CHAPTER 10

RESULTS FOR INDIVIDUAL TASK ACTIVITY TIME

10.1 GENERAL DESCRIPTION OF INDIVIDUAL TASK ACTIVITY TIME

Individual tasks were outlined either on teacher-made wall charts or on the blackboard. Those on wall-charts consisted of written instructions requiring pupils to carry out tasks such as picture interpretation or story writing. For example:

By looking at the shape of these boulders, can you tell whether this picture is near the beginning the middle or the end of a river.

In this photograph we can see several different types of erosion. How many different types can you find? What would this scene look like in five years time? What do you think was the cause of the hillside slipping down?

The pupils were able to select wall chart tasks and sequence their activities according to personal preference. T was disappointed, however, with the success of the pupil choice system and remarked on Day 14 that 'the children can't cope with selecting things for themselves.'

The major individual tasks such as recording the results of the experimental demonstrations, providing definitions for the agents of erosion, describing an experience of
pollution (incense) and identifying the causes of species becoming endangered were teacher-set and followed directly after relevant teacher-directed lessons.

Content usually occurred in an individual task context only after several occurrences in a teacher-directed context. Content which was learned occurred on average, on eight different occasions in teacher-directed lessons before a case study pupil interacted with that content in an individual task, and content which was not learned occurred on average, on six different occasions in teacher-directed lessons before a case study pupil interacted with that content in an individual task. T discussed task requirements and provided comprehensive verbal and written instructions for each task.

Although these tasks were individual tasks recorded in individual unit booklets, class members usually worked with considerable interaction between pupils, and frequent interactions with T. The children appeared to enjoy this work but, on occasions, were unsure of both the task requirements and the necessary course of action to fulfill those requirements. On Day 11 a child was observed to be 'nearly in tears' when she said to Emily, 'I don't know what to do!'

The working habits of the three case study pupils were different. Gus generally worked on the mat in the company of his special set of friends. With two of these friends he frequently engaged in mutual discussions about individual tasks. Other class members often solicited help from Gus as is apparent in an observer's comments recorded on Day 5 of the unit:

...others mucked around with headings and then towards the end of the time seemed to be asking Gus what to do - they also asked him for help with
spelling etc. It was interesting to note that 3 or 4 (pupils) seemed to appeal to Gus for a loan of a rubber/help with spelling/help with what to do - is it because he is extra intelligent? - is he a leader? or perhaps just very popular with others of his age group. Could be a mixture of all three — further observation may help to decide. Often they went past a closer pupil who, for example, had a rubber, to ask Gus for a loan of his.

An interesting observation implicit in this note is the strategy Gus used in completing the content requirements before attending to the presentational requirements. For example, he always worked on the headings at the end of an activity. Others who focused on the headings initially (sometimes for the first hour of task time) seemed to forget the task instructions by the time they were ready to begin.

Gus also seemed to focus on the academic requirements of a task rather than the structural requirements such as length or time limits. For example, another observer noted of Gus's approach to tasks:

Has a tendency to carry on with a task when everyone else is packing up.

On one occasion an incident arose when Gus screwed up a print he had made to depict types of pollution. His peers remonstrated with Gus and pointed out that he would not have prints to put on the wall. Gus argued that the print had not adequately expressed the concept of pollution. His peers seemed genuinely amazed at his action and
discussed amongst themselves the stupidity of Gus's choice. They went on to compare the number of prints each pupil would have to mount on the wall at the end of the lesson.

By contrast Emily's primary concern appeared to be with assignment headings. She always began tasks with headings. Considerable discussion would ensue with her neighbours about colour selection. On occasions Emily would announce that she had decided on a particular colour. Subsequently, other children seated nearby would use the same colour in completing their headings. Emily, was observed to use illustrations apparently unrelated to particular tasks in order to improve her presentation. Emily cajoled a friend into drawing her a copy of a rabbit for her unit booklet.

Emily generally worked at a group of six desks with her set of friends. She wielded considerable influence over who was currently eligible to join the group. Emily frequently solicited information from other children but objected strongly to anybody copying or even viewing her own work. The following excerpts from Emily's interactions with her peers illustrate her concern with presentation and her tendency to demand assistance from others:

Susan, come here! What does rain do?

Hey, Kate, you are meant to have a line in between each one!

Diane's work pattern differed from Gus's and Emily's in that she generally worked silently and disregarded the children around her. Diane sat with different children most days and her conversations were predominantly concerned with requests to borrow a rubber or requests for
help with spelling. The following observer comments exemplify Diane's work pattern:

Diane continued working on morning's language activity and worked solidly without a break thru' (sic) interval - completed final copy - showed it to T and subsequently corrected errors. - 80 minutes solid work with very few occasions 'off-task' - then only when distracted by others.

Diane worked away steadily in spite of the rowdiness of the boys next to her.

Diane does not appear to sit with special friends.

The following comments made by Diane illustrate her overwhelming concern with production, presentation and obedience:

I don't know. Mr H said...

What (sic) one are you doing?

You've done more than me.

I've just finished Number Two.

Let me finish.
10.2 RELATIONSHIP BETWEEN PUPIL OPPORTUNITY TO INTERACT WITH CONTENT IN AN INDIVIDUAL TASK AND PUPIL LEARNING

Half (50.2%) of the tested content occurred within an individual task activity context. The individual tasks in which Gus engaged were relevant to the content of 42 of the 75 items. The individual tasks in which Diane engaged were relevant to the content of 37 of the 75 items. And the individual tasks in which Emily engaged were relevant to 34 of the 75 items. All three pupils explained in the interviews that of the three task contexts they preferred working at individual tasks.

As can be seen in Table 25, content was more likely to be learned if it occurred in an individual task context. Table 25 shows that the content of over three quarters of the items learned and remembered by the case study pupils occurred in some form during the time they spent in individual tasks. Over half the items learned and forgotten involved individual tasks and a third of items not learned involved individual tasks. Mislearned items were least likely to have occurred in an individual task context. Thus opportunity to interact with content in an individual task context was not requisite for learning to occur but this opportunity did facilitate long-term learning - particularly for Diane. Only for Diane, however, was individual task opportunity consistently related to learning (r = 0.72). The reliability coefficients for Gus (r = 0.00) and Emily (0.06) show that this opportunity was not consistently related to their learning, and are congruent with interview data which suggest that both pupils learned from out-of-school circumstances such as museum lessons, and discussions with parents. For Diane, who did not appear to have similar opportunities to learn from out-of-school circumstances, the individual task opportunity was more critical.
Table 25

Percentage of Items in Each of the Five Learning Outcome Categories which Involved Individual Task Activity Time and Mean Time Spent for those Items

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The analyses of time spent in Chapter 8 involved calculation for the mean time spent in task contexts for all items in the category. However, because only 50.2% of the items occurred in an individual task context those means underestimated the average time actually spent in individual tasks for those items which did occur in individual tasks. In Table 25 the means have been calculated only for items which occurred in individual tasks. Although the case study pupils spent varying amounts of time on different content during individual task time, the means shown in Table 25 still provide a useful summary of the time spent.

As can be seen in Table 25, for Gus and Emily the more time spent on tests content in individual tasks the more likely there were to have learned. Content which was not learned by Gus occurred for only a very brief time (2.3 minutes on average, per item) when it did occur in individual task contents. This pattern was similar for Emily although she spent about eight minutes per item, during individual tasks, on content which she did not learn. Both Gus and Emily spent about half an hour on average, on content which they learned and forgot.

By contrast Diane spent less time on content which she learned and forgot, although the mean of 6.0 minutes per items is partially explained by the homework which she completed on Day 11, which involved individual tasks. These appeared to have been completed in one evening. This was a rare occasion when an estimation of time spent had to be made. The words she wrote were counted and multiplied by the time she generally spent writing each word. Because she wrote headings for one task which she failed to complete the average time spent for the other tasks appears lower than it was.
Diane's results also contrast with those of Gus and Emily in the considerable individual task time she spent (22.7 minutes on average) on content which she failed to learn. It seems that although individual task opportunity was important for Diane's long-term learning she was also more likely to spend considerable time, in an individual task context, on content which she failed to learn. This pattern sheds more light on the observers' incorrect assessment that Diane would have a high gain score from the unit because of her habit of working quietly for long periods on individual tasks.

Gus did not mislearn tested content which he worked on during individual tasks. However, both Emily and Diane spent considerable time during individual tasks on content which they mislearned. This is further evidence that Diane, particularly, spent considerable time engaged in activities which did not bring about learning.

10.3 PUPIL BEHAVIOURS DURING INDIVIDUAL TASK ACTIVITY TIME

Eleven different categories of pupil behaviour during individual task activity time were counted: individual interactions with T, peer interactions, writing events, reading events, reading aloud events, art events, diagram events, rubbing out events, organizational events, moving events and waiting events.

The relationships between these behaviours and pupil learning have been reported separately for each behaviour but it is important to remember that the individual behaviours occurred within the context of a pattern of behaviours. Often behaviours occurred concurrently. For example, peer interactions mostly occurred while the pupils were writing, drawing or reading aloud.
Table 26

Mean Numbers of Pupil Behaviours During Individual Task Activity Time in Relation to Pupil Learning:
Means Calculated Only for Items Which Occurred During Individual Task Activity Time (50.2% of all Items)

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Note. * The asterisks indicate values which do not include art work carried out in relation to the river erosion language activities because that work was carried out during another part of T's programme.
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<td>3.6</td>
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<td>1.3</td>
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<tr>
<td><strong>Items Learned and Remembered</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
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<td>69.7</td>
<td>40.8</td>
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<td><strong>Items Learned and Forgotten</strong></td>
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<td>6.6</td>
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</table>
Table 28

Reliability Coefficients for the Relationships between Pupil Behaviours During Individual Task Time and Pupil Learning

<table>
<thead>
<tr>
<th>Pupil(s)</th>
<th>Overall Mean Rate</th>
<th>Gus Mean Rate</th>
<th>Diane Mean Rate</th>
<th>Emily Mean Rate</th>
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</thead>
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<tr>
<td>Behav.</td>
<td>Mean Rate</td>
<td>Mean Rate</td>
<td>Mean Rate</td>
<td>Mean Rate</td>
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<td>0.88 0.90</td>
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<td>Int. P</td>
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<td>0.88 0.90</td>
<td>0.53 0.62</td>
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<td>R Aloud</td>
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<td>0.98 0.90</td>
<td>0.58 0.73</td>
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<tr>
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<td>0.00 0.00</td>
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<td>0.81 0.64</td>
<td>0.86 0.00</td>
<td>0.74 0.55</td>
</tr>
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<td>0.95 0.56</td>
<td>0.92 0.52</td>
<td>0.40 0.00</td>
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<tr>
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<td>0.13 0.00</td>
<td>0.87 0.82</td>
<td>0.42 0.00</td>
</tr>
<tr>
<td>Waiting</td>
<td>0.17 0.30</td>
<td>0.42 0.69</td>
<td>0.00 0.61</td>
<td>0.28 0.94</td>
</tr>
</tbody>
</table>
10.3.1 Individual Interactions with T

As can be seen in Figure 54, during individual task time, the case study pupils engaged in the highest number of interactions with T about mislearned content. The high numbers of interactions Diane and Emily engaged in with T about content which was mislearned comprise a surprising result. Given that the pupils got these items right on pretests it appears that the interactions with T misled them about the concepts during this time. At best the teacher failed to sort out misconceptions about this content during these interactions. This was apparent in observer notes recorded on Day 11 when Emily received five and a half minutes of individual attention from T while he alternately marked her work and discussed it with her. T asked:

T    Tell me about how ice cracks.

Although Emily failed to reply T did not follow up this question and Emily mislearned the related test item. Diane mislearned the item concerning smog as a type of pollution. Like Gus she appeared to have misinterpreted the class discussion reported in Chapter 9 in which T stated that smog is made up of both smoke and fog, and that fog is a natural thing. It is interesting that her subsequent interactions with T during individual task time did not serve to clarify this misconception. Gus did not mislearn any content that occurred during an individual task.

The numbers of interactions with T for items which were learned and remembered were less than for mislearned content (three to four interactions per item). These interactions usually occurred when the pupils took
Figure 54

Interactions with T during Individual Task Time

![Graph showing interactions with T during individual task time.](image)

Figure 55

Rate of Interactions with T During Individual Tasks

![Graph showing the rate of interactions with T during individual tasks.](image)
their work to T to be checked.

Gus engaged in no interactions with T for content which he did not learn. This suggests that these interactions may have been critical to Gus's learning. Emily rarely engaged in interactions with T about content which she failed to learn but Diane engaged in almost two interactions with T per item not learned. Thus individual contact with T was less useful for Diane than for Gus and Emily. As can be seen in Table 28 the relationship between pupil learning and pupil interactions with T was consistent across the three data sets. The overall reliability coefficient is $r = 0.68$.

Emily's and Diane's rates of interaction with T were fairly standard across conditions except for very high rates of interaction about mislearned content. (See Figure 55 and Table 28). Diane's rate of interaction with T was consistent ($r = 0.90$) but unrelated to her learning. Emily's rate of interaction with T was inconsistent across the three data sets. Because Gus did not interact with T, during individual tasks, about content which he did not learn there was a strong consistent ($r = 0.55$) relationship between Gus's rate of interactions with T and his learning. (See Figure 55). The following account illustrates Gus's persistence in obtaining information and clarification from T, even in the face of a personal reprimand. On Day 1 of the unit it was apparent that Gus was determined to elicit information from T even in the face of discouragement. Although T had given the class instructions about an individual task, Gus appeared uncertain about something and asked his peers for help at 1.47'00". He then stood beside T with his hand raised for 30 seconds. T did not respond and Gus initiated a further discussion with four other pupils at 1.48'30". He was reprimanded by T and told to 'get
on with (his) work'. Gus ignored the reprimand and initiated a further discussion with the same four pupils immediately afterwards. At 1.51'00 Gus successfully initiated an interaction with T. Subsequently Gus engaged in three and a half minutes of discussion with his peers. Finally, at 1.55'30" T responded to Gus's question and in response to further queries from Gus, asked the class to stop what they were doing, at which point he clarified the issue for the whole class.

During the interviews Gus revealed that he found interactions with T very useful:

...first I didn't write a very good one (sentence) and Mr H told me a bit more about what I could write and that's where I learned how to make better sentences.

Gus's perception of the value of these interactions is congruent with the quantitative findings that these interactions were related to his learning.

Diane was less confident about the quality of her work and appeared to perceive these interactions as a test to be passed rather than an opportunity to learn:

I just hope that it's okay because I've spent that much time on it and I think I've finished it and then he says I have to go and (mumble) ... lots of silly spelling mistakes. I just hope it's okay the first time.
Diane's orientation to 'getting it right' is slightly different to Gus's objective to 'do it better'. The quantitative findings show that interactions with T were not directly related to Diane's concept learning. Diane's perception of these opportunities as spelling checks may be a partial explanation of the quantitative findings. It is apparent not only in teacher-directed lessons but also during individual task time that Diane became confused about the instructional goals. She seemed to constantly experience difficulties in assessing whether content or skill related goals were operating. These confusions did not seem to be clarified in the task instructions. In fact, Diane appeared to follow T's instructions meticulously. Whereas Gus would openly disobey T in order to clarify an issue Diane appeared to accept everything T said at face value and obediently attempt to follow instructions.

Emily's interview response indicated that she also viewed interactions with T as spelling check opportunities. She also appeared to perceive T's academic assessment as unpredictable. Frequently, both before and after interactions with T, Emily would discuss his (possible) reaction with her peers. Unlike Gus, Emily rarely initiated interactions with T.

10.3.2 Interactions with Peers

All observed peer interactions were counted. The observers recorded as much detail as possible about the content of these interactions, but did not classify the interactions as either on-task or off-task. A classification of the most frequently occurring audible interactions which appeared to be task related is shown in Figure 56. It is interesting to note that these interactions concerned both issues of content, and task
### Classification of Task-Related Peer Verbal Interactions Overheard During Individual and Group Task Activity Time

<table>
<thead>
<tr>
<th>Interaction Types: Individual Task Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Arguments about content.</td>
</tr>
<tr>
<td>2. Requests for (and provision of)</td>
</tr>
<tr>
<td>information about task requirements.</td>
</tr>
<tr>
<td>3. Requests for (and provision of)</td>
</tr>
<tr>
<td>information about content.</td>
</tr>
<tr>
<td>4. Requests for (and provision of)</td>
</tr>
<tr>
<td>information about spelling.</td>
</tr>
<tr>
<td>5. Requests to borrow and offers to lend.</td>
</tr>
<tr>
<td>6. Comparison of own work with that of a</td>
</tr>
<tr>
<td>peer.</td>
</tr>
<tr>
<td>7. Request for peer evaluation of own work.</td>
</tr>
<tr>
<td>8. Evaluation of the work of another pupil.</td>
</tr>
<tr>
<td>9. Requests for prediction of T's reaction.</td>
</tr>
<tr>
<td>10. Statement about preferred approach to</td>
</tr>
<tr>
<td>task.</td>
</tr>
<tr>
<td>11. Exclamations about resource material.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interactions Common During Group Task Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Arguments and questions about organization.</td>
</tr>
<tr>
<td>2. Orders (threats) to others.</td>
</tr>
<tr>
<td>3. Evaluation of the contribution made by self and others to group project.</td>
</tr>
</tbody>
</table>
Figure 57

Interactions with Peers: Individual Task Time

No. of Interactions Per Item

Learning Outcomes

Figure 58

Rate of Peer Interactions (Individual Tasks)
requirements. The most frequently occurring interactions which seemed to be unrelated to the task were engaged in by Emily and involved lengthy discussions of the relative merits of felt tip pen brands, colours and tip size.

There were differences in the kinds of interactions engaged in by the three pupils during individual tasks. Diane's interactions with peers chiefly involved organizational, equipment or spelling issues: For example:

Can I please use your felts?


Can I take the rubber back for you?

Can I have a look at...?

Only when apparently desperate did Diane request information about task relevant content:

How did evolution cause endangered species?

Gus's response to a friend's evaluation of his individual task work, 'Of course it's good. I'm just the bee's bum', is typical of the humour, confidence and concern with content quality, apparent in most of his comments. The following observer descriptions are typical of those employed to note Gus's peer interactions:

Explaining a concept to the boy next to him.

Comparing his work with that of
two other boys.

Discussing his written work with a friend.

Other pupils seem to be constantly asking Gus what to do.

Spells 'erodes'.

On the first day of the unit, immediately before interval, Gus said to his friends 'Let's go and discuss it outside!' in relation to an argument about erosion.

Emily's peer interactions showed a different pattern and involved frequent commands, considerable concern with organizational matters, and requests for information:

Hey, Hanna's sitting there!

What does (sic) avalanches do?

I can't think of what to put.

You're not allowed to copy me!

Get out!

Oh boy! Can I use them.

I've done avalanche. I think my rivers and seas were easiest.

F - L - O - O - D.

Hey, it doesn't say much there.
As can be seen in Figure 57 the overall pattern of pupil interactions with peers during individual task activity time shows a strong relationship between the number of peer interactions and learning, particularly long-term learning. These results were consistent for all three pupils (see Table 26) with an overall reliability coefficient of $r = 0.81$.

The actual mean numbers of peer interactions can be seen in Table 25. On average, Gus engaged in about 70 interactions during the time spent on the content of items learned and remembered, Emily engaged in 43 interactions, and Diane only engaged in 22 interactions. Gus and Emily engaged in fewer interactions on average for content which they learned and forgot than for content which they remembered. Diane who worked on the content she forgot at home did not engage in peer interaction about this content. Where she ran into difficulties she left gaps in her work. Diane engaged in more interactions for content she failed to learn than either Gus or Emily.

Both Gus and Emily engaged in rates of more than one peer interaction per minute for items learned. Diane engaged in only one interaction every two minutes for content learned and remembered. See Figure 58. There was no consistency in the rates of peer interactions engaged in by Gus and Emily. However, for Diane, higher rates of peer interactions were consistently associated with failure to learn ($r = 0.98$). It seems that Diane engaged in fewer interactions and seemed to have gained less from those interactions. This finding is congruent with the absence of discussions of content from her audible interactions with peers.

It is interesting to note that all three case study pupils explained that they did not like working under conditions when there was 'too much noise'.
10.3.3 Writing

Most individual tasks involved written work. Photographs of case study pupil writing associated with the language tasks are shown in Figures 65, 66, and 67. The following examples of writing were also accomplished during individual task time by the case study pupils.

Gus's writing:

As they rushed hungrily backwards and forwards the rough foamy waves eroded the jagged pointy cliffs.

... I smelt smoke. I thought I'd left my dinner in the oven but it couldn't of been because it was safly (sic) stored in my stomach. So what was it, aha orr (sic) the outher (sic) way around aha it must be the kids playing with matchs (sic), nope I'm not married...

Diane's writing:

Most people burn their land or forests so we can have land to build our houses.

Avalanches causes (sic) Erosion by falling down a hill and hitting another rock and so on.

Emily's writing:

The sea washes up the clift (sic)
Figure 59

Writing During Individual Task Time

Learning Outcomes

Figure 60

Rate of Writing Events During Individual Task Time

Learning Outcomes
so there gets sort of a hole in it.

Ice on glaciers (sic) are dangerous to skate down because the glaciers (sic) are going straight (sic) down.

When we put water on a vegetation block of soil it didn't move much dirt.

A total word count of the words written by the case study pupils during individual tasks, excluding draft copies, revealed that Gus wrote 809 words, Diane wrote 803 words and Emily wrote 499 words.

The analyses of pupil writing behaviour showed that the pupils wrote most frequently about content that they learned and remembered. See Figure 59. The amount of writing was consistently related to pupil learning across all three data sets ($r = 0.91$). Gus and Diane engaged in over 40 writing events about this content which would have taken about quarter of an hour of class time per item. Emily engaged in fewer (23.8) writing events for content learned and remembered.

Gus's next highest mean number of writing events occurred for items he knew. He did least writing for content he failed to learn. Diane did about the same amount of writing for items she knew as she did for items she learned and remembered. She did very little writing for items she learned and forgot and was atypical in the 18 writing events, on average, associated with content which she failed to learn.

Emily's writing showed a consistent relationship with her learning. She wrote almost as much, on average, about content she knew as she did about content she
learned and remembered, two thirds as much about content she learned and forgot and least about content she failed to learn. Both Diane and Emily engaged in considerable writing about items they mislearned.

It can be seen in Figure 60 that Gus and Emily actually engaged in higher rates of writing about content which they did not learn. Diane engaged in higher rates for content she learned. The rate of writing events per hour was inconsistent for all three pupils (r = 0.0).

In order to identify the kinds of variables which inhibited pupil learning it is worth examining instances of pupil writing which occurred in relation to content which they either failed to learn or mislearned. Emily's writing about glaciers being dangerous to skate down (shown at the outset of this section) is an instance of her inappropriate employment of anecdotes from teacher-directed lessons. Emily seemed to have entirely forgotten the academic point of the assignment.

Diane, in contrast, seemed to engage in writing which was unrelated to her learning of tested content because her lack of prior experience inhibited her comprehension of the nature of the tasks. Diane followed T's instructions precisely in the task requiring a definition of a mountain stream. Nevertheless he was dissatisfied with her sentence shown in Figure 66. The children were asked to use words written on the blackboard to describe a mountain stream. T had modelled the task using words about glaciers as a basis to construct a group sentence describing a glacier. The words on the blackboard were:
The asterisked words were all used by Diane to describe her stream. The only other adjective she used, 'steep', had been used by T in the glacier sentence. Diane followed T's instructions accurately and understood the necessity to use descriptive words. The observer noted, however, that T was 'not happy' with the words Diane used. Her depiction of a sparkling, bubbling, mumbling, tumbling stream was perceived by T to be totally inappropriate in this context. It was at this point that he commented to the observer, 'Diane has no imagination'. An examination of her work, however, does not necessarily reveal a lack of imagination. Rather her 'image' is inappropriate. Her illustration shown in Figure 66 shows mountains as a backdrop to a relatively flat landscape. Her image is geographically appropriate as an illustration of Southern Alps as seen from the Canterbury Plains (that is, from her home) but not appropriate of a mountain stream. When during the interviews, Diane was questioned about the nature of hills and mountains (which she had never directly experienced) she replied:

Usually, up in the mountains,
usually on hilly land there's
usually volcanoes and that....
The problem Diane had in selecting an appropriate combination of words from the blackboard is, in some ways, similar to the difficulty experienced by a child described by Anderson (1981). The seven year old boy wrote a story using nouns listed on the blackboard. When asked to read the sentences he had written the child was unable to read any of the words he had copied. Although Diane was able to read the words, her misconception of a mountain stream prevented her from understanding the teacher's task requirements.

The children's interview responses provide further insight into the way in which they perceived writing tasks:

I What do you think you learn by writing a story?

Gus Oh it's got to be a sensible story telling you things. I think you learn about it a bit because you have to think of good words and stuff... and if it's a sensible one you can read these over yourself... and if Mr H's told us something about what to write down you just sort of learn something that you didn't know. If it's just a funny story you don't learn anything.

Whereas Gus appeared to perceive new information from T as a starting point for a learning process, Diane perceived T's word as law:

I Do you think you learn very much from writing a story?
Diane
It all depends if I get help.
If Mr H told me something I'd write that down...I think he's trying to get us to use more descriptive words.

Emily's responses provided further insight:

I Do you find writing these definitions difficult?

Emily
To think of them is quite hard when you don't know them already.

I Did you enjoy writing those stories after you'd been in with the incense?

Emily
Yes. Quite easy because you did it in the flea pit and you could still smell it.

Emily perceived writing to be easy when she was able to write about an immediate experience.

10.3.4 Reading

Spontaneous reading aloud behaviour was positively related to learning for all three pupils but the pattern of silent reading behaviour showed varying relationships to pupil learning.
Figure 61

Reading During Individual Task Time

![Bar chart showing reading events per item for Gus, Diane, and Emily.](chart1)

- Gus
- Diane
- Emily

Learning Outcomes

Figure 62

Rate of Reading Events During Individual Task Time

![Bar chart showing rate of reading events per hour for Gus, Diane, and Emily.](chart2)

- Gus
- Diane
- Emily

Learning Outcomes
Figure 63

Reading Aloud Events During Individual Task Time

![Graph showing the number of events per item for different learning outcomes for Gus, Diane, and Emily.]

Learning Outcomes

Figure 64

Rate of Reading Aloud During Individual Task Time

![Graph showing the rate of events per hour for different learning outcomes for Gus, Diane, and Emily.]

Learning Outcomes
As can be seen in Figure 61 the total amount of reading during individual tasks was related to pupil learning. This pattern was consistent across the three data sets for all three pupils (r = 0.74). Gus read most (8.6 events) about content he learned and remembered, and least (1.3 events) about content he did not learn. Content learned and forgotten was in between (3.3 events). His actual silent reading related consistently to his learning. However, in Figure 62 it can be seen that Gus's highest rate of reading was associated with failure to learn. The reason for this is that for two items, his only contact with the content was through reading, and that only took up a few minutes of class time. One of these items never occurred in a teacher-directed context. The content of the other item (concerning frost as an agent of erosion) occurred briefly in a School Journal story. In effect, the few minutes Gus spent reading about the content of these items comprised the total individual task time spent. This reading, unsupported by other activity, did not bring about learning.

Gus engaged in about eight to nine reading events an hour for content he learned and remembered. Thus it appears that reading which occurred in addition to conversation and written assignments facilitated learning but reading alone did not.

From time to time Gus spontaneously read aloud and this behaviour was strongly associated with learning (see Figures 63 and 64). However, Gus's reading aloud behaviour was sporadic and inconsistent across the three data sets. He engaged in no reading aloud about content he failed to learn. Gus frequently appeared to read aloud when faced with confusing instructions or when he wanted to correct his own written work. This behaviour appeared to function as oral self-instruction and fits into the category of behaviours suggested by
Cullen (1980) to be effective learning strategies.

As can be seen in Figure 61 and Table 26 Diane also engaged in her highest mean number of reading events about content she learned and remembered (15.2 events). She engaged in the same amount of reading, on average, about known content, four to five reading events about content she mislearned and some two to three reading for items she failed to learn. In effect, most of her reading occurred for known or learned and remembered content. Her rates of reading fit this pattern with her highest rates of about 20 minutes per hour associated with known and learned and remembered content. Diane's rate of reading behaviour was consistent across the three data sets \( r = 0.90 \). She was a slower reader than Gus so the actual rates may not reflect differences in access to content. Diane did not engage in as much reading aloud behaviour as Gus but the reading aloud behaviour in which she did engage was related to her learning (see Figures 63 and 64). This relationship was consistent in both amount and rate \( r = 0.98 \) and \( r = 0.90 \).

The following example of Diane's reading aloud behaviour which occurred when she was reading wall chart instructions indicates that she used this strategy when faced with a problem:

That doesn't make sense...
(Reading aloud) – How many different sorts of erosion can I find?

Emily engaged in less reading overall but her highest mean reading events were associated with content learned and remembered and known content (see Figure 61). She engaged in fewer than two reading events on
average, for content she learned and forgot, and 2.8 reading events for content she failed to learn. Like Gus Emily's highest reading rate at 21.2 events per hour was associated with failure to learn. She engaged in only about 11 to 12 reading events per hour for known content and content learned and remembered. This pattern was consistent for Emily \( (r = 0.62) \). This pattern for Emily suggests that, like Gus, she did not learn from short periods of reading which comprised the predominant task opportunity to interact with specific content.

As can be seen in Figures 63 and 64, Emily infrequently engaged in reading aloud behaviour but when she did this behaviour occurred in relation to content which was learned. This pattern was consistent for Emily across all three data sets (see Table 28).

Spontaneous reading aloud behaviour was related to learning for all three pupils over and above its relationship to learning through time. Discrimination-learning studies have shown that vocalization aids recall (Carmean & Weir, 1967; DiVesta & Rickards, 1971). Gagne and Smith (1962) found that vocalizing during practice of a problem-solving task produced greater performance than nonvocalizing. Webb (1982) reviewed this literature and advanced the view that vocalizing per se does not bring about learning unless it is associated with cognitive restructuring. It seems that in the present study spontaneous vocalizing during individual tasks occurred when the case study pupils were either trying to understand confusing material, or trying to evaluate and improve their own written work or that of a peer. The relationship between this behaviour and case study pupil learning is consistent with Webb's (1982) view that it was facilitative because it was associated with cognitive restructuring.
Figure 65

An Example of Gus’s Individual Task Work.

Mountian Stream

This rocky, tumbling mountain stream erodes the bulky rocks as it swiftly tumbles down the steep hill.
An Example of Diane's Individual Task Work.

The sparkling bubbling stream tumbled mumbling down the steep rocky mountain.
An Example of Emily's Individual Task Work.

The freezing swift stream has rocky tumbling boulders that have come from the massive mountains.

By EMILY
10.3.5 Art

In the following discussion artwork (pictures and illustrations) is differentiated from diagrams (illustrations with words and other interpretive symbols such as arrows).

The data collected about artwork did not include observational data about the artwork involved in the mountain stream assignments shown in Figures 65 to 67. The case study pupils used opportunities outside the regular unit programme to complete this artwork. Other artwork on the covers of the unit booklets was completed at home. The interviews revealed that Gus's elder brother had obligingly illustrated his booklet cover!

Apart from two teacher-set tasks, artwork during individual task activity time was minimal (see Figures 68 and 69). The data is weak both because of the infrequency of artwork and because of the particular difficulties in recording this data. In Table 22 asterisks are used to indicate those categories for which artwork occurred but observational data was missing.

Given all these difficulties, the results show that artwork was probably most highly associated with known content and learned content for all three pupils but that Diane engaged in considerable artwork about content which she mislearned and failed to learn.

The example of Diane's artwork in Figure 66 shows an inappropriate illustration of a mountain stream. Her lack of prior experience of hills was evident in her failure to depict slope or rugged white water. She drew a picture reminiscent of a local, placid, city
Figure 68

Artwork During Individual Tasks

![Figure 68](image)

Figure 69

Rate of Artwork During Individual Task Time

![Figure 69](image)
The pupils drew diagrams to illustrate the hydrologic cycle and the processes of erosion demonstrated by T. Copies of their diagrams are shown in Figures 70, 71, and 72. As can be seen in Figure 73 diagram drawing during individual task time was highly related to pupil learning for Gus and Emily. All the tested content which was involved in Gus's diagrams was learned. Emily's results show a similar pattern with means of 9.3 and 8.5 diagram drawing events for learned content and virtually none (0.3) for items she failed to learn.

Diane engaged in most diagram drawing about content which she learned and remembered but she also engaged in considerable diagram drawing events in relation to content which she mislearned and failed to learn.

These results were consistent for all three pupils with an overall reliability coefficient of $r = 0.91$.

As can be seen in Figure 74 Gus and Emily both consistently engaged in higher rates of diagram drawing involving content they learned. This reflects the fact that the minimal amount of time they spent drawing diagrams for content they did not learn consisted mainly of drawing headings rather than diagrams depicting concepts and processes.

Diane's highest rate of diagram drawing occurred for content she failed to learn. This result, however, was not consistent across the three data sets ($r = 0.0$). The marked difference between the results for Gus and Emily and the results for Diane with respect to diagram
Figure 70

An Example of Diagram Drawn by Gus as part of an Individual Task

The Hydrologic cycle!

First some water from the sea evaporates and goes down into the mountains and reduces into clouds and streams and runs back down to the sea. There is also evaporation when it blows to the sea from land and the snow in the mountains melts.
Figure 71
An Example of Diagram Drawn by Diane as part of an Individual Task.

to the bottom of the hill.
After that we put lots of water in with the sand and it formed a beach.

Loose hill  Soil with plants  Sand

Wet sand

A Beach

Wet soil

These do not really show what happened.
Figure 72
An Example of Diagram Drawn by Emily as part of an Individual Task.

The hydrologic cycle

Evaporation

Run off

Condensation & (cloud)

Evaporation

precipitation (rain)

This hydrologic cycle shows cloud, rain and evaporation says the small amount of water we have to use at the moment.
Figure 73

Diagram Drawing During Individual Task Time

![Bar chart showing the number of drawing events per item for Gus, Diane, and Emily across different learning outcomes.]

Figure 74

Rate of Diagram Drawing During Individual Task Time

![Bar chart showing the rate of drawing events per hour for Gus, Diane, and Emily across different learning outcomes.]

Learning Outcomes

- Already Known
- Learned & Remembered
- Learned & Forgotten
- Not Learned
- Mislearned
drawing is illuminated by evidence that Diane perceived diagrams in different ways from Gus and Emily. It can be seen in Diane's diagram of the experiments (Figure 71), that she failed to portray sand flying off her hills when the 'wind' blew. T wrote in her booklet, 'These do not really show what happened'. Diane's comments during the interviews revealed that she found the requirements to do neat work and to draw effective diagrams conflicting. She resolved this conflict by valuing neatness above authenticity:

I  Why do you think T says, 'These do not really show what happened'?

Diane  
Well, they are just pictures of it and it doesn't really show bits flying off and that.

I  Yeah. Did you realize that at the time?

Diane  
I didn't really.

I  Why do you think you didn't do the bits flying off the things?

Diane  
I thought it would make it look messy.
10.3.7 Rubbing Out

As can be seen in Figure 75 and Table 25 rubbing out behaviour was associated with long-term learning outcomes for all three pupils. These results were highly consistent for both Gus ($r = 0.95$) and Diane ($r = 0.92$) but not reliably so for Emily ($r = 0.40$).

Gus engaged in 13 rub outs on average, when he worked on the content of items he learned and remembered, and Diane and Emily engaged in between eight and ten rub outs when they worked on the content of items which they learned and remembered. Items learned and forgotten were associated with fewer than half that number. Diane engaged in almost four rub outs, on average, for items she failed to learn (half her average learned and remembered rub outs) but she only engaged in one rub out on average, per item learned and forgotten.

Rates of rubbing out followed the pattern for frequency of rub outs (see Figure 76). The pattern of rub out rates was consistent for Diane and Gus but not for Emily (see Table 26). However, Diane engaged in a high rate of rub outs per hour for items she failed to learn. All three pupils engaged in 12 to 13 rub outs per hour in relation to the content of items learned and remembered. This result is probably an underestimation for Gus who was found to have scribbled out, rather than rubbed out, a number of words with which he was dissatisfied.

Obviously the case study pupils only rubbed out in the context of a writing or drawing task. However, it seems that whereas writing and drawing behaviours showed equivocal relationships to pupil learning, rubbing out showed a strong consistent relationship to
Figure 75
Rubbing Out During Individual Task Time

![Bar chart showing the rate of rubbing out for different learning outcomes for Gus, Diane, and Emily.]

Figure 76
Rate of Rubbing Out (Individual Tasks)

![Bar chart showing the rate of rubbing out for different learning outcomes for Gus, Diane, and Emily.]
pupil learning. The point at which a pupil rubs out a section of his or her work is the point at which he or she is changing a prior view. In effect, rubbing out behaviour may signal a critical moment in the child's learning and may be evidence of cognitive as well as overt restructuring.

10.3.8 Organizational Behaviours

The organizational category included behaviours such as searching through a pencil case, putting work into a different folder and locating a ruler. As can be seen in Figures 77 and 78, although more organizational behaviours occurred over time for items learned (and mislearned) higher rates of organizational behaviour occurred during the time spent on content which was not learned. All three pupils engaged in between four and five organizational behaviours per item learned and remembered (see Table 29).

Gus engaged in his highest rate (12.7) of organizational behaviours during the time spent on content he learned and forgot. His lowest rate of organizational behaviours occurred for content he learned and remembered. This pattern was consistent (r = 0.54) which suggests that organizational behaviours during individual tasks were inhibitive of Gus's learning when they occurred at higher rates.

Emily and Diane were observed to engage in few organizational behaviours for items learned and forgotten. This result partly reflects the absence of data on Diane's behaviour when she carried out relevant homework for these items.
Table 29

Mean Numbers of Organizing, Moving, and Waiting Events During Individual Task Activity Time: Means Calculated Only for Items Which Occurred in an Individual Task Context (50.2% of all Items)

<table>
<thead>
<tr>
<th>Pupils</th>
<th>Organiz</th>
<th>Moving</th>
<th>Waiting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Items Already Known</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>2.7</td>
<td>5.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Diane</td>
<td>4.6</td>
<td>6.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Emily</td>
<td>5.6</td>
<td>5.9</td>
<td>3.3</td>
</tr>
<tr>
<td>Mean</td>
<td>3.9</td>
<td>5.7</td>
<td>2.4</td>
</tr>
</tbody>
</table>

|        | Items Learned and Remembered |        |         |
| Gus    | 4.2     | 11.6   | 3.7     |
| Diane  | 4.1     | 7.2    | 0.5     |
| Emily  | 4.6     | 4.0    | 1.5     |
| Mean   | 4.3     | 7.3    | 1.8     |

|        | Items Learned and Forgotten |        |         |
| Gus    | 11.5    | 1.3    | 3.0     |
| Diane  | 0.0     | 0.0    | 1.0     |
| Emily  | 0.5     | 0.8    | 3.5     |
| Mean   | 4.8     | 0.8    | 2.8     |

|        | Items Not Learned |        |         |
| Gus    | 0.3     | 0.3    | 0.0     |
| Diane  | 2.2     | 6.3    | 2.2     |
| Emily  | 1.0     | 1.8    | 0.8     |
| Mean   | 1.4     | 3.5    | 1.2     |

|        | Items Mislearned |        |         |
| Gus    | -       | -      | -       |
| Diane  | 10.5    | 20.5   | 4.0     |
| Emily  | 0.0     | 3.0    | 3.0     |
| Mean   | 7.0     | 14.7   | 3.7     |
Table 30

Rate of Organizing, Moving and Waiting Events During Individual Task Activity Time

<table>
<thead>
<tr>
<th>Pupil Behaviours</th>
<th>Organizing</th>
<th>Moving</th>
<th>Waiting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Items Already Known</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>5.7</td>
<td>10.5</td>
<td>3.9</td>
</tr>
<tr>
<td>Diane</td>
<td>6.4</td>
<td>9.3</td>
<td>10.3</td>
</tr>
<tr>
<td>Emily</td>
<td>8.5</td>
<td>8.9</td>
<td>4.9</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>6.6</strong></td>
<td><strong>2.8</strong></td>
<td><strong>3.9</strong></td>
</tr>
<tr>
<td><strong>Items Learned and Remembered</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>4.2</td>
<td>11.6</td>
<td>3.7</td>
</tr>
<tr>
<td>Diane</td>
<td>5.4</td>
<td>9.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Emily</td>
<td>6.6</td>
<td>5.7</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>5.4</strong></td>
<td><strong>8.9</strong></td>
<td><strong>2.3</strong></td>
</tr>
<tr>
<td><strong>Items Learned and Forgotten</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>12.7</td>
<td>18.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Diane</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Emily</td>
<td>3.5</td>
<td>1.2</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>8.5</strong></td>
<td><strong>11.0</strong></td>
<td><strong>1.8</strong></td>
</tr>
<tr>
<td><strong>Items Not Learned</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>8.3</td>
<td>8.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Diane</td>
<td>5.7</td>
<td>16.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Emily</td>
<td>7.7</td>
<td>13.5</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>6.2</strong></td>
<td><strong>15.9</strong></td>
<td><strong>5.5</strong></td>
</tr>
<tr>
<td><strong>Items Mislearned</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Diane</td>
<td>11.0</td>
<td>21.5</td>
<td>4.2</td>
</tr>
<tr>
<td>Emily</td>
<td>0.0</td>
<td>5.8</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>8.6</strong></td>
<td><strong>18.1</strong></td>
<td><strong>4.5</strong></td>
</tr>
</tbody>
</table>
Figure 77
Organizational Behaviours During Individual Task Time

![Chart showing organizational behaviours during individual task time for Gus, Diane, and Emily.]

Learning Outcomes

Figure 78
Rate of Organizational Behaviours During Individual Tasks

![Chart showing the rate of organizational behaviours during individual tasks for Gus, Diane, and Emily.]

Learning Outcomes
Table 28 shows that Diane engaged in about the same proportion of organizational behaviours regardless of learning outcome. However, the high numbers and rate of these behaviours which she engaged in for content which she mislearned suggests organizational behaviours served a different function. For example, the high number of organizational behaviours would have included searching for a rubber, and Diane engaged in considerable rubbing out about this content.

Emily's rate of organizational behaviours was inconsistent. The slightly higher rates of such behaviours associated with content she did not learn suggest that her preoccupation with felt-tipped pens was inhibiting her learning.

10.3.9 Moving

The relationships between moving frequencies and learning were different for each case study pupil. As can be seen in Figures 79 and 80, Gus engaged in more moving and higher rates of moving during the time spent on content which he learned. However, Gus's pattern of moving was inconsistent overall, and his moving was specifically related to certain items. Although Diane and Emily engaged in slightly more moving during individual task time spent on learned content, both engaged in higher rates of moving during the time spent on content which they did not learn. The pattern for Emily was inconsistent \((r = 0.42, r = 0.00)\) but Diane's moving was consistently higher for content which she failed to learn \((r = 0.87, r = 0.82)\). Diane also engaged in particularly high rates of moving (at about a third of the time spent) for content she mislearned.
Figure 79
Moving Events During Individual Task Time

Learning Outcomes

Figure 80
Rate of Moving Events During Individual Task Time

Learning Outcomes
It can be seen in Tables 29 and 30 that the actual numbers of moving events were higher for Gus than for Emily or Diane except for Diane's moving during time spent on mislearned content. Emily was more stationary in her work habits than either Gus or Diane. This patterns confirms the general observation that Emily waited for T to come to her while Diane and Gus were more likely to approach T.

The fact that the overall results show that moving was more facilitative of Gus's learning suggest that moving behaviour was positively related to learning when the resources used were more facilitative. It has been apparent throughout these results T was a more facilitative resource for Gus than Diane. Thus it is not surprising that Diane's frequent movements to T were not facilitative of her learning.

10.3.10 Waiting

Waiting during individual task activity time almost exclusively involved pupils waiting in line for the teacher.

The pattern of results showing the relationship between pupil waiting behaviour and pupil learning show a different pattern for Gus than for the girls (Figures 81 and 82). Gus's waiting was exclusively associated with items he already knew or items he learned. Gus's rate of waiting behaviour in relation to learning was relatively consistent \( r = 0.69 \). Diane and Emily engaged in higher rates of waiting behaviour (see Table 24) for content they either mislearned or failed to learn. Diane did her least actual waiting for items she learned and remembered. Diane's waiting pattern was also consistent in relation to rate per hour \( r = 0.61 \). When Diane's pattern is interpreted along with
Figure 81

Waiting Events During Individual Task Time

Figure 82

Rate of Waiting During Individual Task Time
the finding that she engaged in almost two individual interactions with T, on average, for items she failed to learn it seems that she did not necessarily benefit from these interactions. Thus her waiting behaviour constituted wasted time. In contrast, Emily's waiting behaviour usually resulted in effective interaction with T.

The pattern for Gus suggests a very strong relationship between his waiting behaviour and learning. This result is interesting because Gus's waiting pattern was atypical. While waiting in line Gus would attend to all the comments T was making to children ahead of him in the line and at times he would even join in with these interactions. Gus actively used waiting time as an opportunity to attend to T's individual teaching comments to other pupils and it appears that this behaviour was strongly related to his learning.

10.4 SUMMARY

The tasks the pupils engaged in during individual task time can be usefully interpreted in terms of the definition of task outlined by Doyle and Carter (1984):

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.

(p. 130)
Doyle and Carter characterized tasks as being carried out under conditions of ambiguity and risk and argued that the actions of teachers and students in managing these conditions affects the learning outcomes.

A number of recent studies have found that pupil and teacher attention in classrooms is often dominated by concern for order, neatness, presentation and production (Anderson, 1981; Bloome, 1981; Blumenfeld, Pintrich, Meece and Wessels, 1982; Davis and McKnight, 1976; Stake and Easley, 1978).

It is apparent in the findings of this study that the case study pupils had differing orientations to the tasks, differing interpretations of the goals of those tasks and that these variables can be seen to be related to the patterns of pupil behaviour which were related to learning outcomes.

Gus, who appeared to experience minimal ambiguity and who was oriented to learning rather than production not only appeared to derive more enjoyment from the tasks but was constantly approached by other pupils for information about the content or requirements of tasks. It seems that Gus, who was at the top of the class academic and friendship hierarchy appears to have benefited from peer discussion in the same way as the two children cited by Cooper, Marquis and Ayers-Lopez (1982) to be at 'at the crossroads of learning exchanges'. Gus's interactions with T were directly related to his learning, his high rate of interactions with peers did not inhibit his learning, and the writing and diagram drawing tasks in which he engaged seemed to be strongly related to his learning outcomes.

Diane, in contrast, appeared to be anxious about the task goals and her work was frequently found to be inappropriate by T. Diane seemed to be trying to identify
T's requirements with varying success. Even when in direct individual communication with T, Diane was more likely to become confused about that content. Her attention to neatness actively inhibited the effectiveness of her diagrams. Diane focussed on spelling and 'descriptive words' rather than accurate concepts. She was further inhibited in her learning by her lack of relevant prior experience of hills, mountains, and rivers. The quantitative analyses showed that although some of her writing and diagram drawing was related to her learning she often engaged in these activities about content which she failed to learn or mislearned. Diane actually engaged in as much writing activity as Gus even although this involved her in more effort because of her greater difficulties with spelling.

Diane's behaviour was more obedient in T's class than that of Gus and she conformed to T's overt instructions; however this behaviour seems to have prohibited her from deriving the benefit of peer discussion available to Gus and Emily.

Because Emily was a difficult child to interview in comparison with Gus and Diane, it was harder to identify the degree of ambiguity she perceived in individual tasks. The quantitative analyses show that the numbers of interactions with peers in which she engaged, and the amount of writing and diagram drawing she did was directly related to her learning. However, Emily engaged in less production as crudely measured by the word count (60% of the words written by either Gus or Diane) and the fewer test items which were covered during her involvement in individual tasks.

The finding that rubbing out behaviour was related to learning outcomes for all three pupils may provide insight into the kind of mental processing which was associated with effective learning situations in this study. It
seems reasonable to hypothesize that this observable behaviour was a correlate of pupil processing behaviour closely associated with pupil learning.

It has been apparent in these results that content which was mislearned during teacher-directed lessons continued to be processed in its mislearned form during individual tasks. Although some of these misconceptions persisted through group task activities (reported in the following chapter) it is also apparent that peer-directed group contexts were facilitative of misconception changes.
CHAPTER 11

RESULTS FOR GROUP TASK ACTIVITY TIME

11.1 GENERAL DESCRIPTION OF GROUP TASKS

Group tasks involved groups of three, four or five children illustrating concepts or processes discussed during teacher-directed lessons. Examples of group task work illustrating a scene before erosion has happened, and the eroding effects of glaciers and rivers are shown in Figures 93, 94, and 95. The captions at the bottom of these pictures were created by the groups and were part of the task requirement. Other group tasks involved depicting polluted scenes in town and country settings and designing a reserve for endangered species. One task involved library research about the origins and effects of introduced animals.

The groups were peer-directed and T selected both group members and leaders. Generally each group's topic was different from, but related to, the topics allocated to other groups. For example, each group illustrated a different agent of erosion. Because there were only two occasions when the case study pupils were in the same group, the analyses predominantly involve different content.

T frequently selected the case study pupils as group leaders which indicates that T's selection was in accord with peer leadership preferences (shown in Table 1). The case study pupils had quite different leadership styles. Gus provided considerable direction to his group with
comments such as:

It's not going to be so big.
Colour them in dark, dark black.

And the observer noted, after an extended group task session:

Gus - all through appealed to as the final authority during discussion. He didn't push himself forward but they seemed to know he had final answers.

Diane's leadership style was democratic, and she appeared to follow T's instructions to group leaders more closely than either Gus or Emily. Frequently she would appeal to the group to contribute:

We're going to write a caption.
Can anyone suggest...

Does everyone agree with this?

Who agrees? Do you?

On occasions Diane would firmly reprimand group members for disruptive or disobedient behaviour:

Shut up!

Oh, you're messing it all up!

Mr H said to do it (this way)...
Unlike either Gus or Emily, Diane was observed to lose control of the leadership of a group on two occasions. On the first, Hanna, who received fewer votes than Diane in the sociometric analysis, seemed to take over as acting leader because of her dominance in a group discussion. Diane turned her back on the group and fiddled with paper and glue. Even after Hanna challenged her with the comment 'Will you help? You're the leader!', Diane just responded, 'Are I?', and did not contribute to the group for a further five minute period. The following day Diane and Hanna engaged in a verbal confrontation over the spelling of 'chamois'. Diane insisted on spelling the word 'sh..' and as leader expected her decision to stand. However, Hanna appealed to T who gave the correct spelling. It seemed that Diane's democratic approach, and her lack of academic leadership, jeopardized her role as leader of a group.

Although Emily generally liked group task contexts least, she liked working in groups for story writing because 'it makes you get new ideas'. The observers were surprised that Emily, who was noticeably passive in teacher-directed lessons, was a strong group leader. On Day 29 she had in her group, Sam, who had obviously caused considerable frustration to both Gus and Diane on other occasions. However the observer noted:

Sam (causing trouble) but Emily very much in control of proceedings.

Emily provided forthright leadership, to the point of dictatorship, as is apparent in the following directions she gave to group members:
We'd better do a rough copy.
We'll use the chalk on this one.

Get your pad!

You can't have cheetahs either!

No, it's painted on the ground.

We don't colour this in.
We don't!

Why are you rubbing that out?

Kris, don't be stupid!

You're doing it in brown.
It's supposed to be black!

You can't do that!

Arguments between group members were typical and during the interviews all three of the case study pupils expressed frustration about the difficulties of working in these groups. For example:

I You said you like to work on your own best. Now why is that?

Gus Because sometimes when you're working in a group people annoy me and things. And I don't like being annoyed and I just get things done easier on your own.

I Why do you think they annoy
you? What sort of things happen?

Gus Oh, because sometimes they always ask me things; what they mean and things. And always - most of the time, when we're in groups we have to do it all together. And it's really annoying because people want to do different things and you don't know what to expect and it all turns out real messy and doesn't work out...

...I'd let the people get into their own groups and if I thought they were going to be stupid within the groups I'd change them and separate them.

The arguing that was characteristic of the peer-directed groups was valued by T who gave explicit instructions about group arguments on Day 1:

There's one group over there which had some great old arguments. And it was good because they showed up some of the problems very clearly some people are having on what erosion is about.

Now, arguments are a good way of learning. Now, when I talk about an argument, it's not one when you start
yelling and screaming at each other... an argument is when you try and explain to others what you mean. Make it very clear what you mean, and if they argue that what you just said isn't true - then, okay, your argument isn't a very good one, if they can show that something you are thinking is wrong...

T went on to explore an argument in which Emily was involved. Emily was arguing that the sea could not be an agent of erosion because water is not as 'hard' as rock. She did not believe that water could erode rock. It is interesting that although she overcame this misconception and 'learned' that the sea is an agent of erosion, a year later she had 'forgotten' this.

11.2 RELATIONSHIP BETWEEN PUPIL OPPORTUNITY TO INTERACT WITH CONTENT IN A GROUP TASK AND PUPIL LEARNING

Less than a quarter (23.6%) of the tested content occurred within a group task context. Group task time took up about one seventh of the total time spent on tested content. The group tasks in which Gus engaged were relevant to 22 of the 75 items. The group tasks in which Diane engaged were relevant to 16 of the 75 items. And the group tasks in which Emily engaged were relevant to 15 of the 75 items.

As can be seen in Table 28, content was more likely to be learned if it occurred in a group task context. However, because the content of so few items was encountered in group tasks this opportunity was not consistently related
Table 31

Percentage of Items in Each of the Five Learning Outcome Categories Which Involved Group Task Time and Mean Time Spent for Those Items

<table>
<thead>
<tr>
<th>Pupils</th>
<th>Gus</th>
<th>Diane</th>
<th>Emily</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already Known</td>
<td>32.6</td>
<td>31.0</td>
<td>21.4</td>
<td>29.0</td>
</tr>
<tr>
<td>Mean Minutes Per Item</td>
<td>22.8</td>
<td>15.5</td>
<td>29.0</td>
<td>21.8</td>
</tr>
<tr>
<td>Learned and Remembered</td>
<td>35.7</td>
<td>21.4</td>
<td>30.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Mean Minutes Per Item</td>
<td>42.1</td>
<td>42.5</td>
<td>29.4</td>
<td>36.4</td>
</tr>
<tr>
<td>Learned and Forgotten</td>
<td>42.9</td>
<td>0.0</td>
<td>16.7</td>
<td>24.0</td>
</tr>
<tr>
<td>Mean Minutes Per Item</td>
<td>24.0</td>
<td>0.0</td>
<td>45.0</td>
<td>29.3</td>
</tr>
<tr>
<td>Not Learned</td>
<td>0.0</td>
<td>10.5</td>
<td>7.7</td>
<td>9.0</td>
</tr>
<tr>
<td>Mean Minutes Per Item</td>
<td>0.0</td>
<td>11.3</td>
<td>28.0</td>
<td>16.8</td>
</tr>
<tr>
<td>Mislearned</td>
<td>0.0</td>
<td>22.2</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>Mean Minutes Per Item</td>
<td>0.0</td>
<td>51.5</td>
<td>5.5</td>
<td>36.2</td>
</tr>
</tbody>
</table>
to pupil learning patterns for Gus ($r = 0.44$), Diane ($r = 0.28$), or Emily ($r = 0.43$).

The percentages of items in each learning category, which involved group task opportunity varied considerably between the case study pupils. Gus neither failed to learn nor mislearned any item he had the opportunity to interact with during a group task. Diane failed to learn and mislearned more items which occurred during group tasks than she learned. Emily failed to learn one item which occurred during a group task, and she mislearned one item which she interacted with during a group task. Diane, it seems, benefited least from group task opportunity. This pattern is congruent with the observer notes which suggested that she experienced most difficulty in working in group tasks.

The analyses of time spent shown in Table 31 involve calculations for the mean time spent in task contexts for all items in the category (irrespective of the actual number of items which the case study pupils experienced an opportunity to interact with during these tasks). However, fewer than one quarter (23.6%) of the items occurred in a group task context and much more time was spent on the content of these items than the overall averages indicate.

Because less than one quarter of the tested content occurred in group tasks, the relationships between pupil behaviours and learning were rarely consistent in relation to learning, across the three data sets. Group task opportunity was not necessary for learning to occur if both teacher-directed and individual task opportunity had occurred. Accordingly, the reliability coefficients which are given in Table 34 are only reported in the following discussion when a consistent result was obtained.
Because of the lesser importance of group tasks in facilitating case study pupil learning of the tested content, the quantitative results for pupil behaviour patterns during this time are discussed relatively briefly.

Items learned and remembered involved on average, about half an hour to three quarters of an hour of group task time. A similar amount of time was spent on average, in group tasks by Gus and Emily on the content of items learned and forgotten. However, items learned and forgotten by Diane did not involve group task time.

Group task opportunity was particularly effective for Gus. For Diane and Emily, however, group task opportunity did not always facilitate learning and considerable time was spent by them in group tasks which did not facilitate learning of tested content.

11.3 PUPIL BEHAVIOURS DURING GROUP TASK ACTIVITY TIME

The eleven categories of pupil behaviour used for individual task activity time were also used for group task time. More artwork, more interaction and less writing occurred in group tasks than in individual tasks. The waiting category included waiting for other pupils to finish their contribution as well as waiting for T. Although the behaviours were observably the same during both individual task time and group task time the patterns of relationships between those behaviours and pupil learning were often different for the different contexts.
Table 32

Mean Numbers of Pupil Behaviours During Group Task Activity Time in Relation to Pupil Learning:
Means Calculated Only for Items Which Occurred During Group Task Activity Time (23.6% of all Items)

<table>
<thead>
<tr>
<th>Behaviours</th>
<th>Pupils</th>
<th>IntT</th>
<th>IntP</th>
<th>Writ</th>
<th>Read</th>
<th>R Alo</th>
<th>Art</th>
<th>Diag</th>
<th>RubO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Items Already Known</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>2.9</td>
<td>28.1</td>
<td>6.9</td>
<td>2.0</td>
<td>0.5</td>
<td>10.3</td>
<td>0.2</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Diane</td>
<td>3.2</td>
<td>20.6</td>
<td>4.2</td>
<td>1.1</td>
<td>0.7</td>
<td>7.1</td>
<td>0.2</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Emily</td>
<td>5.7</td>
<td>34.0</td>
<td>0.7</td>
<td>0.3</td>
<td>0.3</td>
<td>16.2</td>
<td>1.0</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>3.6</td>
<td>27.0</td>
<td>4.8</td>
<td>1.4</td>
<td>0.5</td>
<td>10.5</td>
<td>0.4</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td><strong>Items Learned and Remembered</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Gus</td>
<td>4.8</td>
<td>39.2</td>
<td>18.8</td>
<td>0.2</td>
<td>0.2</td>
<td>11.2</td>
<td>1.8</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Diane</td>
<td>6.3</td>
<td>53.0</td>
<td>10.7</td>
<td>0.7</td>
<td>0.3</td>
<td>25.3</td>
<td>3.3</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Emily</td>
<td>2.7</td>
<td>35.8</td>
<td>10.7</td>
<td>10.7</td>
<td>0.0</td>
<td>6.5</td>
<td>1.3</td>
<td>1.2</td>
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<tr>
<td><strong>Mean</strong></td>
<td>4.2</td>
<td>40.7</td>
<td>13.6</td>
<td>6.5</td>
<td>0.1</td>
<td>12.2</td>
<td>1.9</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td><strong>Items Learned and Forgotten</strong></td>
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<td></td>
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<tr>
<td>Gus</td>
<td>3.3</td>
<td>28.3</td>
<td>3.7</td>
<td>2.3</td>
<td>0.7</td>
<td>4.0</td>
<td>0.7</td>
<td>0.0</td>
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</tr>
<tr>
<td>Diane</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Emily</td>
<td>6.0</td>
<td>54.0</td>
<td>25.0</td>
<td>6.0</td>
<td>4.0</td>
<td>0.0</td>
<td>9.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>4.0</td>
<td>34.8</td>
<td>9.0</td>
<td>3.3</td>
<td>1.5</td>
<td>3.0</td>
<td>2.8</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td><strong>Items Not Learned</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Diane</td>
<td>2.0</td>
<td>19.0</td>
<td>0.5</td>
<td>0.0</td>
<td>0.0</td>
<td>13.5</td>
<td>4.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Emily</td>
<td>0.0</td>
<td>38.0</td>
<td>21.0</td>
<td>28.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td><strong>Mean</strong></td>
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<td>25.3</td>
<td>7.3</td>
<td>9.3</td>
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<td>2.0</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td><strong>Items Mislearned</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Diane</td>
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<td>77.0</td>
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<td>26.5</td>
<td>1.0</td>
<td>3.5</td>
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</tr>
<tr>
<td>Emily</td>
<td>1.0</td>
<td>8.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>4.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>9.3</td>
<td>54.0</td>
<td>1.0</td>
<td>0.3</td>
<td>0.7</td>
<td>19.0</td>
<td>0.7</td>
<td>2.3</td>
<td></td>
</tr>
</tbody>
</table>
Table 33

Rate of Pupil Behaviours During Group Task Activity Time in Relation to Learning

<table>
<thead>
<tr>
<th>Pupil Behaviours</th>
<th>IntT</th>
<th>Peer</th>
<th>Writ</th>
<th>Read</th>
<th>R.Alo</th>
<th>Art</th>
<th>Diag</th>
<th>Rubout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items Already Known</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gus</td>
<td>7.5</td>
<td>73.9</td>
<td>18.2</td>
<td>5.3</td>
<td>1.3</td>
<td>27.0</td>
<td>0.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Diane</td>
<td>12.5</td>
<td>79.4</td>
<td>16.3</td>
<td>4.3</td>
<td>2.6</td>
<td>27.5</td>
<td>0.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Emily</td>
<td>11.7</td>
<td>70.3</td>
<td>1.4</td>
<td>0.7</td>
<td>0.7</td>
<td>33.5</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Mean</td>
<td>9.8</td>
<td>74.2</td>
<td>13.2</td>
<td>1.4</td>
<td>1.4</td>
<td>28.9</td>
<td>1.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>

| Items Learned and Remembered |      |      |      |      |       |     |      |        |
| Gus                          | 8.5  | 69.8 | 33.5 | 0.4  | 0.4   | 19.9| 3.2  | 0.4    |
| Diane                        | 8.9  | 74.7 | 15.0 | 12.2 | 0.5   | 35.7| 4.7  | 2.3    |
| Emily                        | 5.4  | 73.1 | 21.8 | 21.8 | 0.0   | 13.3| 2.7  | 2.4    |
| Mean                         | 7.5  | 72.3 | 24.1 | 11.6 | 0.3   | 21.7| 3.4  | 1.7    |

| Items Learned and Forgotten |      |      |      |      |       |     |      |        |
| Gus                          | 8.3  | 70.8 | 9.2  | 5.8  | 1.7   | 10.0| 1.7  | 0.0    |
| Diane                        | -    | -    | -    | -    | -     | -   | -    | -      |
| Emily                        | 8.0  | 72.0 | 33.3 | 8.0  | 5.3   | 0.0 | 12.0 | 8.0    |
| Mean                         | 8.2  | 71.3 | 18.5 | 6.7  | 3.1   | 6.2 | 5.6  | 3.1    |

| Items Not Learned |      |      |      |      |       |     |      |        |
| Gus              | -    | -    | -    | -    | -     | -   | -    | -      |
| Diane            | 10.5 | 99.9 | 2.6  | 0.0  | 0.0   | 71.1| 21.1 | 13.2   |
| Emily            | 0.0  | 80.9 | 44.7 | 59.6 | 0.0   | 0.0 | 0.0  | 4.3    |
| Mean             | 4.8  | 90.5 | 26.2 | 33.3 | 0.0   | 32.1| 9.5  | 8.3    |

| Items Mislearned  |      |      |      |      |       |     |      |        |
| Gus              | -    | -    | -    | -    | -     | -   | -    | -      |
| Diane            | 15.7 | 89.5 | 1.7  | 0.6  | 1.2   | 30.8| 1.2  | 4.1    |
| Emily            | 11.1 | 88.9 | 0.0  | 0.0  | 0.0   | 44.4| 0.0  | 0.0    |
| Mean             | 15.5 | 89.5 | 1.7  | 0.6  | 1.1   | 31.5| 1.1  | 3.9    |

Note. The '-' signifies that no group task activity occurred for those items.
Table 34

Reliability Coefficients for the Relationships between Pupil Behaviours During Group Task Time and Pupil Learning

<table>
<thead>
<tr>
<th>Behav.</th>
<th>Overall Mean Rate</th>
<th>Gus Mean Rate</th>
<th>Diane Mean Rate</th>
<th>Emily Mean Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int. T</td>
<td>0.19 0.00</td>
<td>0.00 0.33</td>
<td>0.67 0.21</td>
<td>0.00 0.58</td>
</tr>
<tr>
<td>Int. P</td>
<td>0.23 0.00</td>
<td>0.00 0.45</td>
<td>0.45 0.00</td>
<td>0.00 0.30</td>
</tr>
<tr>
<td>Writing</td>
<td>0.00 0.00</td>
<td>0.32 0.39</td>
<td>0.69 0.71</td>
<td>0.00 0.00</td>
</tr>
<tr>
<td>Reading</td>
<td>0.00 0.00</td>
<td>0.31 0.01</td>
<td>0.00 0.00</td>
<td>0.00 0.00</td>
</tr>
<tr>
<td>R Aloud</td>
<td>0.73 0.52</td>
<td>0.00 0.00</td>
<td>0.00 0.00</td>
<td>0.00 0.00</td>
</tr>
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<td>Artwork</td>
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<td>0.03 0.57</td>
<td>0.00 0.00</td>
<td>0.00 0.00</td>
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<td>0.00 0.00</td>
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<tr>
<td>Rubouts</td>
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<td>Organiz</td>
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<tr>
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<td>0.00 0.21</td>
<td>0.42 0.46</td>
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<tr>
<td>Waiting</td>
<td>0.00 0.58</td>
<td>0.00 0.10</td>
<td>0.74 0.71</td>
<td>0.00 0.02</td>
</tr>
</tbody>
</table>
11.3.1 Interactions with T

In addition to individual interactions with T this category included instances where T was present at the group and, in the course of a short discussion, directly interacted with a case study pupil. Frequently these interactions involved T resolving or sanctioning group quarrels.

When T engaged in 'lessons' rather than brief interactions about group work the extended interaction was classified as teacher-directed time. This circumstance only occurred on three occasions. All three pupils engaged in more interactions with T during group tasks than during individual tasks.

The actual numbers of interactions with T (4.2 on average, per item learned and remembered), and the high rate of these interactions (7.5 per hour spent in group tasks on content learned and remembered) show the high level of teacher monitoring during group task time (see Tables 32 and 33). As can be seen in Figures 83 and 84, the patterns of interaction with T were different for each pupil. Gus engaged in the most interactions (4.8 per item) and the highest rate of interactions (8.5 per hour) for content which he learned and remembered (See Tables 32 and 33). He engaged in slightly fewer interactions per item learned and forgotten (3.3) but at the same rate per hour. Gus engaged in no interactions with T during group task time about tested content which he failed to learn. Gus believed these interactions to be important:

Gus ...because he can tell us whether it's a good idea and stuff like that.

I But wouldn't you know yourself
Figure 83

Interactions with T During Group Tasks

Learning Outcomes

Figure 84

Rate of Interactions with T During Group Tasks

Learning Outcomes
whether it was a good idea?

Gus Well sometimes we just...when we're all feeling restless and we just go and scribble out a picture and it doesn't turn out very good and then Mr H gets in a bad mood and all that.

Diane's pattern was similar to her pattern for individual task time. Some of her interactions with T involved content which she learned but most involved content which she mislearned (see Figures 83 and 84). She engaged in high rates of interaction with T (10 to 16 interactions per hour) for items not learned and mislearned.

Emily interacted with T on average about three to six times about learned content, never about unlearned content and once about mislearned content. Her rate of interaction with T was strongly and consistently ($r = 0.58$) related to her learning. In summary Gus's and Emily's learning outcomes were related to the frequency of their interactions with T but Diane's interactions with T occurred at her highest rates for mislearned content.

An analysis of the content of T's audible interactions with Diane during the group task time spent on mislearned content reveals that these interactions almost exclusively involved issues of procedure and presentation. For example:

Put yours (group picture) down first, Diane.

Okay, you start colouring it in...
11.3.2 Interactions with Peers

The grand mean scores for peer interactions during group task activity time (see Table 32) show that more peer interactions occurred for learned items than for items not learned. However, Figure 85 shows the relationship between the number of peer interactions per item and learning was different for each of the three case study pupils.

Gus engaged in the same number of interactions, on average, for known items during group task time as during individual task time. He engaged, on average, in about 40 interactions per item learned and remembered, and just under 30 interactions per item learned and forgotten. Thus, as for individual task activity time, Gus's interactions with peers were related to his learning. The main difference between the two contexts is that Gus engaged in almost twice the interactions during individual task activity time for items learned and remembered than he did during group tasks.

Diane's results for group task time show a clear relationship between her engagement in peer interactions and her learning. This pattern contrasts with her fairly uniform number of about 20 interactions per item for items learned and not learned during individual task activity time. During group task time Diane engaged in, on average, 53 peer interactions for items learned and remembered and only 19 interactions per item not learned. The main difference in the kind of peer interaction in which Diane engaged in each activity task context is in group task contexts she was
Figure 85

Peer Interactions During Group Tasks

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Gus</th>
<th>Diane</th>
<th>Emily</th>
</tr>
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<tr>
<td>Mislearned</td>
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</table>

Figure 86

Rate of Peer Interactions During Group Tasks

<table>
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<th>Learning Outcomes</th>
<th>Gus</th>
<th>Diane</th>
<th>Emily</th>
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<td>Learned &amp; Forgotten</td>
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<tr>
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</tr>
<tr>
<td>Mislearned</td>
<td>60</td>
<td>70</td>
<td>50</td>
</tr>
</tbody>
</table>
required to engage in discussion about content whereas during individual tasks she chiefly engaged in interactions about organizational issues. Thus the co-operative context appeared to increase the effectiveness of peer interactions for facilitating Diane's learning. This result is consistent with the results of meta-analyses reported by Johnson et al. (1981) that co-operative task structures are more highly related to pupil achievement than individual task structures.

Emily's pattern for group task time contrasts with those of both Gus and Diane. Emily engaged in her lowest average number of interactions for mislearned content as can be seen in Figure 85 and Table 33. She engaged in an average of 34.0 peer interactions for known items and a similar average of 35.8 interactions for items learned and remembered. Emily's highest numbers of peer interactions occurred, on average, for items learned and forgotten. She engaged in about 38 interactions for items she failed to learn and about eight interactions for items mislearned. This result is congruent with observer perceptions of the frequency of 'felt-tipped pen' discussions in which Emily engaged. It appears that much of Emily's conversation during group tasks may have been off-task.

Figure 86 provides information about the rate at which peer interactions occurred. A rate of about 70 interactions per hour was fairly standard for Gus for items known or learned. In effect, Gus interacted with peers fairly continuously during group activity time and this discussion appears to have related to his learning, or at least, not interfered with that learning.
Diane also interacted at a rate of about 70 interactions per hour for items learned and remembered. Although fewer interactions occurred for items she learned her rate was very high at 100 interactions per hour for these items. For mislearned content Diane engaged in a rate of almost 90 interactions per hour.

Emily also engaged in a rate of about 70 peer interactions per hour for known and learned content. For items she failed to learn or mislearned she engaged in higher rates of 80 to 90 peer interactions per hour.

The very high rates of interaction for items not learned reflect the different kind of interaction which occurred during the lesser time spent on these items. Rates of interaction of over 80-90 per hour reflected staccato patterns of pupil interaction rather than on-going discussion about the task in hand. These staccato patterns were perceived to occur when the pupils were confused about or frustrated with task requirements. For example, the Year One teacher directed his reading group to carry out research about any group of conservationists and sent them to the library for resources. As there were no relevant resources, the pupils frantically discussed possible courses of action and expressed frustration at their lack of success. Eventually Diane and Emily wrote about forest rangers and rubbish collectors on the basis of their prior knowledge.
11.3.3 Writing

Writing during group tasks comprised two quite different kinds of products. The first consisted of individual written responses to research questions about introduced animals. For example, Diane, who researched the following information with two other group members, wrote:

In 1773 Captain James Cook introduced animals to New Zealand. Now we are hunting Wild pigs to get the meat and the skins. Captain Cook left pigs in New Zealand and they went wild. They cause erosion by digging up the soil and roots of new trees that are just growing.

The second kind of writing task, which was the predominant kind of writing carried out during group tasks, involved complex sentences constructed by each group as captions for group pictures. Examples of these sentences are shown in Figures 93, 94, and 95.

As can be seen in Figure 87 writing during group tasks was positively related to learning outcomes for Gus and Diane but not for Emily.

All three pupils engaged, on average, in between 10 and 19 writing events during group task time for items learned and remembered. Both Gus and Diane engaged in very few writing events for items learned and forgotten and items not learned. Emily, in contrast, engaged in the most writing events during group tasks about content learned and forgotten (25 writing events per item) and a relatively high number (21 events) for items not learned. The rate of writing events analysis
Figure 87

Writing During Group Tasks

Figure 88

Rate of Writing During Group Tasks

Learning Outcomes
follows the same pattern as for the mean number of writing events (see Figure 88).

This result is particularly significant for Diane because not only were the amount and rate of writing higher for content which she learned but these patterns were consistent in both amount and rate across the three data sets ($r = 0.69$ and $r = 0.71$). Further, she engaged in few writing events about content which she failed to learn or mislearned.

The considerable amount of writing in which Emily engaged about content she failed to learn occurred in relation to only one item about introduced animals. Although she carried out a research assignment about the wild pig as an introduced animal her misconception that introduced animals are those which live in bush country was apparently not displaced during this group assignment. This misconception is considered again in Chapter 12.

11.3.4 Reading

Gus and Diane engaged in very few reading events during group tasks (see Figure 89 and Table 32). Emily engaged in 10.7 reading events on average, for content which she learned and remembered, but she also engaged in almost 30 reading events, on average for items she failed to learn. This reading occurred during the library research project in which she worked under the misconception that introduced animals are animals which live in bush country.

As can be seen in Figure 91 and Table 32, very few reading aloud events occurred. No reading aloud events occurred for items not learned. This pattern suggests
Figure 89

Reading During Group Task Time

![Graph showing reading events per item for Gus, Diane, and Emily across different learning outcomes.]

Figure 90

Rate of Reading During Group Tasks

![Graph showing events per hour for Gus, Diane, and Emily across different learning outcomes.]
Figure 91

Reading Aloud During Group Tasks

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Gus</th>
<th>Diane</th>
<th>Emily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already Known</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Learned &amp; Remembered</td>
<td></td>
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<tr>
<td>Learned &amp; Forgotten</td>
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<td>Not Learned</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mislearned</td>
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</tbody>
</table>

Figure 92

Rate of Reading Aloud During Group Tasks

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Gus</th>
<th>Diane</th>
<th>Emily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already Known</td>
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<tr>
<td>Learned &amp; Remembered</td>
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</tr>
<tr>
<td>Learned &amp; Forgotten</td>
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<tr>
<td>Not Learned</td>
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<td></td>
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<tr>
<td>Mislearned</td>
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</tbody>
</table>
that although infrequent, reading aloud behaviour was related to pupil learning in group tasks as well as in individual tasks. Most reading aloud during group task time occurred in relation to group captions.

11.3.5 Art and Diagrams

Examples of group pictures created during group task activity time can be seen in Figures 93, 94, and 95. The relationship between engagement in group artwork and learning was different for each of the case study pupils. As can be seen in Figures 96 and 97, both the amount and rate of group artwork in which Gus engaged was related to his learning. Gus's rate of artwork was consistently related to his learning \( r = 0.57 \). Diane engaged in most artwork for mislearned content and content learned and remembered. The group project about smog did not displace her mislearned notion that aeroplanes do not cause pollution - even although there was an aeroplane in the picture. Again, this result points to the strength of misconceptions apparently developed as a result of a personal interaction with T. Because Emily spent so few minutes engaged in artwork about the content of the item she mislearned (in spite of group task opportunity) her high rate of artwork for mislearned content is misleading. Again this content concerned content which she had apparently mislearned in the course of an interaction with T.

An examination of the group pictures shown in Figures 93, 94, and 95 provides some interesting insights into pupil learning and mislearning which was not measured by the test. In Figure 93, the illustration of a pine forest as native trees, drawn by a group of which Gus was leader, shows the children's lack of experience of native bush, and their failure to realize that...
An Example of a Picture and Caption Produced by a Group in which Gus was Involved.

Before deforestation the hills are well covered with vegetation and have a lot of insects and animals living in the safe pine forest because they feel so contented and safe with such a lush forest home.
An Example of a Picture and Caption Produced by a Group in which Both Diane and Gus were Involved.

The great huge powerful glacier
Slowly moves down the valley
Chipping off the rough ragged rocks as it goes.
Figure 95

An Example of a Picture and Caption Produced by a Group in which Emily was Involved.

This illustration shows a type of erosion at the rivers. The main erosion is the river making the rocks move in a rubbing motion against each other and thus, making the rocks move over the years. The banks are worn away slowly because of the flowing river that carries away soil as it slides past.
Figure 96

Artwork During Group Tasks

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>No. of Artwork Events Per Item</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td></td>
<td>Diane</td>
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<td></td>
<td>Emily</td>
</tr>
<tr>
<td>Learned &amp; Remembered</td>
<td>Gus</td>
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<td></td>
<td>Diane</td>
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<td></td>
<td>Emily</td>
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<tr>
<td>Learned &amp; Forgotten</td>
<td>Gus</td>
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<tr>
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<td>Diane</td>
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<td></td>
<td>Emily</td>
</tr>
<tr>
<td>Not Learned</td>
<td>Gus</td>
</tr>
<tr>
<td></td>
<td>Diane</td>
</tr>
<tr>
<td></td>
<td>Emily</td>
</tr>
<tr>
<td>Mislearned</td>
<td>Gus</td>
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<tr>
<td></td>
<td>Diane</td>
</tr>
<tr>
<td></td>
<td>Emily</td>
</tr>
</tbody>
</table>

Figure 97

Rate of Artwork Events During Group Tasks

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>No. of Artwork Events Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already Known</td>
<td>Gus</td>
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<td></td>
<td>Diane</td>
</tr>
<tr>
<td></td>
<td>Emily</td>
</tr>
<tr>
<td>Learned &amp; Remembered</td>
<td>Gus</td>
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<td></td>
<td>Diane</td>
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<td></td>
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<tr>
<td>Learned &amp; Forgotten</td>
<td>Gus</td>
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<td></td>
<td>Diane</td>
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<td></td>
<td>Emily</td>
</tr>
<tr>
<td>Not Learned</td>
<td>Gus</td>
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<tr>
<td></td>
<td>Diane</td>
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<tr>
<td></td>
<td>Emily</td>
</tr>
<tr>
<td>Mislearned</td>
<td>Gus</td>
</tr>
<tr>
<td></td>
<td>Diane</td>
</tr>
<tr>
<td></td>
<td>Emily</td>
</tr>
</tbody>
</table>
erosion the road would not have been there! Gus, himself, created the phrase, 'the lush pine forest', which is not an accurate description. T looked at the picture but never discussed these issues with the group. Rather, on the final day of the unit, during a simulated debate between vested interest groups about the siting of a town, he presented the children with a pine forest and a native forest and required them to choose between them. T did not, when asked, consciously relate his challenge to the misconceptions apparent in the group picture. However, his practice of bringing the class back to the mat during group task time in order to clarify such misconceptions suggests that he habitually dealt with pupil misconceptions in this way. It is interesting that in this case, when Gus was lacking relevant prior experience, he also failed to clarify the issue during the unit.

A further issue in relation to group art work is the humorous depiction of mountain climbers masterminded by Gus in the glaciation picture (see Figure 94). Cazden (1983) pointed out that children's humour has not been investigated in the research on classroom discourse. It is interesting to postulate the potential learning for Diane (who was in the same group) which may have been associated with the peer discussion and subsequent depiction of these figures. As Diane had never been on a hill or mountain the depiction of gravity in the falling rock, and the associated discussions about relative proportion, may have helped her to develop a concept of mountain.

It is also interesting to compare Emily's picture of a river which she produced independently during individual task time, shown in Figure 67, with the group picture of a river shown in Figure 95. Emily's contribution to the group river was to follow instructions from other group members in drawing the
Figure 98

Diagram Drawing During Group Tasks

Learning Outcomes

Figure 99

Rate of Diagram Drawing During Group Tasks

Learning Outcomes
river. The ruggedness of the river in the group picture contrasts with the less appropriate depiction of a mountain stream in her own picture. It seems that Emily's concept of a mountain stream developed considerably in the course of the group project.

Diagram drawing during group tasks generally involved complex headings and lettering. That is, it did not involve diagram depictions of concepts as in individual tasks. This behaviour was negatively related to Diane's learning in both amount and rate, and strongly associated with Emily's short-term learning outcomes. Gus engaged in very little diagram drawing during group tasks. There was no consistency in these relationships.

11.3.6 Rubbing Out

The overall pattern for rubbing out behaviour shown in Figures 100 and 101, suggests that rubbing out behaviour during group tasks was negatively related to learning. For Gus, the minimal number of rubbing out events in which he engaged during group task time was related to his learning. For Diane and Emily, however, higher frequencies of rubbing out behaviour occurred for content which was learned and forgotten, not learned or mislearned. The high rate of rubbing out and diagram drawing behaviour in which Emily engaged in relation to content which was learned and forgotten reflect her preoccupation with coloured headings.

It is apparent that rubbing out during group task time was not related to learning in the same way as rubbing out during individual tasks. This is not surprising given that different views among group members about content and spelling were generally resolved before the
Rubbing Out During Group Tasks

Learning Outcomes

Rate of Rubouts During Group Tasks

Learning Outcomes
Table 35

Mean Numbers of Organizing, Moving and Waiting Events
During Group Task Activity Time: Means Calculated
Only for Items Which Occurred in a Group Task Context
(23.6% of all Items)

<table>
<thead>
<tr>
<th>Pupils</th>
<th>Organize</th>
<th>Moving</th>
<th>Waiting</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2.0</td>
<td>6.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Diane</td>
<td>0.4</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
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<td>6.2</td>
<td>6.6</td>
</tr>
<tr>
<td>Mean</td>
<td>1.7</td>
<td>5.1</td>
<td>3.6</td>
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<table>
<thead>
<tr>
<th>Pupils</th>
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<th>Items Learned and Remembered</th>
<th>Items Learned and Forgotten</th>
<th>Items Not Learned</th>
<th>Items Mislearned</th>
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<tr>
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<tr>
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<td>8.7</td>
<td>8.3</td>
<td>-</td>
<td>-</td>
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<td>Emily</td>
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<td>-</td>
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<td>5.1</td>
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Table 36
Rate of Pupil Moving, Organizational and Waiting Events During Group Task Activity Time

<table>
<thead>
<tr>
<th>Pupil</th>
<th>Organiz Events</th>
<th>Moving</th>
<th>Waiting</th>
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</thead>
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<tr>
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<tr>
<td></td>
<td>Items Learned and Remembered</td>
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<td>2.6</td>
<td>0.0</td>
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<tr>
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<tr>
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<td></td>
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</tr>
<tr>
<td>Diane</td>
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<td>Emily</td>
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<tr>
<td>Mean</td>
<td>2.2</td>
<td>6.6</td>
<td>2.2</td>
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</tbody>
</table>
pupils contributed to the group product. Rubbing out in this context seemed to occur as a result of pupil concern with product appearance rather than as the result of a dispute over content.

11.3.7 Organizational Behaviours

Organizational behaviours during group tasks were predominantly behaviours which occurred at the outset of group activity when the pupils were engaged in making group decisions about a joint course of action. However, the kinds of organizational behaviours which occurred during individual tasks (for example, getting a rubber, paper, or a book) were included also. It was apparent that whereas these organizational behaviours were solitary behaviours during individual tasks, during group tasks even the organization of resources generally involved considerable discussion about the task in hand.

More organizational behaviours occurred for all three pupils for learned items (see Table 35 and Figure 102). For both Diane and Emily, the number of organizational behaviours in relation to learning was consistent across the three data sets (r = 0.69 and r = 0.65). Gus engaged in a lower rate of these behaviours per hour for items learned and remembered than did either Diane or Emily. See Table 36 and Figure 103. Again, however, these results were consistent for both Diane and Emily (r = 0.53 and 0.54). Thus, apart from mislearned content, Diane and Emily engaged in more organizational behaviours during group task time spent on content learned and remembered and this pattern was one of the few consistent patterns for group task behaviours.
Figure 102
Organizational Behaviours During Group Tasks

Figure 103
Rate of Organizational Behaviours During Group Tasks
This result provides further evidence that the kinds of behaviours which are closely related to learning are behaviours which are associated with cognitive conflict and cognitive restructuring.

11.3.8 Moving

As can be seen in Figure 104 and Table 35, more moving occurred for learned items than for unlearned items for all three pupils during group task time. Also, considerably higher rates of moving (7.1 - 18.5 events per hour) occurred for learned items. See Figure 105 and Table 36. Each pupil engaged in just over two moving events per hour for items not learned. Thus where group tasks were carried out in a predominantly sedentary mode, learning did not occur. This pattern points to a relationship between opportunity to move to different resources (teacher, other pupils, reference books, wall charts) and pupil learning during group task activity time.

Again, however, Emily engaged in a high rate of moving during the little time she spent on content which she mislearned.

11.3.9 Waiting

Waiting in a group task context generally involved waiting while another group member contributed toward the group product. This behaviour usually involved attending to and monitoring the peer contribution. The results suggest a strong relationship between these behaviours categorized as 'waiting' and pupil learning for all three pupils (see Figures 106 and 107 and
Figure 104

Moving During Group Task Time

Learning Outcomes

Figure 105

Rate of Moving During Group Tasks

Learning Outcomes
Figure 106

Waiting During Group Tasks

Learning Outcomes

No. of Waiting Events Per Item

Already Known  Learned & Remembered  Learned & Forgotten  Not Learned  Mislearned

Gus  Diane  Emily

Figure 107

Rate of Waiting Events During Group Tasks

Learning Outcomes

No. of Events Per Hour

Already Known  Learned & Remembered  Learned & Forgotten  Not Learned  Mislearned

Gus  Diane  Emily
Tables 35 and 36). As has been discussed previously group task opportunity was unevenly spread across items and consistent patterns are rare. However, the relationship between Diane's waiting and learning was highly consistent ($r = 0.74$ and $r = 0.71$).

It seems that as with opportunity to attend to peer comments during teacher-directed lessons, opportunity to attend to peer activity was related to case study pupil learning. Webb (1980) found passive behaviour during group tasks and achievement to be negatively related but she defined passive behaviour as the lack of any discernible involvement. In the present study waiting behaviour was prevalent in the behaviour of all three pupils as they watched other group members make contributions to the group project. During this time the 'waiting' group members would engage in ongoing conversation about the group task.

11.4 SUMMARY

The case study pupil behaviour patterns in relation to learning outcomes were most diverse for group task time. All tested content with which Gus interacted during group task opportunity was learned by him. Thus group task opportunity was particularly facilitative of Gus's learning and over one third of the items he learned involved this opportunity. The high rates of peer interactions in which he engaged appeared to be critical in this process.

In contrast, Diane spent considerable time engaged in group tasks which did not facilitate her learning of tested content. Both her struggles to retain leadership and her primary focus on procedural and presentational elements of these tasks may have contributed to this
failure to benefit. Certainly, group task opportunity did not counteract mislearning which had occurred. Rather she seemed to avoid difficult conceptual contradictions through her preoccupation with other matters.

Emily's group task opportunity was related to her learning and the content which she mislearned or failed to learn generally involved much less time. That is, this content occurred in a group task context such as the creation of a reserve, but was peripheral to the primary focus of the task. One item she failed to learn involved a misconception about introduced animals which was never clarified for her during the unit.

The results for both Diane and Emily, and the presence of a substantial misconception in Gus's group picture of a 'native' forest, indicate that group task situations only facilitated clarification of misconceptions when (a) the children had related prior experience, and (b) the task requirements directly impinged upon the misconception.

Group tasks, by their very nature, took up more time. They were oriented to fewer than a quarter of the tested items (many of which were already known) and were differentially related to case study pupil learning outcomes. Pupil behaviours during this time were also differentially related to learning for the case study pupils. It seems that for Gus and Emily group task opportunity was related to learning, but less so for Diane. However, the results do suggest that at times, group task opportunity was strongly related to learning, particularly in relation to the enrichment of concepts taught in a teacher-directed context.
CHAPTER 12

OPPORTUNITY TO LEARN REVISITED: ISSUES AND EXCEPTIONS

We shall be following the natural order of inquiry if we speak first of common characteristics; and then investigate the characteristics of special cases.

(Aristotle, Physics, 1:6) (McKeon, p. 230)

12.1 OVERVIEW

In Chapter 8 the finding that on average, more opportunity to learn was related to pupil learning was outlined. There were exceptions to this pattern. The exclusion of attitudinal items from the main analyses and the use of means to describe the data were procedural decisions which deflected attention from the exceptions. As discussed in Chapter 2, however, an examination of exceptions in data is a methodological requirement of a grounded approach to data analysis.

In Chapters 8, 9, 10, and 11, it is apparent that the case study pupils spent over a third of the unit time on content relevant to tested items, interacting with content which they apparently already knew. Pupil opportunity to interact with known content is examined in section 12.2 in order to illuminate the function of time spent on such content. It has also been apparent in both the preliminary prediction analyses and the results that
concrete experience is a confounding variable in relation to long-term pupil learning. An overview of the relationship between concrete experience and pupil learning outcomes is discussed in section 12.3. A systematic analysis of all items which constituted exceptions to the time spent finding is reported in section 12.4. Finally, in section 12.5, the focus in this thesis, on knowledge and concept acquisition, is placed in perspective in relation to other unit outcomes such as attitudinal changes, and skill acquisition and development.

12.2 THE FUNCTION OF PUPIL OPPORTUNITY TO INTERACT WITH 'KNOWN' CONTENT

The case study pupils spent 43.5% of the total time they spent on tested content, on content which was apparently known by them. The interview data discussed in Chapter 9 indicated that Gus actively attempted to ensure the teacher did not leave out important points when discussing content known by Gus. Also Gus believed he learned from other pupils' knowledge when they contributed to class discussion. Higher rates of teacher-pupil discussion occurred in relation to content known by the case study pupils. High rates of interactions with T and the highest rate of hand raising occurred in relation to known content. That is, the case study pupils participated overtly and actively in discussions of this content during teacher-directed lessons.

High rates of reading, writing and rubbing out during individual tasks were associated with assignments involving known content. High rates of interactions with T occurred during time spent on known content in both individual and group tasks.
In summary, the pupils were actively involved with known content during the Conservation Unit for close to half of the total time spent. In order to explore the possible function of this pupil involvement, a qualitative analysis is provided of case study pupil opportunity to interact with the content of an item which was known by all three pupils (as measured by correct responses on all three tests). The item, Erosion 1, involved accurate selection of the phrase, 'the place around us', as a definition of the term, environment.

Gus experienced an opportunity to interact with the content of this item in two task contexts (teacher-directed and group) over nine episodes. Diane and Emily experienced an opportunity to interact with this content in seven teacher-directed episodes.

In the first teacher-directed episode on Day 1, T elicited the term from the class:

T Where does all this erosion take place? It's a word you've come across several times...

P In the bank.

T No, we're not talking about the money now.

P In the district.

T Well, what's going on in the district which is part of our?

Gus Environment.
Thus, T used Gus's prior knowledge as a resource for the whole class. The first mention of this term was made by a pupil. T then defined the term for the class and expanded on this definition in relation to the unit content. At the end of that first episode, and in the subsequent four episodes spread over three days, T posed various questions to the class using the term environment in those questions. For example, 'Where is somewhere in our environment where water is frozen?' Thus the children were required to understand this concept in order to answer questions about other concepts. By the fourth episode both Diane and Emily raised their hands to respond to T's question. In episode six T used the term in context in a descriptive statement.

In episode seven, however, T linked the term environment to the concept of habitat as a supportive ecosystem for an animal species. Finally, on Day 24 of the unit, he used the term environment in context, in relation to the extinction of dinosaurs. On this occasion he assumed the new information about the concept of habitat. Thus T derived the term from the class, required the children to understand this term in order to participate in new learning, and developed the concept to a sophisticated degree toward the end of the unit. Although this process was spread over the greater part of the unit, each step in the process was logically dependent on prior discussion. By the end of the unit T had developed the concept to a conceptual level which is required by the New Zealand School Certificate science syllabus.

There was no evidence of Diane or Emily interacting with this concept again. However, on Day 30, Gus used the concept of environment in relation to its meaning as habitat. This occurred in the course of a group task after group members requested him to carry out independent research at home on the needs of an elephant (which they wanted to include in their animal reserve). Gus wrote and
read aloud to his group the following report:

**diet**
If an Elephant weighs up to seven tons it will need more than a sixth of a ton of vegetation per day. that (sic) meas (sic) that the Elephant must graze for 16 hours every 24 hours, their Environment is bushy with a fair few trees and water.

It seems Gus used this enriched concept in the course of an out-of-class follow-up to an in-class task.

A similar process operated in relation to the concept of an introduced animal which Gus already knew at the outset of the unit. During the relevant group task Gus wrote:

The wild pig was introduced to New Zealand in 1773 by Captain James Cook...

He took the research opportunity to check out the validity of this information and discussed the possibility that French explorers introduced wild pigs into New Zealand, with group members. Again, Gus used a task opportunity which involved known content as a stepping stone toward a more sophisticated understanding of the issues involved.

This approach was not unique to Gus. Both Diane and Emily engaged in similar concept enrichment and development during the time they spent interacting with known content. For example, both Diane and Emily 'knew' that rivers cause erosion before the unit. Their concepts of river erosion were clearly more sophisticated at the end of the unit. The growth in Emily's concept of river erosion has been discussed in Chapter 11 in relation to the contrast
between her individual depiction of river erosion and her contribution to a group picture. Diane was inhibited, however, by her lack of concrete experience, as has been discussed in Chapter 10. By the end of the unit she knew that 'rivers cause (sic) erosion by the stones rolling with the current (sic)' but she did not understand what the process actually involved. Because of her lack of relevant experience Diane appeared to learn 'that X did Y' rather than 'how X did Y' - except in relation to processes which she had seen demonstrated by T.

Given the fact that the case study pupils spent almost half the unit time spent on tested content interacting with known content, and the qualitative analyses of pupil behaviour during the time spent on known content, it seems clear that this interaction was critical for new learning. These results provide empirical substantiation for Ausubel's (1968) argument that:

[N]ew ideas and information are learned and retained most efficiently when inclusive and specifically relevant ideas are already available in cognitive structure to serve a subsuming role or to furnish ideational anchorage.

(p.153)

Hewson and Hewson (1984) and Wittrock (1974, 1978) have modified Ausubel's hypothesis by arguing that it is not just a matter of relevant prior knowledge facilitating more efficient learning; rather they argue that learning can only occur when relevant prior knowledge exists to enable the learner to generate appropriate cognitive links with new information:

...learning can happen only by relating the unknown to what is already known, and thus all learning depends on the
prior knowledge of the learner, which serves as a format, or schema, into which new information is fitted.

(p. 5)

Osborne and Wittrock (1982) argued that one of the major problems in the teaching and learning of science has been:

... that the influence on learning science of children's prior knowledge, memories, and experiences has been underestimated.

The pattern of class results, discussed in Chapter 7, that showed children with higher prior knowledge were less likely to mislearn tested content, suggests that prior knowledge not only facilitated new learning but also inhibited mislearning.

12.3 THE RELATIONSHIP BETWEEN CONCRETE EXPERIENCE AND LONG-TERM LEARNING

In this thesis the phrase, concrete experience, is used in the Piagetian sense of 'here-and-now' experience. The issue of concrete experience has been a recurrent theme as a primary inhibiting variable in relation to pupil learning in this study. Because the analysis of the initial prediction errors showed lack of concrete pupil experience of relevant phenomena to be a possible explanation of failure to learn, and 'forgetting', an assessment was made, at this stage, about whether or not the case study pupils would have had relevant concrete experience for every test item. The criteria used to make this assessment are outlined in the following discussion.
The judgement about pupil experience was a difficult judgement to make, except in the cases where T provided a simulated concrete experience of item concepts. Observational data about the concrete experiences provided by T during the unit comprised the first, and most reliable, source of information about pupil concrete experience. Data from the interviews was the second major source of information about concrete experience. The third source was the response of the case study pupils to T's recurrent questions about prior experience. For example:

Hands up those who have been to the beach at Spencer Park?

Finally, if a concrete experience of the concept in question was judged by the researcher to be a common element in the pupil's experience (for example; fog) then an assumption of prior experience was made. This category of prior experience was slightly different from the other three in that no observed link had been made by T between the child's experience and the content of the item.

This procedure for judging whether or not a child had direct concrete experience was conservative, and in some cases the child may have had concrete experience of phenomena relevant to a concept and the researcher would have had no knowledge of this experience.

An analysis of the percentage of items learned and remembered showed that 95.9% of these items involved content for which the case study pupils were judged to have had relevant concrete experience. In contrast only 29.4% of items learned and forgotten involved content for which the case study pupils were judged to have had relevant concrete experience. However, 41.5% of items which were not learned involved content for which the case study pupils were judged to have had relevant concrete
experience.

Before discussing these patterns further the two items learned and remembered, which were not judged to have involved relevant pupil concrete experience, are examined. These were two items which Gus learned and remembered (as measured by his test responses) in spite of lack of concrete experience. Gus learned and remembered that dinosaurs died out because they could not adapt to a changing environment and he 'learned' that the Native Forest Action Council in New Zealand has fought to save the Okarito forest. Gus's test result for the latter item is illuminated by his interview response:

Oh well, seeing it was about the native forests and that I didn't think the government and that would be doing anything so I just...
Well, it was a sort of a guess.

Only six minutes of class time was spent on the content of this item and no mention was made of the Council. Gus did not have a concept of the Council so in fact he had not learned and remembered this content. Rather he used a successful elimination strategy involving a sceptical notion of Government to select the correct answer. The sceptical notion of Government was not verbalized by T. By inference it can be assumed that Gus had been exposed to that view at home and that the information was useful to him when faced with an unknown item. There was further evidence to support this hypothesis in the content of Gus's interview responses when Gus mentioned that his father discussed the daily newspaper with him.

The item about the dinosaurs is problematic because T did talk about the extinction of animals and the evolution of animals during the unit. On the immediate posttest, Gus's
answer that 'dinosaurs changed into modern animals like horses' was, in fact, incorrect but at the time he indicated that he was dissatisfied with the item alternatives and a year later he wrote his own alternative:

They died when their environment changed.

This item was classified as correct on the posttest because Gus had noted that he was dissatisfied with all the responses and he had tried to explain the concept in his own words. That is, a change had taken place which was maintained over both posttests and was in the direction of the correct test response. Thus, the two exceptions were exceptions to the learned and remembered outcome in other ways.

In summary, the case study pupils had relevant concrete experience of almost all tested content which was learned and remembered. Because the analysis shows that the case study pupils were least likely to have had concrete experience of content which was learned and forgotten it seems reasonable to assume that lack of relevant concrete experience was a critical factor in inhibiting 'remembering' or anchoring of learned concepts. This finding is a clear confirmation of Piaget's theory that children of this age learn concepts through concrete experience. It also suggests that pupil concrete experience is a major confounding variable in relation to the relationship between time spent and pupil learning.

White (1977) argued that concrete experience is similar to pictures and diagrams in that it is a 'fertile source of images' (p. 30) which helps initial comprehension and aids recall. However, the data from this study is more congruent with Piaget's view that concrete experience is a necessary pre-condition for learning to occur, and is different in kind from two-dimensional images. The
evidence from this study could be interpreted to indicate that concrete experience simply provides more links in which to nest new information but there seems to be some qualitative difference at least. Perhaps, for example, the potential for episodic links ['recollections of personal involvement in an event' White (1977) (p. 31)] is especially facilitated by concrete experience.

Cazden (1983) cited Mayer and Brause (in press) as another report which provides evidence that concrete experience is important in relation to in-class learning. However, there has not been systematic investigation of this variable in relation to in-class pupil learning in the classroom research tradition. If concrete experience is important for long-term learning, but not requisite for short-term learning, then it is apparent that children with a broad range of concrete experience would be benefiting from classroom learning opportunity in a different way from children who do not have such experience. They would be retaining their new understanding and able to relate new information to this learning throughout their schooling. Children who do not bring a range of relevant experiences to bear upon new concepts would be disadvantaged because they would be unable to use their learning to facilitate further related learning, to the same degree. More critically, this inhibiting variable would not be apparent to teachers who almost invariably employ immediate posttests of specific content learning. Rather a teacher would constantly be faced with an inexplicably widening gap between pupils in the range of their understanding and vocabulary. This hypothesis, based upon the relationship between pupil concrete experience and long-term learning outcomes in the study, comprises a feasible partial explanation for the fanning effect argued by Heyns (1978).
In this section it has been demonstrated that pupil concrete experience operated as a confounding variable in relation to the time spent finding. In the following sections the exceptions to the time spent finding are systematically analyzed in order to identify other variables which might have had a confounding effect on the time spent finding.

12.4 A SYSTEMATIC ANALYSIS OF EXCEPTIONS TO THE RELATIONSHIP BETWEEN TIME SPENT AND PUPIL LEARNING

There are limitations on the analyses reported in Chapters 9, 10, and 11. That certain behaviours were more prevalent for items learned than for items not learned cannot be claimed to be critical (except that over the time spent those behaviours did not inhibit learning) because no causal links have been established with learning. In fact, it could be argued that time per se was the critical factor and the behaviours measured were incidental to learning. That certain behaviours occurred at a higher rate for learned items than for items which were not learned is a stronger finding but what of the case where a behaviour occurred at the same rate for all conditions but only a certain amount of it (hypothetically speaking) would facilitate learning. That is a behaviour such as diagram drawing which occurred at a rate 13.8 events per hour for content not learned (about 4 actual events per item) and a similar rate of 13.5 events per hour for items learned and remembered (about 18 events per item) may have been critical to learning only when more than eight to nine minutes of diagram drawing occurred. Because so few minutes of actual diagram drawing occurred for items which were not learned the rate finding may be misleading. In effect, the analysis has not provided any insight into the possible interaction between pupil behaviours and time spent nor has it confirmed that
certain variables (for example; opportunity to attend to
demonstrations) are important independent of time spent,
because in spite of the rate differences much more time
was spent on the content of items for which the teacher
provided demonstrations.

In this chapter an alternative analysis is provided which
is an attempt to confront the confounding effect of time.
Items which were learned and remembered, learned and
forgotten, or not learned have been classified into four
categories of time spent: items for which less than 15
minutes (the average time spent on items not learned) was
spent on relevant content, items for which between 15
minutes and 46 minutes (between the average time spent on
items not learned and items learned and forgotten) was
spent on relevant content, items for which between 46
minutes and 77 minutes (between the average time spent on
items learned and forgotten and the average time spent on
items learned and remembered) was spent on relevant
content, and items for which over 77 minutes was spent on
relevant content. For the purposes of this analysis
average times have been rounded to the next highest
integer.

First the numbers of items in each category are examined.
Then a systematic analysis of the distribution of learning
outcomes in the time matrix is carried out. Patterns of
pupil behaviour which were distinctive for content which
was learned in spite of less opportunity to learn are
discussed in detail. Finally the results of these
analyses are cross-checked against case study pupil
interview responses in order to identify whether the
quantitative findings about pupil behaviours which
appeared critical to pupil learning are confirmed by the
memories for events reported by the case study pupils one
year later.
12.4.1 Number of Items in Four Categories of Time Spent on Content in Relation to Learning Outcomes

A matrix showing the number of items in each of the 12 categories is shown in Table 37. It is evident that for most of the items, not learned (75.6%) the case study pupils had less than 15 minutes in-class opportunity to learn. The largest number of items learned and remembered (20) fell into the 77 minutes or more category. However, this was only 40.8% of the items learned and remembered. Some items were learned and remembered although less in-class opportunity to learn occurred.

Seven items were learned and remembered in spite of less than 15 minutes of in-class opportunity for pupils to interact with content and six items in this time category were learned and forgotten. All eight items for which the case study pupils had more than 46 minutes of class time to interact with relevant content and which were either learned and forgotten, or not learned, involved pupil misconceptions which had been identified before this analysis was carried out. These misconceptions had either inhibited learning of appropriate concepts or had apparently been displaced for the immediate posttest only to recur for the long-term posttest and interviews. These misconceptions are discussed in this section in order to identify clues which indicate why the considerable opportunity to interact with this content did not displace those misconceptions.
Table 37

Number of Items in Four Categories of Time Spent on Content in Relation to Learning Outcomes

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
<th>Not Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>77 minutes +</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>46 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>15 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>
12.4.2 Misconceptions

Gus, Diane and Emily shared a misconception that rabbits rather than deer are a cause of damage to trees in native forests. The other five items in the over 46 minutes and not learned and remembered category all involved critical misconceptions which were unique to each pupil. These items are discussed individually.

Erosion involved identifying the deer as a major cause of erosion in New Zealand forests. Gus and Emily selected the deer correctly in the immediate posttest but selected the rabbit alternative in the long-term posttest. Diane selected the rabbit on both posttests although she had 51.5 minutes of class time opportunity to learn about the deer. Gus spent 65.5 minutes of class time on the deer and Emily spent just over an hour.

All three pupils mentioned the deer as a cause of erosion in forests during the interviews but selected rabbits as their response. All three children had a misconception that rabbits live in native New Zealand forests and Diane clearly stated this belief during an interview. Also the children had a notion that rabbits cause erosion which was consistently stronger than their knowledge that deer cause erosion. This is evident in Gus's interview response:

I put rabbits because I've um...You always hear people talking about things like um rabbits are bad to have around the place and that, um... (Interviewer Probe)
We learned about it last year and um, there used to be hundreds of rabbits round
um... I think it was Otago. I can't remember if it was there or not. And they kept on eating up all the grass and that um... having no grass left. And they'd put up barbed wire and they still dig holes under it and get into the paddocks and eat everything up and that.

This response contains vivid references to the content of two class discussions. The first involved T telling of his experience at a country school in Otago when trappers were brought into the area and paid $50 for every rabbit they killed. This anecdote was told in detail on the second to last day of the unit. The second discussion occurred during a directed silent reading lesson about a high country sheep station. T asked the pupils to suggest ways to stop the rabbits destroying the farmland. Considerable discussion ensued about the futility of using barbed wire fences to keep rabbits away.

The interview response of another child in T's class indicates that out-of-school knowledge/experience may have been a factor in these exceptional test results:

I Which of these animals has been a major cause of erosion in New Zealand forests?

P I know. Rabbits.

I How did you work that out?

P Oh, I ... Mum and me and my brother... We were out in the country and I heard shots and I said, 'What's that?' and she said, 'It's just those farmers shooting rabbits'. And I asked her
why and she... because it keeps eating the trees and stuff. I can't remember what she said, but she said rabbits are bad.

I  Yeah... Did Mr H talk about it?

P  He talked about deer but I can't remember if he talked about rabbits.

In effect the pupil remembered that the teacher talked about deer, and the case study pupils confirmed that they realized that deer cause erosion, but the strength of their beliefs about rabbits causing erosion displaced the more appropriate response. Furthermore this misconception was not only common to all three case study pupils but also prevalent for the majority of pupils in T's class.

Toulmin (1972) argued that the context in which a person lives (including cultural milieu, language, folklore, as well as everyday experiences) favours the development of some beliefs and inhibits the development of others. The children's misconception about rabbits clearly has its roots in the conventional wisdom of New Zealand culture. For example the novelist, Janet Frame, (1981) used images of erosion which characterize the centrality of the rabbit in the New Zealand subconscious:

He was not a 'typical' New Zealander. He had never shot and killed and skinned rabbits and strung the skins on the wire fence to dry.  

(p. 52)

I learned as a child of its threat and horror. I used to go to Central Otago in my home country. I saw the rabbit-made landscapes, their deserts of golden warrens where they lived sleeping on deep pillows of bullion in crumbling palaces that were pathways to and from the sun. Today, in memory of rabbits, there are men and boys (even a town) named Bunny, proud of the name while children sleep embracing soft-furred rabbit toys, the once kings of the golden kingdom.

(p. 156)

It was strange to think that Theo was from New Zealand, that he knew of the desert places in Central Otago, where the rabbits once had their summer palaces. Theo had studied them. He knew about them as Lords of erosion.

(pp. 180-181)

In effect, Frame considers that knowledge of the rabbit as King of erosion is a special knowledge which is unique to New Zealanders and rooted in childhood learning. The strength of this cultural knowledge was stronger for the children than the pictures, activities, or direct teacher statements that identified the deer as the major cause of forest erosion.

Gus's misconception about smog has already been discussed in the preceding chapters where it has been argued that his misconception seemed to arise in the course of a teacher-directed lesson. His interview response confirmed this interpretation:
Smog is just weather now
I think of it you know.

Diane stated publicly during a teacher-directed lesson that evaporate means to 'sink in'. Although T immediately contradicted this misconception Diane was unable to select evaporation to describe the way water leaves the land to float in clouds in the immediate posttest. A year later, however, she had changed her view and cited the hydrologic cycle chart as evidence to support her selection of evaporation. This was a rare case when the unit seemed to promote post-unit learning.

The other three misconceptions, which persisted in spite of more than 46 minutes of in-class opportunity to learn, included Diane's misconception about the process of boulder erosion in rivers, and Emily's misconceptions about introduced animals and sea erosion. These misconceptions have been discussed in Chapters 9, 10, and 11.

Thus misconceptions prevailed and either inhibited learning or inhibited long-term learning when: (a) cultural beliefs or myths proved stronger than competing facts or explanations, (b) the absence of concrete experience inhibited comprehension of the new facts and processes, and (c) inappropriate although apparently logical links were made between new content and prior knowledge. As discussed throughout the results chapters in relation to mislearning, new misconceptions arose during the course of the unit for all the pupils in T's class. That these misconceptions frequently arose in the course of individual interactions with T confirms Winne and Marx's (1982) observation that pupil misconceptions could be traced
to ineffective communication by the teacher. In this study it was apparent that T's communication was ineffective because the case study pupils perceived both the content per se and the task goals in confused ways. Cosgrove, Osborne, and Tasker (1983) pointed out that such misconceptions are not only widely prevalent in the 'knowledge' children bring to classroom science lessons but also resistant to change:

Both from our own work and the work of others we are beginning to more fully appreciate just how difficult it is to modify strongly held views.

(p.29)

Eaton, Anderson, and Smith (1984) also found that children's misconceptions inhibited learning in spite of four to six weeks of relevant science instruction. They concluded:

We believe the students had difficulty learning about light because neither their text nor their teachers adequately dealt with their misconceptions.

(p.371)

In the following section the data for content which was learned in spite of less opportunity to learn is examined. The prediction analysis showed misconceptions to be also prevalent in data describing pupil interaction with learned content. In the light of the views cited above, that pupil misconceptions are surprisingly resistant to change during classroom teaching, the following analysis provides critical information about the conditions which facilitated case study pupil learning.
12.4.3 Content Which was Learned In Spite of Less Opportunity to Learn

Items for which pupils spent less than 46 minutes of class time (the average time spent on items learned and forgotten) on relevant content but for which long-term learning occurred are exceptions to the opportunity to learn rule. These items were learned and remembered in spite of less class time spent on relevant content. Items which were learned and forgotten in spite of less than 15 minutes (the average time spent on items not learned) spent on relevant content are also exceptions to the opportunity to learn finding. An analysis of pupil behaviours which occurred at higher rates during the class time spent on the content of these items provides an insight into the optimal learning situations. Figure 110 shows that there are patterns of behaviour which were more prevalent during these 'optimal' learning situations during teacher-directed lessons.

It is apparent in Figure 110 that attending to chart opportunity was higher for content which was learned in spite of less time spent. Because the interviews revealed that items learned and remembered in spite of less than 15 minutes of class time spent were either partially known before the unit or associated with out-of-class opportunity to learn, it appears that the most effective learning conditions occurred for those items which were learned and remembered given between 15 and 46 minutes of class time. These items were associated with the highest rates of chart attending opportunity at 28.2 minutes per hour. Items which were learned and remembered given between 46 and 77 minutes of opportunity to learn were associated with the next highest rates of chart attending opportunity at 18.3 minutes per hour. The next highest rate of 15.8
Figure 110

Pupil Behaviours Which Occurred at Higher Rates for Sub-sets of Items than for all Items with the Same Learning Outcome During Teacher-Directed Lessons

<table>
<thead>
<tr>
<th>Item Outcomes</th>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
<th>Not Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of pupil behaviours per hour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean rates for items learned and remembered</td>
<td>Misconceptions</td>
<td>Misconceptions</td>
<td></td>
</tr>
<tr>
<td>77 mins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attending to Charts (18.3)</td>
<td>Misconceptions</td>
<td>Misconceptions</td>
<td></td>
</tr>
<tr>
<td>46 mins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attending to Charts (28.2)</td>
<td>Interactions with T (7.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books (27.3)</td>
<td>Attending to Charts (11.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T Talk (48.5)</td>
<td>Pictures (26.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer Int (22.2)</td>
<td>Chorus Response (4.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiddling (18.3)</td>
<td>T Talk (56.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 mins</td>
<td>BBoard (88.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attending to Talking Self (7.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactions with T (7.6)</td>
<td>Acting (1.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talking Self (6.3)</td>
<td>Peer Int (7.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiddling (22.9)</td>
<td>Chorus Response (5.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 mins</td>
<td>Non-Verb (7.4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note
Behaviours cited occurred at rates higher than 1.3 the overall rates for items within each learning outcome condition.
minutes per hour occurred for content which was learned in less than 15 minutes but forgotten later. And, again, for items which were learned and forgotten given between 15 minutes and 46 minutes of opportunity to learn, the rate of chart attending opportunity was high in relation to all the items learned and forgotten but lower than the rates for the more effective learning situations. This pattern was evident for all three case study pupils. Hence, the conflation of results in Figure 110. Thus the more effective the learning conditions (in relation to less time spent), the higher the rate of chart attending opportunity for all three pupils.

The main chart used by T (shown in Chapter 9 in Figure 31) was a picture-word chart in which the arrows demonstrated the relationships between the different forms of water in the hydrologic cycle. Holliday, Brunner and Donais (1984) found that picture-word charts (incidentally including a diagram of the hydrologic cycle) were more effective in promoting learning for beginning high school students with lower verbal ability than were block word diagrams. Given the younger age of the pupils in this study, and their correspondingly lower verbal ability, it may be that T was using the more effective type of diagram. The research findings on the relationship between instructional use of diagrams or charts and learner achievement have been consistently positive (Dwyer, 1978; Groper, 1970; Holliday, 1975; Holliday and Harvey, 1975; Spangenberg, 1971). However, as Alesandrini (1984) pointed out, this research is in its infancy and has been conducted almost exclusively with adult or high-school subjects. Nevertheless a relationship between use of instructional charts and learning or concept acquisition has been consistently demonstrated, and inferences have been made about the function of such charts in facilitating learning.
Holliday, Brunner, and Donais (1984) pointed out that, in comparison with verbal material:

...recent studies cited elsewhere suggest that a single-flow diagram allows the learner easier and more immediate access to all critical chains and the interrelationships among these chains. This form of instructional condensation into a single 'manageable' display, also provides the learner with a view of the total or 'big' picture at a glance. The idea that learners should be presented with the whole picture rather than the parts, whenever possible, had its historical beginnings in the old Gestalt theory of perception.

(p.137)

White (1977) argued that diagrams, like demonstrations and pictures, have two functions as instructional tools: (a) to help initial comprehension, and (b) to aid recall.

In this study it is interesting that, unlike pictures, charts facilitated long-term learning. Thus, it seems that they did facilitate pupil accessing of learned content. However, chart attending opportunity occurred at higher rates for content learned in less time. Diagrammatic representations of new content facilitated rapid processing of new content. That is, the representation of concepts linked into an overall view facilitates the kind of mental processing associated with learning. This evidence suggests that diagrammatic representations of this kind are closer to the form in which children process content than other pictorial or verbal media.
The occurrence of higher rates of blackboard attending opportunity and opportunity to listen to teacher-only talk in both effective learning categories and ineffective learning categories confirms the suggestion discussed in Chapter 9 that these opportunities were differentially associated with learning according to qualitative dimensions of particular instances.

There is a further unexpected pattern shown in Figure 110. Content for which there was less opportunity to learn, irrespective of learning outcome, was generally associated with higher rates of peer interaction, talking to self behaviour, and fiddling. This was true for all three pupils for the most effective learning conditions (content learned and remembered given between 15 minutes and 46 minutes of opportunity to learn); for two of the three for content learned and forgotten given less than 15 minutes of opportunity; and most characteristic of Gus for content which was not learned but for which less than 15 minutes was spent.

It seems that the case study pupils responded to new content in a characteristic manner. In Chapter 9 it was mentioned that when the observers did overhear talking to self events and peer interactions during teacher-directed lessons those instances seemed to involve efforts to process new content. Further, the association of the highest rates of fiddling with content learned and forgotten, and content mislearned, was postulated to be an observable concomitant of mental conflict experienced by the pupils when they attempted to accommodate to concepts for which they lacked prior experience, or concepts which directly contradicted their prior, appropriate views. This new evidence of the association of higher rates of all three behaviours with the presentation of new content, suggests that these observable but covert processing
behaviours comprise the observable signs of pupil attempts to accommodate to new content which, being unknown, causes cognitive conflict for the pupils. The association of lower rates of these behaviours with content to which the pupils had already been exposed, and subsequently learned, suggests that as the content became progressively integrated into the pupil's cognitive structures the cognitive conflict associated with that content diminished.

Again, the hypotheses generated are congruent with processes postulated by Piaget to be central to children's learning. Piaget argued that learning occurs as a resolution of cognitive conflict and that peer interaction is critical to children's learning because of its potential for creating cognitive conflict. The results of this study clearly support that hypothesis in relation to the function of peer interaction during group and individual tasks. Johnson (1981) characterized the function of cognitive conflict in relation to children's learning in five stages:

During a constructive controversy a student will move:

(1) from a conclusion based on current experiences and information,
(2) to having that conclusion challenged by another person,
(3) to experiencing a state of internal conceptual conflict or disequilibrium,
(4) to actively seeking more information, new experiences, or a more adequate cognitive perspective and reasoning process in hopes of resolving the uncertainty, and
(5) to reaching a new or reorganized conclusion that takes into account the reasoning and perspective of
Johnson's view that cognitive conflict is an initial stage of the learning process supports the interpretation of the data on fiddling, talking to self, and peer interaction, shown in Figure 110, that these behaviours occur at higher rates at the outset of the interaction with new content but diminish as more opportunity to resolve these conflicts occurs. Hewson and Hewson (1984) summarized Siegler's (1983) view which is entirely congruent with the process postulated in this study:

... learning is most efficient when children see inadequacies in their existing knowledge, but concludes that these 'disconfirming experiences' are not sufficient to complete the learning process. In other words the distinction between conflict production and resolution is an important one.

(p. 3)

In Figure 110 the conflated rates for the case study pupils are shown. However, the individual rates of fiddling, talking to self, and peer interaction for content which was not learned given less than 15 minutes of opportunity to learn, were different for the case study pupils. Gus had higher rates than either of the girls, but for all three pupils there were cases when no non-passive response to new content was observed. This information supports Osborne and Wittrock's (1982) view that attention to new information is selective and substantially influenced by prior knowledge. Because Gus had considerably more relevant prior knowledge than either of the girls it follows that he would have been more likely to have
perceived new content as a 'disconfirming experience'. Diane and Emily, in contrast, may not have been able to selectively attend to this new content because of the absence of any relevant schema in their long-term memories.

Figure III shows the higher rates of pupil behaviour during individual tasks and group tasks in relation to the more and less effective learning conditions. The key pattern evident in Figure III shows that virtually no opportunity to process content in group task contexts occurred for items which were forgotten or not learned, and that higher rates of diagram drawing and interactions with T occurred for items learned in spite of less class time. Higher rates of reading and writing occurred during individual tasks for items not learned. The fact that both reading and writing were sometimes facilitative of learning and at other times not so has been discussed in Chapter 10.

The association of task opportunity with content learned and remembered suggests that such opportunity compensated for time spent in facilitating learning. Further, it directly contributed to pupil remembering. Thus, taken together, Figures 110 and 111, provide a clear illustration of the interaction between time and different task opportunities in relation to short-term and long-term learning.

The particularly high rates of interaction with T during both individual and group task opportunity for content which seemed to be learned in the most effective learning conditions provides an indication of the real importance of such interactions (see Figure 111). Although, interactions with T were generally fairly evenly spread over the time spent, and some interactions appeared to directly facilitate mislearning, there was content which was learned and
Pupil Behaviours that Occurred at a Higher Rate for a Sub-set of Items than for all Items with the same Learning Outcome during Individual and Group Task Activity Time

<table>
<thead>
<tr>
<th>Item Outcomes</th>
<th>Learned and Remembered</th>
<th>Not Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 77 mins       |                        |            |
| I-Tasks       | Diagrams (26.9)        |            |
| Interactions  | with T (5.9)           |            |
|               | Misconceptions         |            |
|               |                        |            |

| 46 mins       |                        |            |
| I-Tasks       | Diagrams (36.9)        |            |
| Interactions  | with T (8.1)           |            |
| Group-Tasks   |                         |            |
| Interactions  | with T (27.8)          |            |
|               | Moving (22.2)          |            |
|               | GROUP-TASKS            |            |
|               | NO GROUP-TASKS         |            |
|               |                        |            |

| 0 mins        |                        |            |
| NO I-TASKS    | I-Tasks                |            |
|               | Reading (29.6)         |            |
|               | Writing (59.3)         |            |
| NO GROUP-TASKS| NO GROUP-TASKS        |            |
remembered in spite of less time spent, about which the case study pupils interacted with T at a rate of one interaction every two to eight minutes.

The association of higher rates of diagram drawing opportunity with content learned and remembered given less time spent suggests that not only the opportunity to attend to a chart, but also the opportunity to draw that chart, comprised highly facilitative conditions for learning. Thus, it is clear that diagrammatic representations were valuable both for their value in facilitating initial processing of new content and for their value in anchoring new content so that it was accessible one year later. Alesandrini (1984) reviewed the minimal research carried out to investigate the effects on achievement of learner-drawn pictures. He concluded that the research offers weak support for this strategy. However, the little research that has been carried out has used college student samples, and the pictures involved have not been comparable to the diagrammatic drawings in this study.

12.4.4 Pupil Memories in Relation to Time and Learning

Finally in Figure 112, it can be seen that the congruence between pupil perceptions of how they learned content and the quantitative data is remarkable. Memories for the actual demonstrations of concepts were cited for almost half the items learned and remembered given over 77 minutes of class time. This provides strong confirmatory evidence for the importance of the demonstrations claimed in Chapter 9. Charts and diagrams were the second most frequently mentioned facilitative variable in relation to content learned and remembered. The pupils clearly perceived charts, diagrams and demonstrations as resources they
could draw upon and use to access their knowledge of the relevant concepts and processes.

It can also be seen in Figure 112, that the case study pupils had strong memories for phrases from public teacher-pupil discussion and teacher talk - both in relation to appropriate responses and misconceptions. Often the case study pupils mentioned phrases which occurred in the lessons when the new content was first introduced. This evidence confirms the importance of teacher-pupil discussion, in particular, for facilitating pupil learning. Surprisingly, it also points to the importance of this initial exposure to new content in accessing that content subsequently. Although other evidence (for example, the importance of task opportunity shown in Figure 111) suggests that pupil task involvement was critical for anchoring material, and relevant public talk was not sufficiently facilitative if such anchoring opportunity did not occur, it seems that once it did occur the first mention in a class lesson was available to help accessing for some content. Given that the demonstrations and charts were also associated with public talk the importance of such talk may have been even greater. Thus, both verbal and visual resources were cited by the pupils in relation to content which they learned and remembered.

The congruence of the interview responses and the quantitative analyses points to the usefulness of triangulation as a technique to confirm the validity of results. Further, it suggests that researchers in the field of children's learning have underestimated the usefulness of pupil insights into their own learning. Peterson, Swing, Stark, and Waas (1984) stated that the results of their study of students' cognitions in relation to mathematics achievement suggested that:
Memories for Events which Occurred During the Conservation Unit cited by Case Study Pupils as a basis for their Item Responses

### Item Outcomes

<table>
<thead>
<tr>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentages Calculated out of All Items in each Category</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrations</td>
<td>45.0</td>
<td>Children stated beliefs but not memories 66.7</td>
</tr>
<tr>
<td>Group research task</td>
<td>15.0</td>
<td>Mime and public talk 100.0</td>
</tr>
<tr>
<td>Public talk</td>
<td>15.0</td>
<td>No memory 33.3</td>
</tr>
<tr>
<td>Picture</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>Article</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Other pupil's comment</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>77 mins</td>
<td>No memory 5.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart/Diagram</td>
<td>45.5</td>
<td>Public talk &amp; 'people say' 100.0</td>
</tr>
<tr>
<td>Public talk</td>
<td>36.4</td>
<td>Public talk 66.7</td>
</tr>
<tr>
<td>Writing (Ind. Task)</td>
<td>9.1</td>
<td>Chart (correct response a year later) 33.3</td>
</tr>
<tr>
<td>General knowledge</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>46 mins</td>
<td>No memory 9.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart/diagram</td>
<td>27.3</td>
<td>No memory 100.0</td>
</tr>
<tr>
<td>No memory</td>
<td>27.3</td>
<td>No memory or unsure 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>Public talk</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>15 mins</td>
<td>Book/mime 9.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Learned and Remembered</th>
<th>Learned and Forgotten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out-of-Unit</td>
<td>28.6</td>
<td>No memory 50.0</td>
</tr>
<tr>
<td>Out-of-Unit &amp; guess</td>
<td>14.3</td>
<td>Attempted logic 38.7</td>
</tr>
<tr>
<td>Uncertain</td>
<td>28.6</td>
<td>No notion 32.3</td>
</tr>
<tr>
<td>0 mins</td>
<td>Public talk</td>
<td>Misconception 16.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No data 9.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;People say&quot; 3.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guess 3.2</td>
</tr>
</tbody>
</table>
...students' reports of attention, understanding and cognitive processes were more valid indicators of classroom learning than observer's judgements of time on task.

(p.487)

It is clear that pupil perceptions can provide valuable data about a range of processes in relation to in-class learning opportunities.

12.5 ATTITUDINAL ITEMS: EXCEPTIONS TO THE OPPORTUNITY TO LEARN PATTERN

As Peterson (1979) has argued we should not develop implications from the findings about the effectiveness of variables which facilitate one kind of learning without due regard for other desirable or possible outcomes from instruction. Aristotle made the point:

...we are inquiring not in order to know what virtue is, but in order to become good, since otherwise our inquiry would have been no use..

(Aristotle: Nicomachean Ethics. McKeon, 2, p 1104)

Because the topic studied by T's class was conservation, Aristotle's contention is particularly apposite. T stated at the outset of the unit that he intended to make the children more concerned about issues of conservation, pollution and endangered animals.
It was apparent that in spite of the fact that quantitatively over two thirds of unit time involved attempts by T to bring about attitudinal changes in the pupils (such as more concern about the pollution of the environment, the erosion of the earth, and the plight of endangered animals) the case study pupils' attitudes changed very slightly. The evidence from the interviews and test responses indicates that surprisingly some case study pupil attitudes may have actually deteriorated as a result of the unit.

Gus indicated in a pretest response that he would be concerned if elephants became extinct because of the work they do. After the unit he selected: 'no strong feeling' in response to a relevant test item. A year later he said that he would not be concerned about the possible extinction of elephants. Emily responded to the same item both before and after the unit with the viewpoint that it would be of concern if elephants died out because they are useful in Africa for carrying wood. Diane was the only pupil in T's class who expressed a more concerned view in the immediate posttest than in the pretest. No pupil in T's class, or in the other two classes in the open plan block, showed a long-term positive attitudinal change of more concern for endangered animals (as measured by the test item).

Neither Gus nor Diane showed increased concern about pollution in their posttests. However, Emily reported that although she had never thought about pollution before the Conservation Unit she had become a little worried about it since.

Another pupil in T's class explained that he had not become more concerned about these issues:
...because there's nothing I 
can do about it...

The minimal attitudinal change evident in the case study pupils' responses was representative of class views. This pattern contrasts with the results for knowledge acquisition which were more congruent with T's stated unit aims (see Appendix D). It seems that the considerable time spent by T discussing these issues with the class, and the group and individual tasks designed to foster concern (for example, the planning of an animal reserve) did not lead to intended outcomes. However, because of the non-interventionist methodology it was difficult to obtain critical information about the children's attitudes during the unit. Furthermore, the few test items used to measure attitudinal change provide insufficient evidence. The hypothesis that the Conservation Unit may have fostered a 'learned helplessness' in the children with respect to these issues is discussed in Alton-Lee and Haberfield (1982). It is apparent that attitudinal changes were not related to opportunity to interact with 'content' in the same way as knowledge outcomes.

Although T intended that the Conservation Unit would facilitate expressive language development this study does not include an analysis of pupil gains in this area. There may have been pupil behaviour patterns associated with spelling and writing achievement which were not facilitative of knowledge acquisition.

In summary, although the scope of this study was comprehensive in relation to T's programme, the focus was primarily on knowledge acquisition. The little evidence available about pupil attitudinal changes, in this study, suggests that conditions which facilitated knowledge acquisition did not necessarily facilitate intended attitudinal changes. It is possible that conditions which effectively promoted knowledge acquisition led to
unintended attitudinal changes. That such an effect is even possible reaffirms the necessity for illumination of the teaching-learning process in classrooms rather than for prescriptions for practice.
CHAPTER 13

SUMMARY OF RESULTS

13.1 OVERVIEW

In the first part of this chapter, piegraphs are used to provide a descriptive summary of the data presented in the previous four chapters. In the second part of this chapter a summary is provided of those variables which were either consistently facilitative of, or consistently inhibitive of, pupil learning.

13.2 TIME SPENT

The strongest relationship between any one variable and pupil learning was the relationship between time spent and learning. This relationship, which was consistent across the three random data sets for all three pupils, is summarized in Figures 113 to 117. The radii of the sets of piegraphs in this chapter have been scaled in proportion to the mean time spent in order to visually illustrate the confounding effect of time on all other variables in relation to learning. Figures 113 to 117, representing the mean time spent in different task contexts for the five learning conditions, have been scaled in relation to the most time spent for any condition (76:1 for the average of 76.1 minutes spent on content learned and remembered). Figures 118 to 124, showing the mean time spent in different task contexts, in relation to learning outcomes, for each of the case study
Figure 113

Mean Time Spent in Different Task Contexts
On Known Content

- **Value-Minutes**
- **%**

Scale = 76:1

- **Teacher-Directed Tasks**
  - 19.1
  - 44.5%

- **Group Tasks**
  - 6.3
  - 14.6%

- **Individual Tasks**
  - 17.5
  - 40.7%
Figure 114

Mean Time Spent in Different Task Contexts on Content Learned and Remembered

Value-Minutes

\[ \text{Scale} = 76:1 \]

- Individual Tasks
  - 37.5
  - 49.2%

- Group Tasks
  - 9.6
  - 12.6%

- Teacher-Directed Lessons
  - 29.0
  - 38.1%
Mean Time Spent in Different Task Contexts
On Content learned and Forgotten

- Teacher-Directed Lessons
  23.0
  50.7%

- Individual Tasks
  15.4
  34.0%

- Group Tasks
  6.9
  15.2%

Scale = 76:1
Figure 116

Mean Time Spent in Different Task Contexts
On Content Not Learned

Teacher-Directed Lessons
8.8
61.9%

Group Tasks
1.2
8.4%

Individual Tasks
4.2
29.5%

--- Value-Minutes
--- %

Scale = 76:1
Figure 117

Mean Time Spent in Different Task Contexts On Mislearned Content

- Value-Minutes
  - %

Scale = 76:1

Teacher-Directed Lessons
12.6
47.1%

Individual Tasks
8.1
30.3%

Group Tasks
6.0
22.4%
pupils, have been scaled in relation to the most time spent by any one pupil (89:1 for the average of 89.4 minutes spent by Gus on content he learned and remembered). Figures 124 to 153, showing how time was spent in the different task contexts in relation to learning outcomes, have been scaled in relation to the most time spent by any one pupil (44:1 for the average of 44.2 minutes spent by Gus in individual tasks for content he learned and remembered).

As can be seen in Figures 113 to 117 the most time on average, was spent on content which was learned and remembered and the least time on average, was spent on content which was not learned. The representation of the average time spent on content learned and forgotten is misleading. Although lack of opportunity to anchor new learning appeared to be a primary explanation for the failure to remember, the inhibiting effects of pupil misconceptions and lack of prior concrete experience provided further explanations for this outcome. There were items for which little time was spent and there were items for which over 77 minutes of time was spent, in the learned and forgotten category.

Although the average time spent on known content was similar to the average time spent on content learned and forgotten (see Figures 113 and 115), the total time spent on known content was greater because about a third of the tested content was known by the case study pupils. The average time spent on mislearned content differed considerably between the case study pupils.

Most (63.3%) tested content learned and remembered took up more than three quarters of an hour of class time, and most (75.6%) of the tested content which was not learned took up less than 15 minutes of class time. Not only the length of time but also the spread of time across different episodes was shown to be related to learning.
Figure 118

Mean Time Spent in Different Task Contexts by Gus
On Content Which He Learned and Remembered

<table>
<thead>
<tr>
<th>Task Type</th>
<th>Mean Time</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Task Time</td>
<td>11.2</td>
<td>12.5%</td>
</tr>
<tr>
<td>Teacher-Directed Time</td>
<td>34.0</td>
<td>38.0%</td>
</tr>
<tr>
<td>Individual Task Time</td>
<td>44.2</td>
<td>49.4%</td>
</tr>
</tbody>
</table>

Scale = 89:1
Figure 119

Mean Time Spent in Different Task Contexts by Diane
On Content She Learned and Remembered

Teacher-Directed Lessons
30.6
37.5%

Group Tasks
9.1
11.1%

Individual Tasks
41.9
51.3%

Value=Minutes

% Scale=89:1
Figure 120

Mean Time Spent in Different Task Contexts by Emily On Content She Learned and Remembered

Teacher-Directed Lessons
24.1
38.6%

Group Tasks
8.8
14.1%

Individual Tasks
29.4
47.1%

Scale=89:1
Figure 121

Mean Time Spent in Different Task Contexts
On Content Not Learned: Gus

Teacher-Directed Lessons
4.6
85.1%

Group Tasks
0.0
0.0%

Individual Tasks
0.8
14.8%

Scale = 89:1
Figure 122

Mean Time Spent in Different Task Contexts
On Content Not Learned: Diane

Teacher-Directed Lessons
10.5
55.5%

Group Tasks
1.2
6.3%

Individual Tasks
7.2
38.1%

Value-Minutes

% Scale=89:1
Mean Time Spent in Different Task Contexts
On Content Not Learned: Emily

- Value-Minutes
- %

Scale = 89:1

Teacher-Directed Tasks
9.1
66.4%

Group Tasks
2.2
16.0%

Individual Tasks
2.4
17.5%
A summary of individual case study pupil time spent for items learned and remembered and items not learned is shown in Figures 118 to 123. It is apparent in Figures 118 to 120, that Gus had more opportunity to interact with content which he learned and remembered, than either Diane or Emily. In Figures 121 to 123, it can be seen that Gus spent much less time (only 5.4 minutes per item) on content which he did not learn than either Diane or Emily. Diane spent considerable time (about 20 minutes per item) on content which she failed to learn.

In Chapter 12 it was shown that content with which there was less opportunity to interact was associated with high rates of informal pupil interactions, fiddling, and talking to self, irrespective of learning outcomes. This pattern shows that the case study pupils initially responded to most unknown content in a characteristic manner. As more time was spent on this content, talking to self, peer interaction and fiddling rates diminished. It was suggested that this behaviour reflected changes in pupil mental processing as more time was spent and learning occurred.

It was apparent from the interview data that the case study pupils had out-of-class opportunities to learn tested content. Thus, the time spent in class was confounded by pupil access to these out-of-class opportunities.

13.3 LEARNING CONTEXTS

Opportunity to learn in both teacher-directed lessons and task contexts was shown to be related to long-term learning. However, this relationship varied between case study pupils according to the reported differences in their access to learning opportunities outside the
classroom.

The contrast between the proportion of time spent in different learning contexts for content with different learning outcomes is also shown in Figures 113 to 123.

There was proportionately more individual task opportunity to interact with content which was learned and remembered but proportionately more teacher-directed opportunity to interact with content which was not learned (see Figures 118 to 123). There was also proportionately more teacher-directed opportunity to interact with content which was mislearned and learned and forgotten (see Figures 115 and 117).

There was an interaction between opportunity to learn content in different task contexts and time spent (see Figures 113 to 117). The more time spent, the more likely that the pupils would have experienced individual or group task opportunity. Most content for which there was little time spent, occurred only in teacher-directed lessons.

13.4 CONCRETE EXPERIENCE

Pupil concrete experience seemed to be a pre-requisite for long-term learning for all three case study pupils in this study but there was less content for which Gus did not have relevant concrete experience. Lack of concrete experience counteracted the effect of time spent.
Lack of opportunity to learn and lack of prior experience were two key variables which inhibited pupil learning. A third inhibiting variable, related to lack of prior experience, was the presence of pupil misconceptions about tested content. These misconceptions were resistant to change and difficult to diagnose. They inhibited pupil learning in two ways. In the first kind of instance, pupil misconceptions were temporarily displaced and short-term learning occurred. However, these misconceptions seemed to be proactive and one year after the short-term learning had occurred, such misconceptions were found to reappear in pupil interview responses. In the second kind of instance, pupil misconceptions were strong enough to inhibit any learning; even when the time spent on tested content was comparable with time spent on other content which was learned and remembered.

It was apparent that many misconceptions held by the case study pupils were shared by other pupils in T's class. Misconceptions appeared to have arisen in three ways: (a) they appeared to be logical but inappropriate propositions developed by the children in the absence of adequate experience or information, (b) they were associated with cultural experiences and folklore which appeared to have a proactive or even suppressant effect on new learning, or (c) they arose from mis-interpretations of teacher utterances or actions. The analysis of pupil opportunity to interact with content which was mislearned provided more insight into the development of pupil misconceptions. This data is summarized in section 13.10.
13.6 PATTERNS OF RESOURCE USAGE AND PUPIL BEHAVIOURS DURING TEACHER-DIRECTED LESSONS

Because the time spent variable was so critical in relation to pupil learning it is important to understand how time was spent on content which was learned. In order to highlight the most optimal and least optimal learning conditions the summaries presented contrast the patterns of opportunities and behaviours which occurred during the time spent on content which was learned and remembered with those which occurred during the time spent on content which was not learned.

Relatively more teacher-pupil discussion and less teacher-only talk was associated with content learned and remembered.

The pattern of visual resource attending opportunity is shown in relation to time spent on content which was learned and remembered, and time spent on content which was not learned in Figures 124 to 129. Amounts are shown both as mean minutes of time spent per items and as percentages of time spent in relation to other resource usage. The blackboard and books were frequently used resources irrespective of learning outcome. Demonstrations were a significant resource only during time spent on learned content.

Patterns of pupil behaviour which occurred during teacher-directed time are summarized in Figures 130 to 135. The five most prevalent behaviours for each pupil have been calculated as a proportion of the total of observed behavioural events. Because Gus was twice as active as either Diane or Emily, it is important to realize that similar proportions between the case study pupils reflect different actual frequencies (which are shown in Chapter 9). Thus, these piegraphs provide a
Visual Attending Opportunity During T-D Time
Spent on Content Learned and Remembered: Gus

- Blackboard 17.9 53.1%
- Books 5.3 15.7%
- Demonstrations 2.9 8.6%
- Other 4.3 12.7%
- Pictures 3.3 9.7%

Scale = 44:1

Figure 124
Figure 125

Mean Opportunity to Attend to Visual Resources During T–D Time Spent on Content Learned and Remembered: Diane

- Value-Minutes
- %

Scale = 44:1

- Blackboard
  - 13.5
  - 44.1%
- Demonstrations
  - 4.5
  - 14.7%
- Books
  - 3.8
  - 12.4%
- Charts
  - 2.8
  - 9.1%
- Other
  - 3.3
  - 10.7%
- Pictures
  - 2.7
  - 8.8%
Figure 126

Mean Opportunity to Attend to Visual Resources During T–D Time Spent on Content Learned and Remembered: Emily

<table>
<thead>
<tr>
<th>Visual Resource</th>
<th>Value-Minutes</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackboard</td>
<td>11.3</td>
<td>46.8%</td>
</tr>
<tr>
<td>Books</td>
<td>3.7</td>
<td>15.3%</td>
</tr>
<tr>
<td>Demonstrations</td>
<td>8.7%</td>
<td></td>
</tr>
<tr>
<td>Pictures</td>
<td>7.4%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>15.3%</td>
<td></td>
</tr>
<tr>
<td>Absence of Visual Resource</td>
<td>6.2%</td>
<td></td>
</tr>
</tbody>
</table>

Scale = 44:1
Figure 127

Mean Opportunity to Attend to Visual Resources During T–D Time Spent on Content Not Learned: Gus

Scale = 44:1
Figure 128

Mean Opportunity to Attend to Visual Resources During T–D Time Spent on Content Not Learned: Diane

--- Value-Minutes
--- %

Scale=44:1

- Blackboard 5.8 55.2%
- Books 1.4 13.3%
- Charts 1.1 10.4%
- Other 0.8 7.6%
- Pictures 0.7 6.6%
- Absence of Visual Resource 0.7 6.6%
Figure 129

Mean Opportunity to Attend to Visual Resources During T–D Time Spent on Content Not Learned: Emily
Figure 130

Behaviour During Teacher-Directed Time Spent On Content Learned and Remembered: Gus

- Peer Verbal Interactions 27.9%
- Interactions with T 18.2%
- Hand Raises 14.1%
- Talking to Self 14.0%
- Fiddling 13.8%
- Other 12.0%
Figure 131

Behaviour During Teacher-Directed Time Spent on Content Learned and Remembered: Diane

Peer Verbal 18.5%
Hand Raises 15.6%
Interactions with T 8.3%
Non-Verbal Peer Interactions 8.3%
Fiddling 32.8%
Other 16.5%

Scale = 44:1
Figure 132

Behaviour During T-D Time Spent on Content
Learned and Remembered: Emily

- Non-Verbal Peer: 8.3%
- Hand Raises: 22.9%
- Verbal Peer Interactions: 12.4%
- Individual Interactions with T: 12.1%
- Fiddling: 28.6%
- Other: 15.4%

Scale = 44:1
Figure 133

Behaviour During T–D Time Spent on Content
Not Learned: Gus

Scale = 44:1

- Fiddling 26.4%
- Talking to Self 9.2%
- Peer Verbal 33.3%
- Other 15.0%
- Hand Raises 6.9%
- Non-Verbal Peer Interaction 9.2%
Figure 134

Behaviour During T–D Time Spent on Content
Not Learned: Diane

- Peer Verbal: 14.5%
- Hand Raises: 13.3%
- Non-Verbal Peer Interaction: 10.8%
- Interactions with T: 10.2%
- Fiddling: 25.9%
- Other: 25.3%

Scale = 44:1
Figure 135

Behaviours During T—D Time Spent on Content
Not Learned: Emily

Scale=44:1

- Hand Raises: 26.8%
- Interactions with T: 12.7%
- Fiddling: 38.0%
- Peer Verbal: 9.9%
- Other: 4.1%
- Non-Verbal Interactions with Peers: 8.5%
perspective on individual patterns of behaviour. For Gus, peer verbal interactions, and for Diane and Emily, fiddling, took up the highest proportion of observed behaviours during time spent in teacher-directed lessons on content which was learned and remembered (see Figures 130 to 132). Diane engaged in a relatively smaller proportion of overt participation in lessons than either Gus or Emily.

The lesser time spent on content which was not learned was more critical than the pattern of behaviours (see Figures 133 to 135). However, Gus and Diane did engage in proportionately fewer interactions with T and hand raises during this time. Emily's pattern was similar between conditions except for the 10.7% increase in the proportion of fiddling which was apparent during the lesser time spent on content which was not learned.

13.7 PATTERNS OF PUPIL BEHAVIOUR DURING INDIVIDUAL TASK TIME SPENT ON CONTENT WHICH WAS LEARNED AND REMEMBERED

Peer interaction and writing comprised about 60% of the observed pupil behaviours which occurred during the individual task time spent on content which was learned and remembered (see Figures 136 to 138). Diane engaged in proportionately less peer interaction than Gus or Emily. The other prevalent behaviours were reading, diagram drawing, rubbing out - and for Gus, moving. Figures 139 to 141 show the importance of less time spent rather than behavioural patterns, in relation to learning. However, it is apparent that proportionately fewer rubbing out behaviours occurred during time spent on content which was not learned. Also reading and writing behaviours took up proportionately more of the time spent on this content.
Figure 136

Behaviour During Individual Task Time Spent On Content Learned and Remembered: Gus

Scale = 44:1

Peer Interaction 39.9%
Writing 23.4%
Other 14.1%
Moving 6.5%
Rubbing Out 7.3%
Diagrams 8.7%
Figure 137

Behaviour During Individual Task Time Spent On Content Learned and Remembered: Diane
Figure 138

Behaviour During Individual Task Time Spent On Content Learned and Remembered: Emily

Scale = 44:1
Figure 139

Behaviour During Individual Task Time Spent On Content Not Learned: Gus

Scale = 44:1

- Peer Interaction: 43.4%
- Reading: 17.3%
- Writing: 26.0%
- Other: 13.1%
Figure 140

Behaviour During Individual Task Time Spent On Content Not Learned: Diane

Scale = 44:1

Writing 25.4%
Diagrams 11.2%
Moving 11.0%
Rubbing Out 6.6%
Peer Interaction 31.1%
Other 14.7%
Figure 141

Behaviour During Individual Task Time Spent On Content Not Learned: Emily

Peer Interaction 31.3%

Writing 31.3%

Reading 13.8%

Other 9.8%

Organization 5.0%

Moving 8.8%

Scale = 44:1
Figure 14.2

Behaviour During Group Task Time Spent on Content Learned and Remembered: Gus

Scale = 44:1

- Peer Interaction: 40.8%
- Writing: 19.6%
- Artwork: 11.7%
- Moving: 10.8%
- Other: 9.4%
- Waiting: 7.7%
Figure 143

Behaviour During Group Task Time Spent On Content Learned and Remembered: Diane

Scale = 44:1

- Peer Interactions 40.2%
- Artwork 19.1%
- Other 32.4%
- Writing 8.0%
Figure 144

Behaviour During Group Task Time Spent On Content Learned and Remembered: Emily

Scale = 44:1

Peer Interaction 44.6%

Writing 13.3%

Reading 13.3%

Artwork 8.1%

Other 12.8%

Organization 7.9%
Behaviour During Group Task Time Spent on Content
Not Learned: Diane

Scale = 44:1
Figure 146

Behaviour During Group Task Time Spent
On Content Not Learned: Emily

Scale = 44:1

Peer Interaction 40.8%

Writing 22.5%

Other 6.5%

Reading 30.0%
13.8 PATTERNS OF PUPIL BEHAVIOUR DURING GROUP TASK TIME SPENT ON CONTENT LEARNED AND REMEMBERED

The lesser average time spent on tested content during group task time is reflected in the size of the piegraphs shown in Figures 142 to 146. Group tasks involved 37.0% of tested content learned and remembered.

The pattern of behaviour during group tasks contains a higher proportion of artwork, and lesser proportions of rubbing out and diagram drawing behaviours than behaviour during individual task time. Diane's peer interactions were twice as frequent as they were during individual tasks.

Gus spent no time in group tasks on content which he failed to learn. Diane and Emily spent time in group tasks for only one or two items which they failed to learn. However, the representations shown in Figures 145 and 146, appropriately reflect the lesser overall opportunity to interact with content which was not learned, in group tasks.

13.9 PATTERNS OF PUPIL BEHAVIOUR DURING TIME SPENT ON MISLEARNED CONTENT

Gus mislearned one item for which there was only one minute of teacher-directed opportunity to interact with this content. However, Diane and Emily mislearned a substantial number of items (17). The patterns of behaviour associated with Diane's and Emily's mislearning are shown in Figures 147 to 152.
Figure 147

Behaviour During Teacher-Directed Time Spent On Content Mislearned

Scale = 44:1

- Fiddling: 36.6%
- Hand Raises: 19.6%
- Other: 10.8%
- Peer Verbal: 12.5%
- Non-Verbal Peer Interactions: 7.1%
- Interactions with T: 13.4%
Behaviour During Teacher-Directed Time Spent On Content Mislearned: Emily

Scale = 44:1

- Informal Mime 9.8%
- Interactions with T 9.8%
- Hand Raises 12.2%
- Fiddling 40.2%
- Verbal Peer 14.6%
- Non-Verbal Peer Interaction 13.4%
Figure 149

Behaviour During Individual Task Time Spent On Content Mislearned: Diane

$	ext{Scale} = 44:1$

- Peer Interaction: 20.5%
- Artwork: 18.7%
- Writing: 16.4%
- Moving: 15.3%
- Organization: 7.8%
- Other: 21.3%
Figure 150

Behaviour During Individual Task Time Spent On Content Mislearned: Emily

Scale = 44:1

- Peer Verbal: 39.5%
- Writing: 26.2%
- Other: 11.9%
- Diagrams: 7.9%
- Interactions with T: 10.1%
- Reading: 4.4%
Figure 151

Behaviour During Group Task Time Spent On Content Mislearned: Diane

Scale = 44:1

Peer Interactions 58.3%

Artwork 20.0%

Other 11.3%

Individual Interactions with T 10.2%
Figure 152

Behaviour During Group Task Time Spent on Content Mislearned: Emily

Scale=44:1

- Peer Interactions: 44.4%
- Artwork: 22.2%
- Other: 16.6%
- Organizational: 16.6%
As can be seen by comparing Figures 147 to 152 with Figures 134, 135, 137, 138, 143, and 144, behavioural patterns during the time spent on mislearned content were similar for those during the time spent on content learned and remembered. This indicated that, in spite of the inappropriateness of the pupils' changed views, a similar kind of learning process was occurring for both mislearned and learned content.

Differences that were apparent in pupil behaviour patterns for mislearned content were: (a) higher rates of interactions with T, (b) higher rates of fiddling, and (c) higher rates of peer interaction during teacher-directed lessons (see Figures 147 - 152).

13.10 QUALITATIVE EXCEPTIONS

Before reviewing those behaviours which were related to pupil learning outcomes in relatively stable ways it is important to recognize that the instability of the relationships of many variables to learning is a critical finding of the study.

Many pupil behaviours in this study were found to be positively related to learning in some instances but negatively related to learning in other instances. In most cases the change in the direction of the relationship could be explained by a change in the time spent on the content. However, variation in time did not always explain this variability. There were important contextual and qualitative variables affecting pupil learning. In some further instances, it appeared that an interaction between variables (other than time) changed the relationship between those individual variables and pupil learning outcomes. During teacher-directed lessons, for example, high rates of teacher talk were generally
associated with failure to learn. However, as was shown in Chapter 12, high rates of 'high quality' teacher talk were related to learning which occurred in spite of less time spent. Teacher talk which involved linking new concepts to pupil experience, or detailed explanations of conceptual links between different elements in a resource chart, seemed to be very effective in facilitating pupil learning.

It was apparent that some behaviours were inconsistent in their relation to pupil learning when they occurred in different task contexts. For example, Diane's rubbing out behaviour was negatively related to her learning when it occurred in a group context, but was positively related to her learning when it occurred in an individual context. Such behaviours may have served different functions in different task contexts.

Some behaviours were differentially related to learning within the same task context. In certain cases there appeared to be a content effect rather than a context effect. Engagement in artwork was a behaviour which was both negatively and positively related to pupil learning within the same task contexts. Lack of pupil concrete experience seemed to be an important variable which explained these differences. Behaviours such as writing, diagram drawing, and engagement in artwork were more consistently facilitative of pupil learning when the pupils had relevant concrete experience.

Systematic differences between pupils in their perceptions of task goals, and their attitudes towards the production and presentation of task products, were found to provide further explanations for the instability of the relationships between behaviours such as diagram drawing and writing and pupil learning.
However, there were other variables which were relatively stable in relation to learning outcomes. Given the perspective of instability, those variables which consistently occurred at higher rates during the time spent on learned content can be considered to be particularly facilitative of, or reliable indicators of, learning. Variables which were either consistently facilitative of, or consistently inhibitive of learning provide insight into the nature of the learning process. Thus in the second part of this summary, variables which showed relatively stable relationships with case study pupil learning are summarized in order to provide a link with the theoretical explanations argued in Chapter 14.

13.11 SUMMARY OF FACILITATIVE OPPORTUNITIES AND BEHAVIOURS IN RELATION TO PUPIL LEARNING

Table 38 provides an overview of the number of opportunities/behaviours which were facilitative of learning in both amount and rate. There were 12 variables which were facilitative of learning for all three case study pupils. There were 25 further variables which were facilitative of learning for one or two of the case study pupils.

Gus had the highest total number of facilitative variables (29), indicating that a wider range of opportunities/behaviours was facilitative for Gus, than Emily, and a wider range of facilitative opportunities/behaviours was facilitative for Emily than Diane. This pattern is congruent with case study pupil ranking in relation to unit learning outcomes.

A summary of behaviours and opportunities which were positively related to long-term learning for all three pupils is shown in Table 39. Only one variable (excluding
Table 38

**Total Number of Opportunities/Behaviours Which were Facilitative of Learning in Both Amount and Rate (Calculated Across 75 Items)**

<table>
<thead>
<tr>
<th>No. of Pupils with same result pattern</th>
<th>Pupil</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gus</td>
<td>Diane</td>
<td>Emily</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29</strong></td>
<td><strong>19</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

(time) was positively and consistently related to pupil learning for all three pupils across the three random data sets: opportunity to attend to a demonstration. This variable was highly facilitative of learning and the most stable variable identified in this study in its relationship to pupil learning. Opportunity to attend to teacher-pupil discussion was the next most consistently facilitative variable in relation to pupil learning. Because of the considerable proportion of time (63.1% of teacher-directed time spent on content learned and remembered) taken up by teacher-pupil discussion this variable is one of the most substantially facilitative of
Table 39

Opportunities and Behaviours Which Were Positively Related to Pupil Long-term Learning in Both Amount and Rate for all Three Case Study Pupils.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Proportion of total events or time spent in relevant task context</th>
<th>Consistency in relation to learning</th>
<th>Amount</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total=3</td>
<td>Total=3</td>
</tr>
<tr>
<td>Demonstration attending</td>
<td>10.3%</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>opportunity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher-pupil discussion</td>
<td>63.1%</td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>attending opportunity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubbing out (Ind)</td>
<td>7.9%</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Organization (Group)</td>
<td>4.6%</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Spontaneous reading aloud</td>
<td>1.1%</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>(Ind)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting [opportunity to</td>
<td>5.3%</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>attend to peer activity]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Group)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving (Group)</td>
<td>7.3%</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
pupil long-term learning. Waiting, before and after making an overt contribution to group tasks, was also positively related to learning for all three pupils. Thus, it appears that opportunity to attend to peer activity was generally facilitative of learning. Three of the other variables which were positively related to long-term learning for the three pupils (rubbing out during individual tasks, organization during group tasks, and spontaneous reading aloud during individual tasks) have all been argued to have an association with overt or covert cognitive conflict and cognitive restructuring. Spontaneous reading aloud during group tasks was also related to long-term pupil learning for all three pupils, however, because it occurred so rarely (0.2% of behavioural events during group task time spent on content learned and remembered) this behaviour has not been included in Table 39. The last variable shown in Table 39, moving during group tasks, was not consistently related to learning across data sets although it was positively related to learning for all three pupils. Thus pupil-initiated movement to resources was facilitative of learning, but pupil movement could also show a negative relation with learning in some instances. For example, when reading did not facilitate Emily's learning, movement to fetch the book was not facilitative.

At least half of the variables most unequivocally facilitative of learning for all three pupils are often classified as off-task: moving, organizing, waiting, and possibly rubbing out.

Table 40 includes a list of those variables which were positively related to short-term learning but not long-term learning in both rate and amount for all three pupils. The association of high rates of picture attending opportunity and mime with short-term learning suggests that these variables were facilitative of learning but not remembering because of the lack of
Table 40

Opportunities and Behaviours Which Were Positively Related to Pupil Short-term Learning in Both Amount and Rate for all Three Case Study Pupils

<table>
<thead>
<tr>
<th>Variable</th>
<th>Proportion of total events or time spent</th>
<th>Consistency in relevant task</th>
<th>Amount</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture attending</td>
<td>16.4%</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>opportunity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-verbal communication</td>
<td>7.0%</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>with peers (T-D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal mime (T-D)</td>
<td>5.4%</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Informal mime (T-D)</td>
<td>4.8%</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

associated concrete experience. As discussed in Chapter 9, the association of non-verbal communication between peers with short-term learning suggests that instances such as peer joke sharing may have contributed to the pupils relating new information to relevant prior knowledge.
Just over one half (55.5%) of the facilitative variables summarized in Tables 39 and 40 occurred during teacher-directed lessons, and just under one half occurred in task contexts.

The variables which were facilitative of learning in amount and rate, for only two of the case study pupils were: hand raises during teacher-directed lessons, peer interactions during teacher-directed lessons, interactions with T chart attending opportunity during teacher-directed lessons, diagram drawing during individual and group tasks, and writing, artwork, reading and rub-outs during group tasks.

13.12 SUMMARY OF OPPORTUNITIES/BEHAVIOURS WHICH WERE INHIBITIVE (OR ASSOCIATED WITH) FAILURE TO LEARN

Table 41 provides an overall view of the number of variables which were associated with pupil failure to learn, when they occurred at higher rates. Unlike the pattern of facilitative variables, the pattern of inhibitive variables shows only one variable was inhibitive of pupil learning for all three pupils. This was high rates of teacher-only talk during teacher-directed lessons. The analysis shown in Chapter 12, indicates that teacher talk is an 'unstable' variable because apparently effective teacher talk occurred at high rates for some items. The nine variables inhibitive of learning for two of the case study pupils were: absence of visual resources during teacher-directed lessons, high rates of blackboard attending opportunity, high rates of chorus responses, high rates of peer interactions (during both individual tasks and group tasks), and high rates of reading, moving, waiting and writing during individual tasks.
Table 41

Total Number of Opportunities/Behaviours Which were Inhibitive of Learning or Associated with Failure to Learn When They Occurred at Higher Rates

<table>
<thead>
<tr>
<th>No. of pupils with same result pattern</th>
<th>Pupil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gus</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

There were five variables which were negatively related to learning in both amount and rate. These variables were most strongly inhibitive of pupil concept learning and appeared to contribute nothing at all to this end. Rather they comprised wasted unit time (see Table 42). As can be seen in Table 42, no variable was negatively related to Gus's learning in both amount and rate, and only one variable was negatively related to Emily's learning in both amount and rate. This was Emily's reading during group tasks which chiefly concerned her library research in relation to introduced animals. Her prior
Table 42

Opportunities and Behaviours Which Were Negatively Related to Learning in Both Amount and Rate

<table>
<thead>
<tr>
<th>Behaviour (Consistency)</th>
<th>Pupil</th>
<th>Gus</th>
<th>Diane</th>
<th>Emily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting during individual tasks</td>
<td>-</td>
<td>-ve</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absence of visual resource</td>
<td>-</td>
<td>-ve</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagram drawing in group tasks</td>
<td>-</td>
<td>-ve</td>
<td>-</td>
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<td>Rubbing out in group tasks</td>
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<td>Reading during group tasks</td>
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<tr>
<td>Total for Pupils</td>
<td>0</td>
<td>4</td>
<td>1</td>
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misconception about introduced animals, and possibly the inappropriateness of the material in relation to this concept, rendered this behaviour fruitless. The high rate of 44.7 events per hour indicates that she spent close to three quarters of the time on this content (during group tasks) reading. When Emily read at an overall rate of 11.1 events per hour her reading was not inhibitive of learning.
There were four variables which were negatively related, in both amount and rate, to Diane's learning (see Table 41). Diane's waiting for T during individual tasks was wasted time both because she did nothing during this time (in contrast with Gus who exploited this opportunity), and because she did not appear to directly benefit from her interactions with T which followed the waiting. The negative relationship between absence of visual resources and learning is not surprising. Diane's difficulties with diagrams have already been discussed at length. These difficulties were strongly inhibitive of her learning. This inhibitive effect points to the critical mediating factor of pupil perceptions of task requirements - Diane experienced conflict about diagrams because she strived for 'neat' pictures without 'messy bits'. The strong negative relationship between Diane's rubbing out behaviour during group tasks and her learning contrasts with the result for individual tasks. This points to a conclusion that rubbing out for Diane served different functions in different contexts and is congruent with the observations regarding Diane's problems in working within a group situation.

13.13 PUPIL SIMILARITIES IN RELATION TO LEARNING PATTERNS

First, concrete experience was critical to all three pupils as a pre-requisite for long-term learning irrespective of differential achievement patterns. Gus and Emily had considerably wider repertoires of relevant concrete experience.

Second, opportunity to learn was important to all three pupils. However, because Gus and Emily had considerable out-of-class access to further opportunity to learn, they were less dependent than Diane upon in-class opportunity to learn.
Third, facilitative attending opportunities during teacher-directed lessons were generally the same for all three pupils with the notable exception of rate of blackboard attending opportunity.

Fourth, certain behaviours which appeared to be critically related to mental processing behaviours involving conflict and change such as rubbing out and spontaneous reading aloud behaviour, were facilitative of learning for all three pupils.

Fifth, behaviours which involved opportunity to attend to peer activity, verbal or non-verbal, appeared to be highly related to pupil learning. In fact direct facilitative contact with peers appeared to be more consistently related to pupil learning than direct individual contact with T. Not surprisingly, this contact was most beneficial when closely associated with relevant content or tasks.

Sixth, all three pupils seemed more likely to have learned when teacher-directed lessons and pupil tasks involved a range of resources and behaviours rather than a dominant activity.

13.14 DIFFERENCES BETWEEN CASE STUDY PUPIL LEARNING PATTERNS

At the outset of this chapter it was apparent that Gus engaged in more facilitative experiences and fewer inhibitive experiences than either Emily or Diane. Diane engaged in the most inhibitive experiences and the fewest facilitative experiences although she was observed during the unit to be consistently more on-task than either Gus or Emily.
Gus learned more and mislearned less tested content than either Diane or Emily. He engaged in higher rates of public involvement during teacher-directed lessons and interacted with more tested content during individual and group tasks than either Diane or Emily. He benefited more from blackboard attending opportunity, interactions with T, talking to self behaviour, peer interactions during group tasks, and from behaviours associated with resource usage than Diane or Emily. Contributing factors to Gus's higher achievement were his: (a) high level of prior knowledge, (b) higher reading ability and his access to content in the high ability reading group, (c) orientation to learning (to the point of disobedience) rather than production or presentation, (d) content relevant peer-interactions, and (e) out-of-class experience and access to resources.

Diane learned least and became more confused about unit content than Gus or Emily. Reading, writing, and fiddling behaviours were more consistently related to Diane's learning than they were to Gus's or Emily's. This individual pattern reflects her characteristic pattern of covert rather than overt involvement with unit content. Contributing factors to Diane's low achievement were her: (a) lack of relevant prior knowledge and experience, (b) lack of orientation towards learning and associated confusion about task goals, (c) failure to interact with peers about content, and (d) low access to out-of-class resources.

Emily interacted less with tested content than either Gus or Diane and she produced less written work. Her learning was high in relation to her low level of prior knowledge but below average in relation to T's class. Opportunities which were showed unique relationships with Emily's learning included teacher-directed lessons when there were non-visual resources, and her interactions with peers during individual tasks.
Emily appeared to be inhibited from learning by her: (a) low level of prior knowledge, (b) lack of involvement with content, and (c) preoccupation with presentation. However, she was aided in her learning by her high access to out-of-school opportunities to interact with relevant experiences and content.
A THEORY OF LEARNING AND TEACHING

14.1 OVERVIEW

The theory advanced in this chapter, as discussed in Chapter 2, is a nascent theory which is grounded in the findings generated by this study. It is, therefore, a theory which explains the learning of three children in one class programme. The extent to which the theory has wider applicability is a matter for empirical investigation. The theory is nascent in the sense that it needs to be refined in the light of evidence from a number of similar studies. The theory is a theory of knowledge acquisition; not a theory of skill development or attitudinal change.

The theory is advanced in two stages. In section 14.2, the explanation which has been constructed in response to the first research question (What facilitates pupil learning in classrooms?) is outlined. In section 14.3, the second part of the theory which has been developed in response to the second research question (What is the nature of pupil learning in classrooms?) is advanced. Because these questions can only be adequately addressed by findings from a number of such studies the phrase 'in classrooms' is omitted in the following outline.
14.2 WHAT FACILITATES PUPIL LEARNING?

The variables which related to pupil learning in this study can be conceptualized as three main variable clusters: (a) opportunity to learn specific content (provided by the teacher), (b) pupil behaviour, and (c) pupil in-class and out-of-class access to facilitative resources. The varying degrees of interaction between these three variable clusters explain varying pupil outcomes.

14.2.1 Variable A: Opportunity to Learn

The elements of the first variable cluster, opportunity to learn specific content, are listed in Figure 153. Both the quantity (length and spread) and the quality of the opportunity to learn specific content are critical to pupil learning. The qualitative elements are made up of variables found to be consistently positively related to pupil learning in this study. As can be seen in Figure 153, opportunity is only facilitative in the event of pupil misconceptions when those misconceptions are challenged.

The case study pupils received relatively similar opportunities to interact with content which they learned and remembered. However, the amount of opportunity did vary according to the reading group to which the children were allocated. That is, Gus who was in the high ability reading group consistently received more in-class opportunity to learn than either Diane or Emily. Absence from school also influenced the relative opportunity to learn.
Figure 153

Elements of Variable Cluster A: Facilitative Opportunity

1. Sufficient length and spread of opportunity to interact with content.

2. Opportunity to interact with content in both teacher-directed lessons and relevant tasks.

3. Given misconceptions; sufficient conflict opportunity to displace inappropriate links.

Teacher-Directed Opportunity - Specific

4. Opportunity to experience a concrete demonstration of the concept.

5. Opportunity to attend to teacher-pupil discussion of the concept (public links to pupil prior knowledge and experience, clarification of concept boundaries in the light of instances and non-instances).

6. Opportunity to attend to diagrammatic and pictorial representations of the concept.

7. Opportunity to act out the concept.
Figure 153 cont.

Task Opportunity - Specific

8. Opportunity to carry out a task which requires identifying the critical elements of a concept.

9. Opportunity to engage in a task which involves utilizing relevant concrete experience in order to respond to task requirements.

10. Opportunity to engage in task requirements which are incompatible with extant misconceptions.

11. Opportunity to interact with teacher, and peers in order to clarify task requirements in relation to content.

12. Opportunity to interact with teacher, peers, and a range of other resources in order to refine concept.

13. Opportunity to attend to peer engagement in tasks.

14. Opportunity to express concept in verbal, diagrammatic, written, or pictorial form.
However, the extent to which the case study pupils were able to effectively utilize this opportunity to learn depended on the other two variable clusters. That is to say that the pupils varied in the extent to which they were able to exploit the opportunity to learn in relation to the degree of resource access they enjoyed, and the kinds of behaviour in which they engaged during this opportunity. For example, the opportunity to attend to blackboard work was facilitative for Gus, who was an above average ability reader, but was negatively related to learning outcomes when it occurred at high rates during time spent by Diane and Emily, who were average ability readers.

Thus, the opportunity to learn was potentially similar for each pupil because they were in the same programme. However, the three variable clusters interacted and affected the effectiveness of this opportunity for each pupil.

The kinds of pupil behaviours which were most facilitative of learning, when they occurred during this opportunity, are outlined in the following section.

14.2.2 Variable B: Pupil Behaviour which Facilitated Learning

The kinds of pupil behaviours which facilitated pupil learning in this study are listed in Figure 154.

The postulation of covert processing as a facilitative pupil behaviour is based upon three kinds of evidence. First, the pattern of behaviours which occurred at high rates when less time was spent on new content, irrespective of learning outcomes, provides evidence
that the pupils responded to unknown content in a characteristic manner. The covert talking to self (or mouthing to self) behaviours which occurred in these circumstances were interpreted by the observers to be attempts made by the pupils to interact with the new material without engaging in public discussion. That is, the case study pupils appeared to be experimenting with ideas of which they were uncertain. Second, the association of high rates of fiddling with content learned and forgotten, and content mislearned, as well as with all content upon which less time was spent, suggests that a high rate of this activity was a sign of covert pupil attempts to integrate (or, as is discussed in the second part of this chapter, accommodate to) new or difficult content. Content which was mislearned involved pupils changing correct ideas and replacing those ideas with misconceptions. It is plausible that the particularly high rates of fiddling associated with this change were indicators of internal conflict and cognitive restructuring. It is also plausible that the high rates of fiddling associated with content which was learned and forgotten were indicators of the conflict experienced when the case study pupils attempted to understand content for which they did not have relevant concrete experience.

It is more plausible to postulate that these patterns of fiddling behaviour were indicators or symptoms of unobservable processing behaviour, than it is to accept that fiddling in itself brings about learning or change.

Although Behaviours 2 and 3 (Figure 154: covert processing and public processing during teacher-directed lessons) are behaviours which were facilitative of pupil learning and, in fact, appeared to be necessary for learning to occur, the pattern of results showed that these behaviours were rarely
sufficient for learning to occur. That is, the covert processing was likely to lead to learning only when followed by overt processing and task engagement. The items which seemed to be exceptions to this pattern were items for which the case study pupils experienced out-of-class opportunity to learn.

The behaviours identified as facilitative in relation to task engagement comprise a summary list of behaviours which were positively related to learning.

Some of these behaviours included in Figure 154 were not consistently related to pupil learning. In order to explain the inconsistency of these relationships, again it is necessary to interpret the function of pupil behaviours in terms of the interaction between the three variable clusters. For example, some pupil behaviour such as writing was inhibitive of learning because the task opportunity did not involve opportunities to engage in activities which were incompatible with extant misconceptions. That is, pupil behaviour which was not engaged with conceptually relevant tasks did not facilitate learning. This interaction between variables is advanced as a more useful way of conceptualizing pupil behaviours which facilitate learning than the traditional explanation implicit in the term on-task behaviour. There were instances when apparently on-task behaviours in this study inhibited learning, and there were instances when off-task behaviours facilitated learning.

The three case study pupils varied in the number of, and kinds of, behaviours which were facilitative of learning. For example, peer interaction during teacher-directed lessons was more consistently positively related to learning for Diane than Gus, because at times Gus appeared to engage in so much peer interaction that he could not have continued to attend
Figure 154

Variable Cluster B: Pupil Behaviours which Facilitate, or are Related to, Concept Learning

Behaviours in Response to Teacher-Directed Lessons

1. Attending during facilitative opportunity.

2. Covert processing of new content during teacher-directed lessons. Observable signs: talking to self under breath, relevant peer interaction, fiddling, acting out a concept privately, laughing.

Facilitative Behaviours During Relevant Task Opportunity

4. Verbal interaction with teacher, and peers involving clarification of task goals in terms of content requirements. For example, peer interaction at the outset of an individual task, peer discussion and organization of a group task.

5. Private or public oral expression of critical elements of a concept, or confusing resource material.

6. Interaction with teacher and peers about critical elements of a concept.

7. Arguments about misconceptions.

8. Movement to, and use of, relevant resources such as charts, books or listening post.

9. Expression of concept in diagrammatic, written or art form.

10. Rubbing out behaviour. That is, the elimination of perceived inappropriate expression of a concept.

Figure 154 cont.

to the lesson. However, peer interaction during individual task opportunity was more facilitative of learning for Gus than Diane because while he engaged in
higher rates of conversation which was content-relevant, she engaged in lower rates of conversation, and that in which she did engage was related to the presentation and efficient production of assignments rather than the conceptual issues involved. Emily engaged in fewer facilitative behaviours than Gus but more than Diane in relation to her learning outcomes. Not only were fewer of Diane's behaviours facilitative of learning, but also more of her behaviours were inhibitive of learning.

Again these differences between pupils are systematically explained by the interactions between the three variable clusters. Marked differences between the case study pupils in their access to resources are considered in the following section.

14.2.3 Variable C: Pupil Resource Access

The third variable cluster, the pupil resource factor, is not customarily used to explain pupil learning in classrooms. Rather constructs such as aptitude, ability or general intelligence are used to explain pupil learning. However, in this study opportunity to learn was only effective if the pupil had appropriate resources to exploit that opportunity. Further pupil behaviours were only facilitative when these behaviours were associated with high pupil resource factors. The evidence from this study suggested that the variations in pupil access to resources had their origins outside the classroom in the case study pupils' homes. And, as has been shown in this study, this variable interacted with the in-class facilitative opportunity to render that opportunity more or less effective, in predictable ways.
Figure 155

Elements of Variable Cluster B (Access to Resource Factor) which Facilitate Pupil Learning

<table>
<thead>
<tr>
<th>Resources</th>
<th>Pupil Resource Access Level</th>
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<tr>
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<td>Gus Diane Emily</td>
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1. Prior knowledge.  | Hi  Lo  Lo |

2. Home resources:

2a. Mobility in relation to a range of concrete experiences.  | Hi  Lo  Hi |

2b. Learning orientation. Expectation to ask questions, discuss school work, relate school learning to family experiences.  | Hi  Lo  Med |

2c. Access to verbal interaction about concepts (with parents, siblings and other family members).  | Hi  Lo  Med |

2d. Access to resources: artifacts, reference books, television, newspapers and magazines, library, museum, tuition, pamphlets, photographs, paper, pencils, coloured pens, ruler.  | Hi  Lo  Hi |
3. Resource Access Factor: In-Class

3a. Status: access to interaction with peers with high resource access.

3b. Information processing skills: reading, familiarity with diagrams and reference procedures.

3c. Access to technical resources: pencils, rubber, felt-tipped pens, ruler.

The amount of relevant prior knowledge held by the pupils at the outset of the unit may have been their most valuable resource in relation to additional learning. Not only was new content consistently linked by T to prior pupil knowledge during the unit, but also mislearning was more likely to occur when prior knowledge was low.

As can be seen in Figure 155 there appeared to be four kinds of home resource factors, in addition to prior knowledge, which influenced pupil in-class achievement in this study: mobility, orientation, access to verbal interaction about concepts, and access to information in various material resources.

It was apparent from the analysis of interview data in relation to test outcomes, that mobility, identified with ownership and use patterns of a family car, influenced in-class achievement significantly because
of its effects on the range of first hand experiences enjoyed by the children. The same factor was also found to be a significant predictor of children's in-school achievement in a study of 865 Christchurch children carried out by Densem (1979).

The learning orientation which consistently rendered Gus's behaviours more facilitative than Diane's may also have its roots in the pupils' homes. Learning tasks which occurred naturally in Gus's family setting were open-ended with a strong emphasis on finding out the 'why' of things. Not only was this orientation observed in Gus's interactions with his mother after school but also Gus frequently referred to family conversations in the course of his interview responses:

Sometimes when, say we're watching something on T.V. or Mum's reading a book, or we're doing a crossword or something, and someone says, 'Oh, I wonder what that means?'...

T commented of Gus:

(Gus's) family want all their children to do well. Gus is determined to learn, to find answers. He isn't satisfied by being fobbed off.

This orientation to learning was apparent in Emily's family but less information was available. Emily's mother drove her to an out-of-school science club. T commented on the frequency of family holidays and trips abroad. He explained that Emily was always taken on
such trips, even when the family travelled overseas. Like Gus's mother, Emily's father attended the school open day and engaged in extended conversations with her about her work. Emily's father was also involved in parent committees to raise funds for the school and he provided transport for class trips.

Diane's home environment was not apparently oriented towards learning. T commented that Diane's parents had 'no educational goals' for their children. Diane described having to act 'shy' when relatives visited and she gave the impression during the interviews, that the discussion of schoolwork at home would appear 'smart' and inappropriate. Neither parent attended the school open day. Watson (1981) found that parental involvement in children's school learning was significantly correlated with pupil achievement. This relationship was also apparent in the results from the Plowden report and the follow-up conducted by Peaker (1971).

This evidence from the interview data, that the pupils had fundamentally different attitudes to learning, is also supported by in-class events. Although T did promote learning, his instructions seemed to emphasize production and presentation rather than learning. Frequently, the peer pressure was observed to be directed towards presentation and production at the expense of conceptual validity. And, as discussed in earlier chapters Gus's learning orientation resulted in reprimands from T. While Diane's obedience to T frequently resulted in behaviour which did not facilitate learning Gus's disobedience frequently resulted in behaviour which did facilitate learning.

In addition to the kinds of orientation to learning held by the pupils, specific access to verbal interaction about tested concepts appeared to be
important to their learning. There were considerable differences in the reports given by the case study pupils of content related interactions out-of-school. Gus not only frequently discussed issues with both his parents but also engaged in content relevant interactions with his older brother. Emily engaged in content-relevant interactions with her father as well as product-oriented interactions. Also Emily's parents arranged for her to interact with other adults about school-relevant content in her museum club. Diane never reported discussing unit concepts with family members.

The case study pupils and other class members varied considerably in the range of resources to which they had access. For example, Diane used only library material whereas Emily and Gus reported using encyclopaedias and other reference books from home. In Figure 155, the case study pupils have been given a high, medium, or low rating to describe their relative level of access to the resources which were found to be related to unit learning. It is apparent that the contrast between Gus (with 8 'Hi' ratings) and Diane (with 5 'Lo' ratings) is considerable.

In summary, although the outline given above is merely a sketch of the resource factor based mainly on the interview data, it does point to an area in which differences between the case study pupils corresponded with differences in their learning outcomes. It has been evident in the literature for some decades that there is a high correlation between pupil home background and school achievement. However, of the learning theorists reviewed by Haertal, Weinstein, and Walberg (1983) only Walberg (1980) has advanced resource access factors such as access to mass media and educationally stimulating conditions in the home as influencing children's in-class learning in an ongoing
way rather than as presage entry variables. The present study suggests that particular elements of the resource access factor such as range of concrete experiences and access to curriculum relevant conversations, which may be especially critical.

14.3 APPLICATION OF THE THREE-VARIABLE INTERACTION MODEL TO THE STUDY FINDINGS

The ways in which the interaction of these three variables contributed to different pupil outcomes are shown in Figures 156 to 165. Long-term learning occurs when a substantial proportion of facilitative pupil behaviours occur during opportunities to interact with relevant content (depicted as overlap between the pupil behaviour and the opportunity circles in Figure 156) and when the pupil also has a high level of access to relevant resources (depicted as overlap with the resource access factor in Figure 156).

Short-term learning involves a lower proportion of facilitative pupil behaviour occurring in relation to relevant content (a small overlap of the two factors in Figure 157). The resource access factor is also depicted as having a small overlap indicating the absence of relevant concrete experience.

The differences between the case study pupils in the variables which were associated with their long-term learning are shown in Figures 158 to 160. Gus had the greatest facilitative opportunity to interact with content learned and remembered. His behaviour involved considerable interaction with that content (even outside of teacher-provided opportunity), and his access to resources was high both at school and home (see Figure 158). Diane had less facilitative opportunity,
Figure 156

General Model of Concept Learning (Long-Term)
General Model of Concept Learning (Short-Term).

Figure 157

Facilitative opportunity to interact with concept.

- Facilitative opportunity not exploited by pupil.
- Pupil behaviour does not involve interaction with relevant content.
- Potential resources pupil can draw upon to facilitate interaction with relevant content.
- Pupil behaviour which facilitates interaction with relevant content.
- Facilitative opportunity extends into pupil's private resources e.g. homework.
- Pupil initiates exploitation of private resources e.g. asks questions of parent about relevant content.
- Pupil uses resources effectively to maximize involvement with relevant content during facilitative opportunity.

Pupil behaviour.

Resource access factor.
Figure 158

Model of Concept Learning (Long-Term) for Gus.

FACILITATIVE OPPORTUNITY TO INTERACT WITH CONCEPT

PUPIL BEHAVIOUR

RESOURCE ACCESS FACTOR
Figure 159

Model of Concept Learning (Long-Term) for Diane.

FACILITATIVE OPPORTUNITY TO INTERACT WITH CONCEPT

RESOURCE ACCESS FACTOR

PUPIL BEHAVIOUR
Figure 160

Model of Concept Learning (Long Term) for Emily.
Figure 161

Application of Concept Learning Model to Gus's Experience of Content which he did not Learn.

FACILITATIVE OPPORTUNITY
TO INTERACT WITH
CONCEPT

PUPIL BEHAVIOUR

RESOURCE ACCESS
FACTOR
Figure 162

Application of Concept Learning Model to Diane's Experience of Content which she did not Learn.
Application of Concept Learning Model to Emily’s Experience of Content which she did not Learn.
Figure 164

Application of Concept Learning Model to Diane's Experience of Content which she Mislearned.
Figure 165

Application of Concept Learning Model to Emily's Experience of Content which she Mislearned.
considerably less access to resources, and she engaged in many behaviours that did not involve interaction with tested content (see Figure 159). Emily had even less in-class facilitative opportunity to interact with specific content, she engaged in more behaviour than Diane that did not involve interacting with tested content, but she had more out-of-class and in-class access to resources than Diane (see Figure 160).

The same diagrammatic representation is used to illustrate the kinds of variable interactions which resulted in pupil failure to learn, in Figures 161 to 163. Gus experienced little facilitative opportunity to learn this content and his resource access, although generally high, was not so with regard to this particular content. Alternatively, the failure to perceive links to relevant knowledge may have inhibited Gus's ability to utilize available resources. The model illustrating Diane's failure to learn tested content shows that she had more facilitative opportunity than Gus to interact with this content, but this was still insufficient. Although her resource access factor was low compared with that of Gus, she was like Gus in that her resource access factor was not exploited in relation to this content. Emily experienced more opportunity to interact with content which she failed to learn, than Gus, but less than Diane. She interacted less with this content than either Gus or Diane. However, like the others, she either did not have relevant resource access or was unable to make links with the resources available to her.

The model is used in Figures 164 and 165 to illustrate the lack of interaction between the three variables when mislearning occurred for Diane and Emily (Gus mislearned only one item). Although there was facilitative opportunity to interact with this content the pupils made links to inappropriate experiences and resources during this time.
Although a model for pupil experience of known content is not shown, this experience would involve considerable interaction between facilitative opportunity and extant resource access, which, in turn, would lead to pupil involvement with new content.

14.4 WHAT IS THE NATURE OF PUPIL LEARNING?

The model outlined in the previous section summarizes the kinds of conditions which facilitate pupil learning as an interaction between three key variable clusters. Those opportunities and behaviours which were most facilitative of learning, and those which were most inhibitive of learning, provide clues about the nature of classroom learning. In this part of the theory those clues are integrated into an explanation of the nature of learning or knowledge acquisition.

The evidence from the study indicates that learning (knowledge acquisition) is a process which occurs in stages on a continuum through time. Three stages are postulated: (a) Awareness and Disequilibrium, (b) Cognitive Restructuring and Integration, and (c) Schema Development and Anchoring. For some content which was not learned, no pupil awareness or disequilibrium occurred. For this content the case study pupils did not even begin the learning process. The extent and relevance of their prior knowledge were factors which strongly influenced whether or not they engaged in the learning process for new content. If there were sufficient relevant schema in the children's extant knowledge then the learning process would begin.
14.4.1 Awareness and Disequilibrium

This stage is the first and briefest. The unknown concept registers in the child's awareness and creates a disequilibrium in the child. That is, the child recognizes the concept as unknown and responds with high rates of behaviours which express the unease created by that disequilibrium: fiddling, talking to self, and engaging in discussion with peers. Until the disequilibrium is resolved no learning occurs.

In this study the stage of awareness and disequilibrium usually occurred in the course of a whole class lesson when the teacher introduced the new content into a class discussion. However, the pretest appeared to create awareness and disequilibrium for some content.

The more relevant prior knowledge held by the child, the more likely that child is to become aware of the unknown content and to experience disequilibrium in relation to extant knowledge. Although awareness and disequilibrium are necessary as a first step in the learning process they are insufficient to bring about short- or long-term learning.

14.4.2 Cognitive Restructuring, Integration, and Resolution

The child engages in active processing (covert and overt) as he or she attempts to link the new fact or concept to existing schemas and prior experiences.

If the new fact is incompatible with existing schemas the child has to begin the process of changing those schemas and restructuring prior notions in order to
integrate the new concept - that is, the child engages in the process characterized by Piaget as accommodation. In order for appropriate links to be forged, existing misconceptions and inappropriate links must be challenged and displaced. If the child attempts to integrate the new fact without displacing inappropriate links short-term learning may occur, but the prior misconception (or in some cases the new misconception) may act in a pro-active manner to displace the short-term 'learning'. The misconception may even inhibit short-term learning if it is too strongly held for accommodation to occur. That is, if it seems like a better explanation to the child than the new and competing fact or concept.

If the new concept is compatible with existing schema the child engages in the less demanding process of integrating the new concept into the appropriate existing networks - the process of assimilation. In these cases less time is necessary for learning to occur.

In this study the stage of cognitive restructuring, integration, and resolution occurred during both teacher-directed lessons and pupil tasks. Class discussion served as an arena for public thinking which provided an external model of the internal thinking process. The public identification of links with relevant experiences, links with other relevant knowledge, and the public rejection of inappropriate links, served to directly facilitate integration of the new fact into appropriate schemas, and to model for the pupils the kind of covert processing which is necessary to bring about learning. This process was continued into pupil tasks and clearly apparent at the organizational phase of group tasks.
The public verbal rejection of inappropriate links enabled the pupils to reject misconceptions. Also, the concrete demonstrations and diagrammatic representations of new content in relation to known content facilitated this process. When, however, the teacher linked new content to other experiences and knowledge unique to him, learning was inhibited.

If insufficient opportunity to learn occurred and the pupils had only the opportunity to make isolated links between the new fact and known content then short-term learning occurred.

14.4.3 Schema Development and Anchoring

The third stage involves the child in actively developing the skeleton schema into a dense schematic network which both serves to refine the concept and to link the concept to (and possibly restructure) so many other schema in the child's conceptual network that the concept becomes part of the child's readily accessible general knowledge of the world; that is, known content.

The process of dis-establishing inappropriate links continues but is less central in this stage as the child actively forges and expresses new links and refinements of understanding. This process is consistent with Anderson's concept of accretion. It is a process which occurs as the child engages with the concept and actively expresses the new understandings and evaluates his or her expression.

In the present study, pupil task opportunity was generally necessary for schema development and anchoring to occur.
14.4.4

Haertel, Walberg, and Weinstein (1983) reviewed eight 'theories or models presenting holistic conceptions of student learning in classroom settings' (p.75) in relation to Walberg's (1980) model of educational productivity - Bennett (1978), Bloom (1976), Bruner (1966), Carroll (1963), Cooley and Leinhardt (1975), Gagne (1974), Glaser (1976), and Harnischfeger and Wiley (1976). The theory generated from this study shows both strong similarities and strong differences with those theories. None of the eight theories specifically included pupil concrete experience as a presage condition for learning. In this respect the present theory is more congruent with Piaget's theory of learning for children at the concrete operations stage. Relevant prior knowledge, which was argued to be a facilitative presage condition for pupil learning in this study, was identified as important by Cooley and Leinhardt (1975), Bloom (1976), Bennet (1978), and Glaser (1976).

Quantity of instruction or opportunity was included as a critical variable by Carroll (1963), Cooley and Leinhardt (1975), Bloom (1976), Harnischfeger and Wiley (1976) and Bennet (1978).

The present theory differs strongly from those reviewed in the elements identified as contributing to instructional quality. For example: external motivators, reinforcement, punishment, and sequencing were not issues in this study. The emphasis in those theories is generally on teacher variables (except for Harnischfeger and Wiley (1976)) whereas the emphasis in this study was on the kind and quality of pupil opportunities within the overall learning context. The focus in this theory is congruent with Wittrock's
generative theory of learning and the kinds of opportunities identified as facilitative of learning have been argued to be those which facilitate the process of pupil generation of appropriate cognitive links.

Finally, the present theory is discordant with all eight theories reviewed in the emphasis on the interaction between the ongoing school programme and the home resource access factor. However, as discussed previously, Walberg's (1980) model of educational productivity includes a notion that the classroom is an open system that is not isolated from external influences. The present theory is congruent with that model in the importance attached to education-stimulating conditions in the home and peer group, and exposure to mass media.

This theory also differs from other theories of learning and teaching in that it is not prescriptive. It is a theory of teaching in the minimal sense that it illuminates pupil learning in a classroom context. The theory provides explanations for the effectiveness of some teacher behaviours and provision of opportunities and for the ineffectiveness of other behaviours and provisions. It does not provide prescriptions for other contexts.
The investigation of the truth is in one way hard, in another, easy. An indication of this is found in the fact that no one is able to attain the truth adequately, while, on the other hand, we do not collectively fail, but everyone says something true about the nature of things.

(Aristotle, Metaphysics. McKeon, 2:1) (p. 712)

15.1 HEURISTIC VALUE OF THE STUDY

Aristotle's view about the value of individual investigations is particularly pertinent to an interpretation of the implications of this study. The findings of this study were grounded in, and confirmed within, the data on three pupils in one classroom. Any implications from the study serve only as hypotheses in different settings with different pupils, teachers, and programmes.

Nevertheless, the congruence of the study findings with research findings from several traditions suggests that a number of studies employing similar methodologies may collectively map out the parameters of the relationships discovered.

The research methodology could be developed further. The test is a critical instrument. It may be fruitful to refine test items in order to: (a) tap pupil misconceptions, and (b) identify more closely the kinds of
links generated by pupils when they learn new content. It may be useful to risk more intervention in a class programme in order to obtain ongoing insight into pupil perceptions. It would certainly seem worthwhile to record verbatim informal peer interactions with remote microphones. Clearly the methodology would have to be adapted to the circumstances of any particular study.

The findings of this study raise a number of questions which are not being adequately addressed in research in this field. The unexpected relationships in this study between pupil learning and some behaviours (for example, rubbing out and fiddling) suggest that investigations of pupil learning in classrooms should empirically explore such relationships. The strong confounding effects of pupil concrete experience, pupil misconceptions, and pupil access to resources merit further investigation. Although pupil misconceptions are currently receiving considerable attention in this field, neither pupil concrete experience nor pupil access to resources (in-class and out-of-class) has been adequately investigated. The congruence of the theory generated from this study with extant theories in cognitive psychology suggests that the classroom is a fertile setting for developing theories of learning which eventually may provide more illumination for teachers than theories generated from laboratory investigations.

In summary, this study provided some illumination of the learning of three pupils. The kinds of variables which facilitated, and inhibited, learning were identified, and the kinds of variables which confounded these relationships were identified. A nascent theory explaining the patterns of results was advanced. The exploratory orientation proved fruitful and validates this alternative approach to classroom research.
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5. IMPLICATIONS FOR TEACHERS

5.1 The Haberlee Evaluation Technique

The Haberlee Evaluation Technique has been designed by the teacher and researcher to enable teachers and pupils to evaluate their own programmes effectively. The technique differs from traditional school testing procedures in that the focus is on evaluating the teaching and learning rather than the pupils. Test outcomes are tallied across items by the teacher and pupils. This is in contrast to traditional test marking procedures where the number of correct responses is totalled for each individual pupil. We have endeavoured to develop the technique as a practical procedure for busy teachers. Because pupil participation is an integral part of the process no teacher marking is required out of school hours.

************

At the outset of a new topic or unit of work the teacher asks the children to complete a written pretest with respect to desired learning outcomes. The test can be very simple with 10 or even five items - whatever is appropriate given the class level and composition, the nature of the new content, and teacher time available.

When the children have completed their test responses, the teacher gathers them in, glances over them quickly to assess prior knowledge and preconceptions, and files them in a drawer.

When the topic has been covered in class the teacher administers the same test. She then hands back to each pupil his/her own pretest.

The pupils and teacher then 'mark' pupil learning. After discussing appropriate responses to the first item the teacher then asks the children to indicate whether they learned Item 1. The ensuing discussion might go something like this:

'O.K. Who learned that ......? Who already knew that. What did we do that enabled so many of you to learn that ......?'

'Oh dear, what happened with Item 4? Did we do very much on that in class: Who had difficulty trying to understand ......? Could anybody tell me that the problems were there? Perhaps we should have done more activity work in that area?'

The teachers could record a brief summary of outcome patterns for a formal evaluation record.

************
CONSERVATION UNIT

GENERAL AIM: The children will become more aware of the World environment, and the influences modern Society exerts upon it.

SPECIFIC OBJECTIVES:

1. To become aware of the natural processes of erosion and the compounding effects of Man's activities.
2. To expose children to the wide range of sources of pollution.
3. To gain some understanding of the large number of life forms being threatened by unnatural changes in the environment.
4. To appreciate the efforts being made to alleviate the problems caused in all areas of the study, and ways in which they, as children, can contribute.

THOUGHT RUNNING THROUGH WHOLE UNIT:
Be aware of the way the environment is being damaged and ways we are combating the problems.

EROSION:

CONTENT: Refer to separate sheet -

Science Unit No. 17 EROSION.

Agents of erosion: water (rain, rivers, sea)
Ice, snow, frost, sun, wind.

deforestation - fire,
bulldozer, slips,
cultivation on farms
introduced animals (deer
opossum, rabbits, pigs)

Development of ski field, etc, leading to
increased avalanche risk.
Maturity of rivers (mountains to sea)

RESOURCES: collection of pictures with captions to encourage discussion, written expression, etc.,

16 mm filmed
Filamstrip

MOVEMENT: 1. Can be a boulder - freeze - lumpy, jagged - crack - tumble down hillside - down river - further abrasion

Ice - children in square of desks - expand with freezing - observe effect on desks.

**ART:**
- Comparative mural - before-during-after - crayon and dye

**WORD STUDY:** - see separate sheet

**WRITTEN EXPRESSION:**

Diary of a Tree & Beach - 150 year span.
Diary of a Boulder - spanning thousands of years.

Illustration - Caption

15 Divisions.

Description of scene on a photo

**JOURNAL STORIES:** - see separate sheet

**RESEARCH:** - in groups of two or three, the children to research a wild animal of N.Z. - how it came to N.Z. when, why, etc.

**POLLUTION:**

**CONTENT:**
- Air - the oxygen and carbon-dioxide cycle
- Water - the hydrological cycle
- Noise
- Visual - litter, architecture, town-planning, etc.

The effects of -

above cycles
- food chains (eco systems)
- life cycles
- living conditions

**METHODS:**

1) Incense sticks - burn several in the classroom with windows closed - await children reactions.

2) Walk around St. Albans district - children note things that look unpleasant - buildings, rubbish, powerlines etc.

3) Act out T.V. advertisement on noise pollution or role play "noisy" situations.

4) Photographs or pictures depicting aspects of pollution, captions and suggestions for activities

5) Children to find pictures of contrasting architectural styles - good and bad - fitting into environment.
1) hydrological cycle
2) oxygen/carbon dioxide cycles
3) effects on eco-systems – food chains
   life cycles
   living conditions

BLOW-UP BOOK:

Lester and Clyde

SHARED BOOK:

The Lorax – Dr. Seuss
The Shmeka – Colin Thiele

MOTION:

1. Plants – seeds – sprouting – growing –
   withering in polluted air – dying.
2. Fish – struggling to find fresh water –
   turn belly up to die.
3. breathing fresh air – polluted air.

ART:

1. Mural – paint – polluted city
   planes, smog, effluent, litter, etc.
   Written
   Class chart – build up as captions for murals
2. Litter Critter
3. Make an Anti-litter Poster using Litter
4. Community Project –
   eg. clean up around Edgeware Shopping Centre.

SONGS:

1) Damn the Dam – John Hanlon
   The Elephant – Hemert, Frank, Wodds

ENDANGERED SPECIES:

CONTENT:

- effect of – animals on animals
  – introduced animals (ferrets, stoats, rats, cats)
  on ground dwelling birds (eggs and young)
  – animals – vegetation – animals
    eg, rabbits, deer, opossums – vegetation –
    native birds, bat.
- Evolution –
  low berries – little flight – birds
  couldn’t fly when need arose.
- Man – refer back to previous sub-topics
  – Whaling
  – Sealing
  – deforestation for farming, forestry,
- oil tankers, airplanes
- over exploitation -
  - crayfishing
  - whitebait
  - toheroa
- regulations to protect
  - National Parks
  - Ministry of Agriculture and Fisheries
  - Ministry for the Environment - Wildlife Division
  - Acclimatisation Society
  - Local Parks and Reserves Dept.
- Voluntary -
  - Forest and Bird Protection Society
  - Native Forest Action League
  - Ecology Action
  - Environmental Vanguard
  - Environment Centre
  - Clean Air Society

**METHOD AND ACTIVITIES:**

- Posters with captions directing discussion and possible follow-up activity
- Readers Digest Skill Builders - in reading groups for directed silent reading and co-operative reading (see separate sheet)
- Current Events - oil spillage - krill - upset food chain upset life cycle

**WRITTEN EXPRESSION:**

- Children select endangered animal - research and write a factual piece of writing
- Imagine yourself as an endangered animal searching for a better environment.

**VISIT:**

- Willowbank -

  Mr. Willis to talk to us before we see the reserve
  Follow-up (*see Art) - how to design own wildlife part - in small groups.

**ART:**

- Follow-up to Willowbank - planning a wildlife park
- Ink print of an animal in its natural environment

**READERS TO CHILDREN:**

- The Meeting Pool - Mervyn Skipper
  - movement related to story
  - art follow-up
  - children make up a similar type of story
CONCLUSION to whole unit.

In groups of 15 or more children apply all the knowledge and attitudes they have gained during the whole unit, to plan a "model" town. Children will role play the various factions in a community vying for the best positions in the town.
JOURNALS:

PART 1

1966 No. 2 Mountain Holiday
1971 No. 3 Saving the Soil
No. 4 The Soil Conservation & Rivers Control Council
1972 No. 1 Mr. Light the Rubbish Man
No. 4 Hunting for Tuhoeas
1973 No. 1 Blackbirds
No. 3 Magpies
1975 No. 1 The Grey Warblers
No. 3 The Gannet's Egg
1976 No. 1 Possum in the Basement
No. 2 Mr. Tui - Quarryman
No. 4 How animals Mls
No. 5 The Dead Forest
1977 No. 1 The Kakapo - Secret
No. 2 Bounding Ducks
As Dead As a Doa
No. 3 Up with the Herons
No. 4 Penguins on the Snares
No. 5 Doctor Kills - ZOOLOGIST
1978 No. 1 What are Fossils?
Dinosaurs
No. 2 Allosaurus
No. 3 Dinosaurs
No. 4 Dinosaurs
1978 No. 5 The Tustara
1979 No. 2 Dins Cud - Nursery Worker

PART 2:

1966 No. 2 Power from Maraetai
1969 No. 4 Earthquakes
1970 No. 3 Geckos
No. 4 The Canada Goose
1971 No. 1 Ted and his Canada Goose
1972 No. 1 The New Zealand Fur Seal
Watching the Seals
No. 3 Holiday on a Volcano
No. 4 The Katipo Spider
1973 No. 1 High on a Mountain
No. 4 The Little Island
1975 No. 1 Muttonbirds or Sooty Shearwaters
Watt Family - Muttonbirders
No. 3 Dugongs
Watching hares
No. 4 Hop the Possum
1976 No. 1 How Insects Hide
No. 2 Mr. Gilsenan - Bushman
Snow on the Mountains
No. 3 Mr. Smith - New Doctor
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<td>Wild Horses of the Kaimanawas</td>
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<td>No. 4</td>
<td>Sea Lions</td>
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<td>No. 5</td>
<td>The Egg-shell Necklace</td>
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<td>1978</td>
<td>No. 1</td>
<td>Mr. Christensen - Soil Scientist</td>
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<td></td>
<td>No. 2</td>
<td>The Reef Heron</td>
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<td>No. 3</td>
<td>Sea Lions</td>
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<td>The Eel Fisherman</td>
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<td>1968</td>
<td>No. 1</td>
<td>Saving the World's rarest Beast</td>
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<td></td>
<td>No. 2</td>
<td>The Hurrican</td>
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<td>The Eel Fisherman</td>
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<td>No. 3</td>
<td>The Pied Stilt</td>
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<td></td>
<td>No. 4</td>
<td>The Icefield</td>
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<td>No. 5</td>
<td>About Zoos 1. What is a Zoo?</td>
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<td>1970</td>
<td>No. 1</td>
<td>The Tiger</td>
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<td>The Reef Heron</td>
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<td>1971</td>
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<td>Whales</td>
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<td>No. 2</td>
<td>Coeulaun Under the Earth</td>
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<td>1972</td>
<td>No. 1</td>
<td>Visit to the Fur Seals</td>
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<td>No. 2</td>
<td>Dolphins - Man's Friends in the Sea</td>
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<td>The Smallest Penguin of All</td>
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<td>1973</td>
<td>No. 1</td>
<td>Kea</td>
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<td></td>
<td>No. 2</td>
<td>Wild Goats</td>
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<td>1974</td>
<td>No. 1</td>
<td>In Search of the Kokako</td>
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<td>Keta</td>
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<td>Rings Under the Earth</td>
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<td>Miss Hauser : Architectural draughtswoman</td>
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<td>Teggs, Eggs and Turtles</td>
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<td>1977</td>
<td>No. 1</td>
<td>The Island that was Eaten by Rats</td>
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<td></td>
<td>No. 2</td>
<td>Beyond Recovery</td>
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<td>No. 3</td>
<td>The Perrot</td>
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READER

(Book Reader Digest Skill Builder Stories D.S.R. or Co-op Rdg Lessons)

R.A. 6 yrs.
"Take Care of the Woods" L.1 pt.

R.A. 7 yrs.
"Pablo's Battles with Buffalo" L.2. Pt. 1.
"New Kind of Lion Hunt" L.2. Pt. 2.
"The Cuddelly Koala" L.2. Pt. 3.

R.A. 8 yrs.
"Noah of the North" L.3. Pt. 2.

R.A. 9 yrs.
"Big Game Hunter With a Heart" L.4. Pt. 3
"Wanted; Friends for the Rhino" L.4. Pt. 2.

R.A. 10 yrs.
"The Mustang's Last Stand" L.5. Pt. 3.
"Big Changes in the Bag Woods" L.5. Pt. 2.

R.A. 11 yrs.
"The Lion Makes the Last Stand" L.6. Pt. 1.

Discuss: How could our - Home School City Country Be made a more pleasant environment

Role Play (See St.) Businessmen and conservation planning new town, factories, Straight roads for lorries, railway, transport firm yards etc.,

Mervyn Skipper - Rdg to Chm.
<table>
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<tr>
<th>WORD STUDY - &quot;PROTECTION UNIT&quot;</th>
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<tbody>
<tr>
<td>Afferation</td>
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<td>civilisation</td>
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<td>destruction</td>
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**Algor**
- fauna, survival, milling, timber, animals, life, relax, niche
- avalanche, forests, chemical, diminish, destroy, ice, wind, water, concern
APPENDIX C

GENERAL DESCRIPTION OF CONSERVATION UNIT
DESCRIPTION OF CONSERVATION UNIT: SEQUENCE OF ACTIVITIES

Note: Resource references are recorded in teacher planning notes (see Appendix B).

Erosion Sub-topic

Week One

Day 1

T-D Lesson: Introduction to the Conservation Unit in general, and to the topic of erosion in particular.

Individual Task: The pupils were required to provide an illustrated example of erosion with a caption.

Group Task: The pupils were required to explain and defend their examples of erosion to their peers.

T-D Lesson: Discussion of appropriate and inappropriate examples leading into a creative mime lesson about ice as an agent of erosion.

Day 2

T-D Lesson: The agents of erosion.

Group Tasks: Pupils working in groups with each group illustrating, and providing a caption for a kind of water erosion (ice, rivers, glaciers, snow, and sea).

Day 3

T-D Lesson: The agents of erosion - review and extension.

Group Tasks: Group illustrations continued.

T-D Lesson: Creative mime involving depicting agents of, and effects of, erosion (for example, deforestation, bulldozers, mountain stream erosion).

Day 4

T-D Lesson: Language lesson. Discussion of appropriate vocabulary to describe the eroding effect of glaciers.

Individual Task: Pupils required to write sentences describing the eroding effect of a mountain stream using vocabulary provided (from teacher-pupil discussion on the blackboard). Illustrations required.
Day 5

T-D Lesson: Revision of water erosion leading into individual task.

Individual Task: Pupils required to write a paragraph and illustration explaining the eroding effects of the major agents of erosion.

Individual Tasks (Pupil choice): Wall-chart activities including language, science, and spelling tasks. Agents of erosion paragraphs.

Group Task (Pupil choice): Library research assignment to identify the origins and effects of an introduced animal.

Day 6

T-D Lesson (High ability reading group only): Guided silent reading lesson about erosion in the New Zealand high country.

Individual/Group Tasks: Pupil choice as for Day 5

Day 7

T-D Lesson: Use of references in the school library.

T-D Lesson: Demonstration simulating wind and water erosion using vacuum cleaner, turf, sand, an empty aquarium, and water.

T-D Lesson: Review of the demonstration lesson leading into instructions for individual task.

Individual Task: Pupils required to write an account of the demonstration lesson as a series of experiment reports (diagrams required).

Day 8

Individual Tasks (Pupil choice): As for Day 5 with additional task choices - writing up the experiments, using the listening post to hear the School Journal article about erosion in the New Zealand high country.

T-D Lesson: Class discussion about introduced animals in New Zealand. T used a book brought from the library by Diane.

Individual Tasks: As above.
Day 9

T-D Lesson: Brief lesson about the jaw bone of a wild boar (artefact supplied by a pupil).

Individual Tasks: As for Day 8.

Day 10

T-D Lesson: Class lesson on deforestation.

Group Tasks: Groups required to illustrate a New Zealand forest landscape before, during, or after the advent of erosion.

Day 11

T-D Lesson: Language lesson - erosion vocabulary. Review and word analysis.

Individual Tasks: Pupil choice as for Day 8.

Group Tasks: Finishing off group pictures of landscapes before, during, and after erosion.

Day 12

T-D Lessons: Guided silent reading.
   High ability group: School Journal article about flooding.
   Average ability group: School Journal article about endangered New Zealand birds.

Pollution

T-D Lesson: Introductory brainstorm on the different kinds of pollution (for example, air pollution, water pollution, visual pollution, noise pollution).

Individual and Group Tasks: Finishing Off.
Day 13

T-D Lesson: Language lesson involving teacher-pupil discussion about pollution-relevant vocabulary.

Individual Task: Pupils required to write phrases to describe fresh air and foul air. Final copy written out on a smudged paper cloud shape.

Group Task: Pupils required to read their pollution phrases to their peers in pupil-directed groups.

Day 14

T-D Lesson: Language lesson on word beginnings (for example, scree, chamois, thar).

Group Tasks: Pollution murals illustrating different polluted landscapes. (City and country).

Day 15

T-D Lesson: Guided silent reading lesson. High ability group only - School Journal article about bushfire.

Group Tasks: Groups writing captions for pollution murals.

T-D Lesson: Shared-Book ('Olaf's Incredible Machine')

T-D Lesson: Hydrologic chart.

Day 16

T-D Lesson: Shared-Book ('The Sknucks').

Individual Task: Pupils required to draw diagrams of the hydrologic chart.
Day 17

T-D Lesson: Guided silent reading lesson.  
High ability group only - School Journal article about recycling used materials.

T-D Lesson: Pupils taken into an incense-filled withdrawal room.

Individual Task: Pupils required to write sentences describing their experience of pollution in the incense-filled room.

--------------------------------------------------------
Day 18

T-D Lesson: Shared-book ('The Sknucks').

Individual Task: Hydrologic cycle charts.

--------------------------------------------------------
Day 19

T-D Lesson: Shared reading of a blown-up book ('Lester and Clyde').

Individual Task: Language task related to the polluting words in the story.

--------------------------------------------------------
Day 20

Individual Tasks (Pupil choice): Hydrologic cycle, incense sentences, or wall-chart activities.

T-D Lesson: Water and air cycles and the value of these resources to humans.

T-D Lesson: Shared-book ('Lester and Clyde')

--------------------------------------------------------
Day 21 (School Open Day)

T-D Lesson: Instructions about print-making.

Individual Task: Pupils required to make prints depicting any aspect of pollution.

--------------------------------------------------------
Day 22

T-D Lessons: Shared-book in different reading groups using 'The Lorax'.

Day 23

T-D Lesson: Pupils reading incense sentences to the class.

Endangered Animals

T-D Lesson: Introductory lesson about endangered and extinct animals in relation to the conservation theme.

Day 24

T-D Lesson: Discussion of forthcoming class trip to Orana Park. Lesson about the destruction of animals by humans and the fragility of the life cycle.

Individual Task: Pupils required to write paragraphs explaining the reasons for animals becoming endangered.

Day 25

T-D Lesson: Guided silent reading. High ability group only (School Journal article about endangered species in Africa).

Field Trip to Orana Park

Day 26

Individual Tasks: Pupils allowed to read School Journal stories and articles relevant to the conservation theme.

T-D Lesson: T read an article on the Kokako to the class.
Day 27

T-D Lesson: Guided silent reading.
   Average ability group only (School Journal article about a reserve for endangered animals).
   Lesson leads in to instructions for a research assignment about a conservation group.

Day 28

T-D Lesson: Class discussion about endangered animals depicted on a commercial chart.

Individual Task: Free reading of relevant School Journal articles.

Day 29

T-D Lesson: T showed the class illustrations from a book about endangered animals. Instructions given to the class for a group task designing a reserve for endangered animals.

Group Task: Creating endangered animal reserves.

Day 30

T-D Lesson: Review of group task with discussion of the requirements of animals in captivity.

Group Task: Reserve designs continued.

Day 31

T-D Lesson: Endangered animals in reserves.

Group Task: Reserve designs continued.

Day 32

Simulated debate: pupils required to role-play people with vested interests who have to site a town.
CONSERVATION TEST

Name:  
Class: STANDARD  
Teacher:  

Example: Circle the letter beside the correct answer.

1) St. Albans School is in the district of:
   a. Riccarton  
   b. Cashmere  
   c. St. Albans  
   d. I don't know

Now try another example:

2. Many New Zealand families like to keep for a pet a:
   a. lion  
   b. cat  
   c. snake  
   d. I don't know

When your teacher tells you so you may turn over!
CONSERVATION TEST

PART ONE: EROSION

1) We use the word 'environment' to describe:
   a) the place around us
   b) a great deal of pollution
   c) very noisy places
   d) I don't know

2) We use the word 'erosion' to describe:
   a) the different levels of soil on a riverbank
   b) the wearing down of something
   c) ways in which pollution can be prevented
   d) I don't know

3) When water freezes into ice it:
   a) expands or takes up more space
   b) takes up the same amount of space as before
   c) gets smaller or takes up less space
   d) I don't know

4) As a boulder moves around in its journey from the mountain down the river it becomes:
   a) sharper and more jagged
   b) no different because boulders are very hard
   c) smoother and smaller
   d) I don't know
5) A good way to slow down or stop erosion in the mountains is to:
   a) introduce animals from another place
   b) plant lots of trees
   c) lay out tar-sealed roads
   d) I don't know

6) Farming has been a major cause of erosion in New Zealand because farmers:
   a) use machines which run on oil fuel
   b) have destroyed much of the native bush and vegetation
   c) export or send our produce overseas
   d) I don't know

7) The word 'deforestation' means:
   a) planting trees to make a forest
   b) cutting down all the trees in a forest
   c) clearing away the little trees in a forest
   d) I don't know

8) Which of these animals has been a major cause of erosion in New Zealand forests:
   a) sheep
   b) deer
   c) rabbits
   d) I don't know
9) The path where stones and earth have tumbled down a mountainside is called a:
   a) race
   b) spur
   c) slip
   d) fall
   e) I don't know

10) When we say an animal has been 'introduced' we mean it:
    a) is a native animal
    b) lives only in bush country
    c) came from another country
    d) I don't know

11) Rain can cause erosion by:
    a) making the plants grow too fast
    b) making the rivers flood over their banks
    c) keeping the sun away from the grass
    d) I don't know

12) Erosion in the sandhills is caused mostly by:
    a) hot sun
    b) heavy rain
    c) rabbits
    d) strong winds
    e) I don't know
13) What sort of hillsides are most likely to be eroded:
   a) bare hillsides
   b) grass-covered hillsides
   c) tree-covered hillsides
   d) I don't know

14) Which agent of erosion causes wide valleys in the mountains:
   a) bulldozers
   b) glaciers
   c) wind
   d) skiers
   e) I don't know

15) When a native forest is cut down:
   a) it takes many years for the trees to grow again
   b) it takes several months for the trees to grow again
   c) the trees don't grow again because there is no shelter
   d) I don't know
16) Who has been fighting against the destruction of the forest at Southern Okarito?
   a) the Native Forest Action League
   b) the Ministry of Agriculture and Fisheries
   c) the Government
   d) the Trade Unions
   e) I don't know

17) Erosion is caused by:
   a) people
   b) animals
   c) weather and water
   d) all of the above: people, animals, weather and water
   e) I don't know

18) Why do we want to stop erosion?
   a) it makes the mountains look ugly
   b) it makes the ground very muddy
   c) it takes away the growing soil
   d) it fills up the sea and makes it too high
   e) I don't know
19) Tick the boxes besides those of the following which are agents of erosion:

- water
- plastic
- trees
- bicycles
- wind
- sun
- fog
- gold

- fire
- ice
- snow
- frost
- paper
- rain
- rivers
- sea

20) Give an example of erosion close to St. Albans:

_____________________________________________________________________

_____________________________________________________________________

What causes this erosion?

_____________________________________________________________________

_____________________________________________________________________
CONSERVATION TEST

PART TWO: POLLUTION

1) Pollution is mainly caused by:
   a) storms
   b) people
   c) animals
   d) earthquakes
   e) I don't know

2) The amount of air around our world could be described as:
   a) infinite
   b) finite
   c) nobody knows if it is infinite or not
   d) I don't know

3) What do plants take in from the air:
   a) hydrogen
   b) oxygen
   c) carbon dioxide
   d) carbonic air
   e) I don't know

4) What do plants give out into the air:
   a) hydrogen
   b) oxygen
   c) carbon dioxide
   d) carbonic air
   e) I don't know
5) Which of the following words describes one kind of water pollution:

a) smog
b) erosion
c) effluent
d) flora
e) I don't know

6) How much of the earth's water is usable for man to drink?

a) less than one per cent
b) about a quarter of all the earth's water
c) about a half of all the earth's water
d) I don't know

7) Water is necessary for:

a) all living things
b) most living things
c) some living things only
d) I don't know

8) The water we use everyday comes mostly from:

a) evaporation
b) run-off
c) precipitation
d) I don't know
9) How much water is needed to grow the grass to feed the animals to produce one kilogram of meat:
   a) about five milk bottles full
   b) about 50 litres
   c) thousands of litres
   d) I don't know

10) When we can make good use of something for a second time we call this:
    a) secondary
    b) preservation
    c) regeneration
    d) recycling
    e) I don't know

11) Which of the following is the worst kind of pollution around the countryside:
    a) rotting wood and leaves
    b) muddy swamps
    c) old plastic bottles and chemicals
    d) old newspapers
    e) I don't know

12) Which of the following causes the worst kind of pollution of our rivers and seas:
    a) oil
    b) dead fish
    c) floating seaweed and driftwood
    d) I don't know
13) The hydrological cycle is about:
   a) soil  
   b) erosion  
   c) fire  
   d) water  
   e) I don't know

14) Which of the following is a food chain:
   a) 
   b) 
   c) 
   d) I don't know

15) How does the water leave the sea to get back on to land:
   a) it goes up rivers  
   b) it's pumped in pipes  
   c) it evaporates and floats in clouds  
   d) it soaks under the ground  
   e) I don't know
16) How do you feel about pollution:
   a) I think it is a serious problem and it concerns me
   b) I feel a little worried about pollution
   c) I haven't really thought about it
   d) I don't know

17) Can a very loud noise damage a person's hearing for the rest of their life?
   a) Yes
   b) No
   c) I don't know

18) Do you think there is water underneath the ground under your school?
   a) Yes
   b) No
   c) I don't know
19) Put a tick in the box beside each of the following which you think is a kind of pollution:

- flowers in a vase
- broken bottles in the river
- timber stacked in a timber yard
- smoke from a car exhaust
- a man in very old clothes
- a deafening noise from an aeroplane
- tree leaves lying beside the road
- smoke from a forest fire
- the roar of a strong wind
- people smoking
- litter
- children playing in the street
- pesticides and weedicides
- smog on a cold night
- cars lined up in a car park

20) Name two ways in which motorbikes can cause pollution when they are going down the road:

- 
- 

21) Name one kind of pollution that you would find in the St. Albans District:

- 

22) Name any one way in which you can help the problem of pollution:

- 

CONSERVATION TEST

PART THREE: ENDANGERED ANIMALS

1) When there are no more of a particular kind of animal left anywhere in the world, we say those animals are:
   a) endangered
   b) departed
   c) extinct
   d) untreated
   e) I don't know

2) Which of these animals is in danger of dying out because it is hunted by man:
   a) deer
   b) opossum
   c) dolphins
   d) whales
   e) I don't know

3) Which of these animals destroys the New Zealand bush and forests:
   a) puma
   b) wood pigeon
   c) opossum
   d) sheep
   e) I don't know
4) Birds that live on the ground and cannot fly are easy to destroy because:

a) they can be seen easily
b) animals can eat their eggs
c) they are small
d) they cannot fight
e) I don't know

5) When we say that crayfish have been 'over-exploited' we mean that:

a) there are too many of them
b) there is not enough food for them
c) too many have been caught
d) they have grown too big
e) I don't know

6) The New Zealand Government has protected a great deal of our native forest by setting up:

a) National Parks
b) Sawmilling Companies
c) Tourist Resorts
d) An Agriculture Department
e) I don't know
7) Most endangered animal species of New Zealand live in the:
   a) ground
   b) rivers
   c) cities
   d) native forests
   e) I don't know

8) An endangered New Zealand bird is the:
   a) thrush
   b) kokako
   c) pukeko
   d) magpie
   e) I don't know

9) Birds which cannot fly need to have:
   a) tall trees to climb up
   b) open spaces to run in
   c) very light feathers
   d) food near the ground
   e) I don't know

10) We use the words 'life cycle' to describe:
    a) how an animal moves around its environment to hunt and gather food
    b) the way some animals go to sleep during the winter so they don't need so much food
    c) the way an animal changes from a baby to an adult
    d) I don't know
11) How does coal mining endanger some animals:
   a) the smoke from the coal suffocates these animals
   b) the coal pollutes the ground and kills the animals
   c) when the forest is cleared for the mines the animals lose their homes
   d) I don't know

12) When we talk about native fauna we mean:
   a) native plants
   b) native animals
   c) native rivers
   d) baby deer
   e) I don't know

13) What do we mean by 'vegetation':
   a) fruits and vegetables
   b) all kinds of plants
   c) all living things
   d) soils and rocks
   e) I don't know

14) Why are there no dinosaurs left today?
   a) Cavemen hunted and killed them all
   b) they changed into modern animals like horses
   c) they lost the ability to feed and protect themselves
   d) they just disappeared for no reason
   e) I don't know
15) The Government is protecting the toheroas by:

a) growing them on toheroa farms
b) stopping people from taking too many
c) telling people that toheroas are dangerous
d) putting fences round their breeding grounds
e) I don't know

16) Oil spillages in the sea are very bad for fish because the oil:

a) changes the colouring of the fish
b) blinds their eyes
c) poisons their food
d) keeps the sun off the fish so they become chilled
e) I don't know

17) Do you think it would matter if all the elephants died out and there was none left:

a) Yes. Why? ________________________________
    ________________________________

b) No. Why? ________________________________
    ________________________________

c) I haven't any strong feeling about this.
18) Put a tick beside the animals and birds which are native to New Zealand:

- kiwi
- bush rat
- wood pigeon
- ferret
- lizard
- bat
- opossum
- kotuku
- rabbit
- tuatara
- wild pig
- stoat
- sheep
- mountain goat
- pukeko
- fantail
- cat
- deer
- man
- dog
- thrush
- takahe
- quail
- bell bird

19. Give the names of two animals which live outside New Zealand and are in danger of dying out:

____________________
____________________

20. Do you think there will ever be a time when there are no people left anywhere in the world.
   a) Yes
   b) No

Why do you think so? __________________________
____________________
Circle the letter beside the phrase which best describes how you felt about the test. Then in the space beside write down why you think you felt that way.

a) Very difficult because

b) Hard because

c) Not too hard because

d) Easy because

THANK YOU
You may find the questions in this test quite different from those in other tests. You should enjoy answering some questions but you may find other questions difficult. DON'T WORRY! Please be as honest as you can and do your best. If you are unsure about a question just write down what you do know as best you can.

1) Why did we study Conservation?

2) Why were the observers in the classroom?

3) During the Conservation Unit were the observers watching the whole class?
   a) All the time
   b) Some of the time

4) During the Conservation Unit were the observers watching the small groups you worked in:
   a) All the time
   b) Some of the time
   c) None of the time

5) During the Conservation Unit were the observers watching you?
   a) All of the time
   b) Most of the time
   c) Some of the time
   d) None of the time
   Explain why you think so:

6) How did you feel about the observers being in the class area?

7) Which situation did you find best to work in?
   a) Whole class
   b) Small group
   c) On your own
   d) Other
8) Which situation do you think you learn best in?
   a) Whole class
   b) Small group
   c) On your own
   d) Other __________________________

9) Write down the names of your special friends in class.

10) Write down the names of your special friends in other classes. Write which class they are in. You may not have friends in other classes. If so leave this question.
    Sarah, Ann, Do.

11) Do you prefer to work with:
    a) girls
    b) boys

12) Who would you choose from class to be the leader of a whole class discussion?

13) Who would you choose from class to be leader of your group for an art activity?

14) Who would you choose from class to be leader of your group if the group had to write a caption or story?

15) If you had to work with a partner who would you choose? __________________________
    Why?

16) During the Conservation Unit what would you have liked to learn more about?
    Why?

17) Were you pleased with the work you did? __________________________
    a) Yes Why?
    b) No Why?
18) Write down as many words as you can think of to describe a glacier:
Jagged, enormous, sharp, high, worn.

19) Why did Mr. Haberfield take you into the Flea Pit one day and use the vacuum cleaner to blow air over different things like sand and grass? To show us how wind blows vegetation and how it gets worn away.

20) Why did Mr. Haberfield take you into the Flea Pit one day when there was incense burning? To show us how pollution causes.

21) Name an animal which has been introduced to New Zealand which you learned about during the Conservation Unit.
Wild pig

Briefly explain how that animal caused erosion:
by digging up weeds

22) How can sounds be pollution?
by the noise

23) Why is smog bad for people?
because it gets in their lungs

24) Draw a diagram to show as much of the Hydrologic Cycle as you can remember:

[Diagram of the Hydrologic Cycle with labels for wind, water, soil, and other aspects.]
25) Should we have places like Orana Park?
   a) Yes
   b) No

26) Write down as many reasons as you can think of to explain why the Kokako is
    endangered:
    - because people are killing them
    - because the grass was eating the trees in the forest.

27) Write down your feelings about the class meeting you had in the Flea Pit to plan
    a city:

28) Do you remember learning to use an atlas during the Conservation Unit?
   a) Yes
   b) No

29) Listen to these words as I read them out. Write down the last four letters which
    make the ending on these words.

30) Write down the three letters which make the beginning sound in these words:

On the back of this sheet make any comments you would like to about the Conservation
Unit, this text or your ideas about how you learn.

THANK YOU