer, the tutors would give it to them with the exhortation to make greater efforts to remember. They laid great emphasis on the virtue of remembering and the vice of forgetting. The required answers were usually a single word or phrase. Success, to the tutors, lay in the ability of their tutees to immediately produce from memory short factual answers to a series of questions. The tutees were completely familiar with the "question game" and followed along without demurring.

Thus Denis with Lenny:
S1 What are planets? . . . {7 secs} You don't know? {this without any introduction}.
S2 Ah . . . planets um . . . wait.
S1 I teach you before {in a playful voice - Denis is a "coaxer"}.
S2 Where were me? Let me remember {what counts for both Lenny and Denis}.
Denis follows with some spelling clues. The answer he is seeking is "rock". In the end he tells Lenny and concludes with great emphasis: "You hafta member!".

Charley with Kenny:

S1 What does the sun do? {typical I-R-E opening gambit}.
S2 The sun do make sunshine to the planets . . . right?
S1 Well what else? {impatiently} . . . {3 secs}
Think, think, what I taught you last time. Just think {Charley is a "hectorer"}
. . . {5 secs} You don't know? . . . {14 secs}
Charley tells Kenny the answer and concludes with a reproving tone "You forgot!". He follows with another question which Kenny can't answer and administers the rebuke "Just one week you forget everything?".

Hetty with Olly:

S1 All the planets name again {Olly had just been through this with problems with both names and pronunciation}.
S2 Really? {Olly can't believe that Hetty is going to go through it all again}.
S1 Yeah. Start off with this one {Hetty does not relent}.
S2 What this one?
S1 Oh Venus {with exasperation} . . . Five times!
Repetition is Hetty's favourite pedagogical device for dealing with a faulty memory. Olly obliges by saying "Venus" five times. Later, when he repeats a mistake, Hetty "ups the ante" to ten times and overrides Olly's protests.

The I-R-E style had other disadvantages than the domination of the discourse by the tutors (out-talking the tutees by 2½ times) and the relatively low quality of the academic discourse generated (ratio of Reasoning to Informing .4 for Set Questions and Review and .3 overall). The questioning mode of I-R-E put the tutors totally in control of the discourse with the tutees always on the defensive which had other consequences:

1. The tutors were not sufficiently challenged. They did not always know the answer to a question themselves, e.g. "What are planetary rings?". They did not try to
investigate the question by dialogue with the tutee but either immediately or after waiting for the tutee to flounder went off to ask a teacher for the answer. The teacher would then dialogue with them but they usually simply told the answer to the tutee.

2. The tutees grew to resent being constantly on the defensive against a never ceasing stream of questions, to which they often did not know the answer, while the tutors grew exasperated because they had to constantly prompt the tutees. The tutors' exasperation is illustrated by the extracts above. The tutees' resentments were detectable from their tone of voice and from the occasional sub-vocal expression like "shuddup!".

3. This below-the-surface emotional strain no doubt contributed to the feelings of tiredness expressed by the tutors who found their task much more demanding than they had anticipated, as we have discussed in the section "Analysis by tutors' teaching style" in Chapter 4, PT(1) Results.

The strategy

The object of the strategy is to bring about a change in the ratio of tutor (teacher) to tutee (student) talk so that discourse and control of discourse is more equally shared. Our experience shows that this may be accomplished by changing the style of teaching from predominately knowledge transmission, the traditional I-R-E style, to predominantly knowledge construction in which the tutor and tutee use the knowledge structures of reasoning in a dialogue together to master pedagogic content, in our case the content of the Our World stack. This was to a large extent accomplished in PT(2) by orienting the tutors to the new approach and giving them knowledge-structure-based key visuals to support their
framing of academic discourse appropriate for each topic. The essential difference in outcome between these two approaches is that in knowledge transmission tutor talk is the product of simple (often read) questions and repetitions while tutee talk is the product of rote learning and memory; whereas in knowledge construction tutor and tutee talk is the product of thinking and problem solving. Knowledge transmission aims for a knowledge of "facts"; knowledge construction aims for an understanding of concepts.

**Traditional teaching paradigm grounded in technology**

**The technological base**

In the third part of our review of literature (chapter 2C) we have traced the linkage that media theorists claim between teaching style and technology employed. Writing was the first of the technologies of communication or media but is so taken for granted that we do not normally think of it as such. However, writing created the text which, with the learning academy or school, from the Greek period on through the Middle Ages became the authoritative base of education. Text-based teaching replaced preliterate "assisted performance" learning as the essential content of education. The teacher's task was to transmit the "truth" and "facts" of the text, be it religious, philosophic, medical or other branch of contemporary categories of knowledge; and the student's task was to listen and remember. The invention of printing immeasurably raised the power of the text which, in the form of the printed book, became progressively cheaper until the point was reached where students could have their own copies. However, the teacher remained the intermediary through whom the content of the text was explained and transmitted. The students' task remained to listen and remember.
Hence we can suggest that the knowledge transmission model of teaching with its "recitation" and I-R-E style of discourse is firmly based on the technology of print. This in turn is carrying on the same authoritarian model of teaching created by the technology of manuscript writing. This model is so deeply engrained in Western culture that it has become instinctive and is therefore on a subconscious level extremely resistant to change. Consequently, when a new technology like the computer is introduced, it is not used in a way best suited to it but is subverted to support the old technology. The computer screen becomes a page of text and the computer itself becomes a page turner as in early CAL. This is an inappropriate use of technology. The style of teaching remains unchanged.

Inappropriate use of technology in Our World PT(1)

In the first peer tutoring phase of the Our World unit, the tutors instinctively taught by the knowledge transmission model, using the traditional I-R-E approach they were accustomed to from their earlier education and producing somewhat indifferent academic discourse: mostly Informing discourse in short turns and short utterances with little Reasoning. The Our World stack was simply used as a reference to check whether or not answers to a predetermined list of questions were correct. The tutors could just as well have turned to text and pictures in a printed book to verify answers. The HyperCard stack offered the convenience of clicking easily from one part of the stack to another without the need to "turn pages", i.e. flip through all screens. On its own this was but a marginal advantage. The true advantages of HyperCard were not exploited: interactivity and movement between text, graphics and animation, to name the features present in a simple form in the Our World stack.
This was because there was no need to use these features in knowledge transmission teaching. All that was required were correct answers to predetermined questions. True, the computer was more exciting to the students than a book; but that was an expensive excitement when no more was accomplished than could have been accomplished with a printed text, e.g. even the booklet the students produced by printing out the HyperCard stack.

**Role of new technologies in changing teaching paradigm**

**Appropriate use of technology in Our World PT(2)**

In the second peer tutoring phase of the Our World unit, PT(2), the tutors were given two extra supports: the first was a new Tutorial stack as a front end to the Our World stack which illustrated each theme to be taught with a key visual designed to make overt the basic knowledge structure of the theme, e.g. description, classification, sequence etc.; the second was a series of four training sessions which introduced them to the Tutorial stack, asked them to: a) use the visual to "tell the story" (explain the theme) to the tutee; b) have the tutee "tell the story" back again; c) encourage the tutee to ask questions at any time; and d) use time in the training session to practice on each other.

As a result of these preparations the tutors were successful in moving into a knowledge-construction style of teaching with the tutees for much of the PT(2) sessions. The quality of the academic discourse in terms of Reasoning discourse generated markedly improved, particularly in the tutors' explanations. The amount of I-R-E transmission discourse dramatically dropped but did persist when the tutor had to intervene to help the tutee in the "telling the story back" sequences. On those occasions the tutor reverted to the traditional "default" teaching style.
On the whole, therefore, the PT(2) sessions made more appropriate use of computer hypermedia technology represented by the HyperCard Tutorial and Our World stacks. The computer was used for the dynamic display of multimedia information as a book is used for the static display of text, pictures and diagrams. Multimedia includes all the contents of a book with the addition of sound, video and animation etc. In addition the user of multimedia has what the reader of a book does not have: the ability to flexibly and instantly navigate the stack both extensively (going from topic to topic in any desired sequence) and in depth (going from a topic into any number of subtopics before proceeding further).

The Tutorial graphics were highly interactive. The graphics were not presented ready made but were built up by the students as they went through them, clicking up one element at a time. The students found them particularly helpful for review because the content vocabulary did not appear unless clicked up. This gave the students the opportunity to see if they could give a coherent explanation with only the help of the graphic outline and the functional phrases provided. Then they could click up the content words to check themselves. This approach was particularly helpful in those visuals that represented movement, e.g. the orbit of the earth around the sun. The graphic showed the basic idea non verbally which the student could cognize in L1 and then describe verbally in L2, one step at a time. This the students did successfully and then showed that they could apply the same principles without hesitation to an analogous movement, e.g. the orbit of the moon around the earth. As shown by the extracts from transcripts we have quoted, the tutees did indeed construct the knowledge they were expected to acquire by dynamic interactions with the tutors around the computers.
Appropriate use of technology in the Our World unit generally

On a much smaller scale, the Our World unit reflects some of the same objectives as the CSILE project in Ontario, cited in our review of literature. The Our World students were encouraged to do their own research, to look out the materials that would contribute to their topics, to cooperatively discuss these in small groups and decide how to organize them for presentation in a hypermedia database.

They consulted library texts and library computer resource programs dealing with the solar system and the physical geography of the earth. The teachers left them to make their own decisions and, although helping them to refine their ideas, did not give them a ready made template for developing their themes. In the computer lab they mastered the HyperCard authoring program with hands-on instruction from the computer coordinating teacher. He left them on their own to convert their research material into HyperCard format and edit and refine it but remained available to consult with them when they ran into problems.

The construction of the Our World stack can therefore be judged as an appropriate application of technology. The students used print where print was appropriate: retrieving information from printed texts in the library. They used the library computer for the retrieval of information in HyperCard, not print format: i.e. in multimedia format integrating in a unified presentation, pictures, charts, text on screen, sound, video, animation and embedded programs (like simulations). They programmed their own HyperCard stacks combining pictures, diagrams, text and, with some assistance, embedded programs (e.g. to simulate the change from day to night) and sound (for sound labels). In this they used the computer, in terms of Taylor's (1980) distinctions, as a tool for word processing and creating graphics and
pictures; and as a *tutee* (i.e. telling the computer what to do) in designing and placing various types of HyperCard buttons for navigating the stack. At all times they were in control of the computer; the computer was not, as in CAI, used as a *tutor*, in control of them.

A wide range of information was freely accessed by the students, both print information in the school library and electronically stored information in various commercial HyperCard programs. The teacher acted as guide, consultant and coach rather than exercising a gatekeeping role. This was, in all phases, a knowledge construction operation, greatly facilitated by computer technology.

"Our World" unit a window to the future

"Our World" was the one unit during the year in the curriculum of the ESL students in which they worked in the computer lab. The computer lab services the whole school. Therefore use of its facilities is rationed of necessity. Many, perhaps the majority of schools, do not have a computer lab as well equipped as this one or do not have one at all. Therefore a unit like "Our World" does not herald an imminent move to a new paradigm of teaching. The value of the unit is rather as a demonstration of what can be done with the proper use of technology and as a pointer to the future.

Although "Our World" made good use of computer technology in its use of the Macintosh HyperCard authoring system, it did so in a self contained system without access through modem to information in the outside world. The School print library was the prime information source. An additional source was the library's commercial HyperCard programs. However, "Multimedia" as currently implemented and discussed in the literature is a technology that links the computer to the world-wide telecommunications network and thus
makes information either freely or not so freely available to any user and puts users in touch with each other through e-mail regardless of their locations in space. The outstanding implementation of this technology is the Internet.\textsuperscript{1}

The distance between multimedia in Our World and multimedia in the Internet is not simply a gap but a chasm. However, it is not difficult to imagine the Our World students sitting at their computers in the computer lab connected to Internet-like resources created specially for educational use even though this is not likely to occur any time soon. Sooner or later, however, it would seem that a transition like this will take place whether it be five or fifty years into the future. When it does, print will still be important but perhaps no longer the dominant technology in education. Perhaps not until these changes take place will the knowledge-transmission model of teaching born of print yield to a knowledge construction model of teaching born of the need for students to fashion into intelligible information data

\textsuperscript{1} The Internet's ancestry goes back to the 1969 ARPANET project, funded by the U.S. Department of Defense's Advanced Research Project Agency, to provide a facility that would enable scientists in quickly moving fields to share information through access to specialised databases, publish papers electronically and keep in touch with each other through on-line e-mail. In 1983 ARPANET split into ARPANET for research and MILNET for military operational use. Other networks proliferated, created by various agencies and corporations. created their own networks, including the BITNET (founded by the National Science Foundation and IBM) for scholarly and academic discussions outside of the sciences. In the mid-1980s. Local networks grouped with larger networks until in the mid-1980s the network of networks emerged that is today called the Internet (originally called ARPA Internet). By now, it is said to have over 20 million users with new users and new networks being added on a daily basis.

The equivalent of the Internet is funded by other national governments such as Japan and France. Public funding continues in the U.S. where "Senator Albert Gore of Tennessee emerged as the champion of a network that would enable schoolchildren to access the Library of Congress and rural physicians to upload CATscans to metropolitan medical centres . . . Experts such as Robert Kahn, who had been instrumental in creating ARPANET, made a strong case for the utility of a national information infrastructure that would bring the benefits of the Net to elementary schools and libraries as well as to laboratories, universities and businesses" (Rheingold, 1993).
drawn from universally accessible databases for education. In the meantime the Our World project has shown that a knowledge construction approach, with its particular benefits to second language education, can be successfully implemented for units designed to take advantage of relatively simple computer technology.
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Mohan, B. A. (ms.). Tasks and mainstreaming.


Porter (Eds.). *Skills, technology and management in education*. Deakin, A.C.T: The Australian College of Education.


*Note: Names of students and teachers have been blanked out on all cards where they appear throughout all appendices.

The above is the index card to the "Our World" Question and Answer cards. Choices are:

1. Click on the right arrow at the top right of this and all subsequent cards to go sequentially through the stack from the first card to the last. Click on the left or right arrow to go backwards or forwards one card from any point in the Q&A cards.

2. Click on any one of the four icons shown in the body of this card, Solar System, Day and Night, Earth's Atmosphere, Our Earth, to go directly to the cards devoted to the topic chosen.

3. Click on the globe to the right of the right arrow to go to the Index Card for the "Our World" topic cards.

4. Click on the "?" icon to the left of the left arrow to return to this Question and Answer menu card from any point in the "Our World" topic or Q&A cards.

5. Click on the "Home" icon at the top left of this card to return to the HyperCard "Home" card from which one can go to any other HyperCard stack or feature.

6. Click on the sound icon (beneath the "?" icon) to hear (as well as see) labels when clicked.
All Question and Answer cards have the characteristics of the card shown above:
1. The title of this card is. "Our Solar System Card1" and shows schematically the sun and the nine planets (with moons and planetary rings) in order of closeness to the sun.
2. Clicking on the "?" icons (bottom left and right) pop up the question boxes.
3. Clicking on the "?" icons in the body of the picture also pop up the question boxes: the "?" close to the sun pops up the first question; the "?" furthest from the sun pops up the second.
4. Clicking on the answer "balloon" icons (bottom left and right) pop up the answer boxes corresponding to the questions immediately above them, as shown on the next page.
5. Clicking on the "Find" button at the top between the left and right arrow icons activates the HyperCard "Find" function. A box appears in which the viewer types any word, e.g. "atmosphere", and hits the "Return" key; the cursor goes to the first appearance of the word in the open text in the stack. The process can be repeated until all appearances of "atmosphere" have been exhausted.
6. The next pages show the first two of three Solar System, Day and Night, Atmosphere, and Our Earth Cards with all question and answer boxes opened.
APPENDIX 1: sample Q & A Cards

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which is the closest planet to the sun?</td>
<td>The closest planet to the sun is Mercury.</td>
</tr>
<tr>
<td>Which is the farthest planet from the sun?</td>
<td>The farthest planet from the sun is Pluto.</td>
</tr>
<tr>
<td>Which planets have rings around them?</td>
<td>They are Uranus, Saturn &amp; Jupiter.</td>
</tr>
<tr>
<td>Which is the biggest planet?</td>
<td>The biggest planet is Jupiter.</td>
</tr>
</tbody>
</table>
### A Look At Our World

#### DAY AND NIGHT CARD 1

<table>
<thead>
<tr>
<th>Does the sun always shine?</th>
<th>When one half of our world faces the sun what time will it be?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, the sun always shines.</td>
<td>It will be daytime.</td>
</tr>
</tbody>
</table>

#### DAY AND NIGHT CARD 2

<table>
<thead>
<tr>
<th>When half our world doesn't face the sun what time will it be?</th>
<th>What causes day and night?</th>
</tr>
</thead>
<tbody>
<tr>
<td>It will be night time.</td>
<td>Our world spins around on its axis so one half faces the sun.</td>
</tr>
</tbody>
</table>
### APPENDIX 1: "Our World" sample Q & A Cards

#### ATMOSPHERE CARD 1

<table>
<thead>
<tr>
<th>What is the layer that protects our earth from the sun?</th>
<th>How many layers are there in the atmosphere?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ozone layer of the atmosphere protects our earth.</td>
<td>There are four layers in the atmosphere.</td>
</tr>
</tbody>
</table>

#### ATMOSPHERE CARD 2

<table>
<thead>
<tr>
<th>Why is the atmosphere important?</th>
<th>Which layer is near to the earth?</th>
</tr>
</thead>
<tbody>
<tr>
<td>It can give us air to breathe. It can protect us from the sun.</td>
<td>The troposphere is near to the earth.</td>
</tr>
</tbody>
</table>
### A Look At Our World

#### OUR EARTH CARD 1

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which is the smallest continent on the earth?</td>
<td>AUSTRALIA is the smallest continent on the earth.</td>
</tr>
<tr>
<td>Which is the biggest continent on the earth?</td>
<td>ASIA is the biggest continent on the earth.</td>
</tr>
</tbody>
</table>

#### OUR EARTH CARD 2

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the name of continent number 1?</td>
<td>The name of the continent number 1 is NORTH AMERICA.</td>
</tr>
<tr>
<td>What is the name of continent number 4?</td>
<td>The name of the continent number 4 is ASIA.</td>
</tr>
</tbody>
</table>
### APPENDIX 2: "Our World: Tutor's Checklist"

<table>
<thead>
<tr>
<th>IDEA QUESTIONS</th>
<th>WORDS USED/LEARNED</th>
<th>CHECKLIST (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLAR SYSTEM CARDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is our solar system?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What does our solar system do?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is our solar system part of?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THE SUN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the sun?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the sun like?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What does the sun do?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THE PLANETS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are planets?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What do planets do?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are moons?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where is Earth?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are the names of the planets?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which planet is the largest/smallest?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which planet is the nearest/farthest?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are planetary rings?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which planets have them?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAY &amp; NIGHT CARDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is day/night time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What causes day &amp; night?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How long does it take for Earth to spin?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATMOSPHERE CARDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the atmosphere?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are the layers?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How are the layers different?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What causes the atmosphere to move?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which layers are very important?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTINENTS &amp; OCEANS CARDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are continents?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are oceans?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which ocean is the smallest/largest?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which continent is the smallest/largest?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OurWorld Cards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What can you find in the oceans?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What can you find on the continents?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ELL/T/Toole  Concept/Vocab Checklist  June 3, 1992
APPENDIX 3: "Our World" Classification Work Sheet

The students fill in this worksheet as they go through the Q&A Cards (App.1) and Topic Cards (App.4). The top five lines classify the Q&A Cards; the lower five lines classify the Topic Cards. The inserted letters provide clues to the students for filling in the blanks. The classification principle is from the biggest to smallest. At the top is the Universe to which belongs the Solar System to which belongs the Sun, Planets and Moons. Belonging to the Planets is Earth to which belongs Day & Night and Atmosphere. Belonging to Earth at successively lower levels are, on one side, Continents, Mountains, Volcanoes, Caves and Rock, and on the other, Oceans, Islands, Lakes and Rivers. The students assigned these categories themselves and vigorously defended them, including Islands as having more to do with oceans than the waterless categories on the left hand side. Discussing alternative assignments and classification schemes is the subject for future lessons.
This is the index or "Menu" card to the whole "Our World" stack, consisting of the "Question and Answer" cards (first four choices from the top down) and the "Topic" cards (remaining choices):

1. Click on any label (i.e. "button") to go to the cards in the stack for that topic.
2. Click on the globe icon (top right) to return to this Menu card from any point in the stack.
3. Click the left or right hand arrows at the top to go forwards or backwards one card. Continue to click either of these arrows to go right through the stack from one topic to the next.
4. Click the "Find" button (between the arrows) from any point in the stack to bring up the "Find" box. Type in any word and hit "Return" to go to the first instance of that word in open text. Reactivate "Find" (the word remains typed) and hit return to find the next instance of the word and so on.
5. Click on "?" icon from here or anywhere else in the stack to go to the Q&A cards (see App. 1)
6. Click on sound icon (left of "?") to activate sound so that labels are spoken when clicked.
7. From any card in the stack, click on "Tutorial" button (left of sound icon) to go to "Tutorial" stack (App. 5); on "Introduction" (next left) to go to Introduction card (names of students, not shown); on question "balloon" icon (far left) to go to "About this project" card (see two pages on).
8. Click on the "Home" icon (bottom left) to go to the HyperCard "Home" card from which one can go to any other HyperCard stack or feature.
As the card, "About This Project", on the next page shows, the students' work was published both electronically as an interactive HyperCard stack and on paper as a booklet. This card shows the strictly sequential "Table of Contents" for the printed booklet which is the equivalent for print of the classificatory Menu (p.1 of this Appendix) for the electronic publication. The difference is the flexibility with which one can electronically navigate the stack and go to and from other stacks which have related information compared with the hard copy page turning and physical retrieval and referencing of other print sources which is required when working with the printed booklet.

Also on the next page is the Bibliography card showing the various volumes the students consulted in their research for the project in the school library.
APPENDIX 4: "Our World" sample Topic Cards

A Look At Our World by Division III

Tropical rain forest

About This Project

The students who wrote and illustrated this book are recent immigrant students who have been receiving integrative support from Teacher-Librarian and English Language Liaison Teacher and Computing Support Teacher.

Stress has been placed on the research and publishing process. The students' work was published on paper and electronically as a HyperCard stack.

BIBLIOGRAPHY

"Deserts" is the first of the topics in the Topic Cards. Each topic is represented by three or four cards, an "Introduction" card plus two or three others. Each student was responsible for at least one card and a group of two or three students could collaborate on a third or fourth card.

The research and composition of the text was done in the library and key entered onto HyperCard cards in the computer lab and edited as required. The drawings were done in the library and scanned onto floppy disks by the computer coordinator/teacher in the computer lab. The students copied the disks into their HyperCard stacks and edited the drawings using HyperCard graphics tools.

The computer coordinator/teacher assembled all of the individual cards into one stack and put the stack on the network file so that all students could access the complete stack. Each group then was able to see what the other groups had done and the students could ask and answer questions of each other.
APPENDIX 4: "Our World" sample Topic Cards

HOT DESERTS 1

Hot deserts are very dry. It hardly ever rains on deserts. Many cactus plants are on hot deserts. Some people live in the desert, but they have to wear clothes in deserts because they want to protect themselves from the sun. An Oasis is in the desert. An Oasis is like a small lake.

Deserts

HOT DESERTS 2

Camels:
Camels can live on the desert because camels do not often need food or water. People in the desert travel on camels.

Mirages:
A mirage is when someone sees something on the deserts that is not real. Now you know something about deserts.

Deserts
APPENDIX 5: "Our World" sample Tutorial Cards

Introduction

The Tutorial cards are organized over the "Our World" Q&A topics as shown in the opening Menu card on the next page. A series of cards are devoted to each topic. The first card for each topic shows a blank visual, i.e. a visual on which appears functional words or phrases appropriate to the knowledge structure underlying the visual, e.g. Classification, but no content words. The tutor brings up the content words (upper case in boxes) by clicking through the visual and explaining what is meant to the tutee, one stage at a time.

There may be anything from one to five or six stages on a visual. "Sequence" visuals tend to have the most stages. Each stage is additive, i.e. the content words brought up by the first click remain on screen, adding to those brought up by subsequent clicks. At the end of this process the visual is complete with all content words and functional words and phrases. Tutors can, if they wish, use this opportunity to review the whole visual which they have explained in stages. They can then clear the visual and invite the tutee to take over the clicking, explaining what is meant in his or her own words stage by stage. Alternatively the tutor may leave the fully unfolded visual on screen and ask the tutee to explain it.

For review, the tutors can ask the tutees to explain the visual fully without clicking up any content words, or to click up content words only if they are stuck or need confirmation of the correctness or otherwise of words they have used.

In practice, the tutors tended to bring up only the first, unlabelled card and explain it to the tutee and then ask the tutee to come up with his or her explanation, still without bringing up the content words. These were brought up only after the tutee had finished his or her explanation or had got stuck. Naturally the tutees had trouble with this approach which is appropriate for review at the end of the period after going through the topics but not for going through them the first time.

However, both tutors and tutees liked this additive feature of HyperCard when going through the stack on their own. Asked whether she would prefer HyperCard or informational work sheets, the tutee Ursula replied: "I think I would have it in HyperCard . . . because it doesn't have the answers. When you want to have the answer you click on and if you don't want to have the answer you click it off."
The above is the index or "Menu" card for the "Tutorial" stack:

1. Click on any of the topics listed to go to the cards relating to that topic.
2. Click on the globe icon (top right) to go to the "Our World" topic cards.
3. Click on the right arrow (next to Globe icon) to go forward one card from any point in the stack. Continue to click on this arrow to go right through the stack.
4. Click on the "Find" button (next to right arrow) to activate the HyperCard "Find" feature. This will find every instance of any word (in open text) typed in the "Find" box appearing on screen.
5. Click on the four-arrow icon (next to "Find" button) to return to this menu card from any point in the tutorial stack.
6. Click on the "?" icon (top centre) from any point in the stack to go to the Q&A cards.
7. Click on the "Home" icon (top left) to go to the HyperCard "Home" card from which one can go to any other HyperCard stack or feature.
This is the first of four cards that develop the "Universe" classification visual. At any time the students can switch between the Tutorial and the Q&A and Topic cards to get more information or illustrate a point. Shown on screen is a large circle with small circles beneath it and the classification functional phrase "is made up of" All functional words and phrases appear in lower case.

1. Click on the large circle and the content words THE UNIVERSE appear in upper case.
2. Click anywhere on the small circles and the content words THE STARS appear.

These two additions to the screen are shown on the next page. The open ended horizontal arrows indicate that "The Universe is made up of" an unlimited number of "stars".

3. Click on the downwards arrow beneath one of the circles or on the circle itself and the word SUN appears in the circle and an informational text box states "Some stars, like our sun, have planets and form systems". There are now two choices:

   a. Click again on the downwards arrow to move to the Solar System classification cards.
   b. Click on the pointing hand (lower left) to reverse the hand, clear the screen and display the functional phrase "belongs to". Repeating steps 1 and 2 in reverse order goes through "bottoms up" instead of "tops down" classification, showing that "the stars belong to the Universe".

- The "bottoms-up" classification sequence is not shown in this appendix.
A Look At Our World

THE UNIVERSE
Classification 1

THE UNIVERSE is made up of

THE STARS
This card marks the end of the Universe "tops-down" classification sequence. Clicking the pointing hand (bottom left) reverses the process (as explained two pages back) to go through the "bottoms-up" classification sequence (not shown in this appendix). This appendix continues with the Solar System classification sequence, entered by clicking either the downward arrow (bottom centre) or the right arrow (Top right).

The next page shows the first and last cards of the "tops-down" Solar System classification with the functional phrase "is made up of". The first click on the large circle at the top brings up the content words "The Solar System" and "The Sun". The next click brings up "The Planets". The last click brings up "Moons". From these elements we derive the classificatory sentence "The Solar System is made up of the Sun, the planets and moons".

Interestingly, the students tended to read the visual as a part-whole classification, e.g. "The Sun is made up of the planets", "The planets are made up of moons", instead of a componential analysis like a family tree: "The Solar System (family) is made up of the Sun (grandfather), the planets (children) and Moons (grand-children). The addition to the visual of "and" before "the planets" and before "moons" would prevent this incorrect reading.
A Look At Our World

THE SOLAR SYSTEM
Classification 1

Is made up of

THE SUN

THE PLANETS

Moons
This card represents the final stage of the Solar System "bottoms-up" classification. Note that the pointing hand (bottom left) has been clicked and its direction reversed from its previous orientation when the sequence was "tops-down". The functional phrase "belong to" replaces "is made up of" and the phrase "which are all part of" is added. The visual now supports the utterances:

"The moons belong to the planets. The planets belong to the Sun. The moons, planets and sun are all part of the Solar System".

The next set of visuals leave classification and support a description of the Solar System.
The first card in this series (not shown) has no wording except the functional words and phrases in lower case on the right. These are intended to trigger various descriptive statements which together constitute an overall description of the Solar System.

1. Click on "number of planets" to bring up the labels of the planets in their appropriate places on the visual and show the number (9) at the beginning of the line (shown above).

2. Click on "biggest" to bring up the label JUPITER and a connecting line (not shown).

3. Click on "smallest" to bring up the label MERCURY and a connecting line (not shown).

4. Click on "nearest to the" to bring up the labels SUN and MERCURY and a connecting line between them (shown on the next page).

5. Click on "farthest . . ." to bring up labels SUN, PLUTO and connecting line (not shown).

7. Click on "Some have" to bring up a label RINGS and connecting lines to unlabelled Jupiter, Saturn and Uranus (not shown).

8. Click on "Others have" to bring up a label MOONS and connecting lines to unlabelled Earth, Mars, Neptune and Pluto (not shown).

9. Click on "Some have both__and__" to bring up the labels RINGS and MOONS and connecting lines to Jupiter, Uranus and Saturn (shown on the next page).
... number of planets ...
... biggest ...
... smallest ...
... nearest to the ...
... farthest from the ...

Some have ...
Others have ...
Some have both ____ and ____.
Above is the first of a series of cards that describe "Two Ways of Rotating":

1. Click on either the larger central or smaller peripheral circle (top right) to bring up the labels SUN against the large and EARTH against the small circle together with an arrow pointing from Earth to the functional synonymous phrases in the middle and another arrow pointing from the functional phrases to the Sun. This supports the descriptive utterances, "The earth goes (or rotates or revolves) around the sun" (shown on next page).

2. Click on either the larger or smaller circle (bottom left) to bring up the additional labels EARTH and MOON and pointing arrows to support the descriptive utterances, "The moon goes (or rotates or revolves) around the earth".

3. Click on the large circle on the right to bring up the additional labels EARTH and EARTH'S AXIS and pointing arrows and also the additional functional phrase "spins around" to support the descriptive utterance "The earth spins (or goes or revolves or rotates) around Earth's (or it's own) axis". The point is to show that "spins" is correct here but is not correct for the first two cases.

4. Click on the balloon icon (lower left corner) to bring up the additional labels "takes 1 month" beneath "Earth" and "Moon"; "takes 1 year" beneath "Sun" and "Earth"; and "takes 1 day" between "Earth" and "Earth's axis". This last and completely labelled card is shown on the next page.
A Look At Our World

TWO WAYS OF ROTATING

Description

EARTH goes around rotates around revolves around SUN

takes 1 year takes 1 month

MOON

goes around rotates around revolves around or spins around

EARTH'S AXIS takes 1 day
The "Our Earth" classification series starts, like the other series, with an unlabelled visual with appropriate functional words and phrases in lower case. The above card shows the first phase of labelling: clicking on the leftmost box brings up the labels Earth, Land and Water to support the utterance "Earth is made up of Land and Water".

Clicking on Land brings up the labels Islands and Continents to support the utterance "Land is divided into Islands and Continents". Clicking on Water brings up the labels The Oceans, Seas, Rivers, and Lakes to support the utterance "Water is divided into the oceans, seas, rivers and lakes". This card is shown on the next page.

Clicking on "The Continents" brings up the names of the continents and clicking on "The Oceans" brings up the names of the oceans on a new card (not shown).

Clicking on the pointing hand icon (lower left) brings up a new card for "bottoms-up" classification. The final card in this series is shown on the next page. Note that the direction of the arrowed lines is reversed and the functional phrase "make up the" replaces the "top-down" phrase "is divided into".
The Volcano sequence runs through three cards. The first one (shown above) has two visuals: one, at the top left, is a cut-away diagram of a volcano with the key content words shown; the other is the sequence schematic with six sequential steps, including a split at step 3.

The first click on step one brings up all the functional words and phrases for all the steps and the key content word for step one, "earthquake" (shown on next page). This supports an utterance like "First there is an earthquake" or "First an earthquake happens".

The other steps are clicked in sequence to bring up the key content vocabulary for each step. The final card with all information displayed is shown on the next page.

Both tutors and tutees had more problems with the volcano sequence than with any other. Two problems were identified:

1. The vocabulary was difficult because the students were not familiar with words like "magma", "lava", "solidifies", "cone", "crater".

2. The students did not make use of the cut-away diagram. This may have been because the student-produced drawing lacked in clarity -- Gladys commented "it's not really like a mountain"; or may have been because they lacked experience of cut-away diagrams and did not realize how they should be interpreted.
A LOOK AT OUR WORLD

VOLCANIC ERUPTION

Sequence

1. FIRST
   ... earthquake...

2. AS A RESULT
   ... disturbs magma ...

3. THEN
   ... magma forced up ...
   ... magma becomes lava and flows ...

4. AT THE SAME TIME
   ... lava solidifies into ...

5. FINALLY (LASTLY)

Steam & ash blown out ...

Crater

Lava

Cone

Magma