

The Role of Language in Design and Technology: Implications for Curricular Changes

Janet White

National Foundation for Educational Research

Current thinking in the field of design and technology, and in language studies, emphasises knowledge of process as an important outcome of learning and teaching. For example, the attempt to synthesise craft, design and technology subjects into a manageable area for GCSE purposes relies on the identification of common themes of understanding, enquiry and communication. Of the four domains selected for assessment, one is entitled 'product realisation', while the other three refer to abilities in 'design and problem solving', 'communication', and

'knowledge and understanding' (SEC, 1985).

A great deal of current work in the language curriculum is also concerned to highlight the processes that go into the making of finished 'products', and to stress the link between language and thinking. We can see signs of this emphasis particularly in the recent upsurge of interest in oracy and in new ideas about the teaching of writing. It seems to me that there is much to be gained from the fact that within two subject areas — Design and Language — highly similar new emphases are

being developed. Previous experience shows that it is not enough to proclaim language — across-the-curriculum as would-be panacea; without a specific understanding of the ways in which language is used in different curricular areas, and of the way each subject shapes its meanings through language, none of us is in a position to say whereabouts language is at all. To prevent the isolation of language as the property of the English department solely, we need information from language users in other subjects.

This article is thus primarily a way of putting on record some observations from 'the language side'. I will be concentrating on the role and nature of writing in areas such as extended project work, involving semi-technical, and non-narrative uses. Similar observations might be made about reading or spoken language.

I wish to develop several themes:

1. the nature of existing practice in project-type work,
2. the model of learning presupposed by a great deal of writing practices, and
3. signs of changes in the writing experiences of school children.

Writing and learning: the search for extended project work.

Since the 1982 Secondary survey (DES 1984), the APU language team has been collecting evidence about the use of writing to plan investigations. A specific category used in the work-sampling (or course work) component of the surveys has been described as follows:

- * a piece of writing concerned with practical work or devising an investigation (eg. craft, design, technology, home economics, fieldwork, science).

In the 1983 survey (DES, forthcoming), we made our request to teachers even more pointed in the attempt to secure writing that was in fact concerned with the process of planning:

- * It is quite common in schools for pupils to write a description of an investigation which they or their teacher have just made. It is probably less common for pupils to be asked to plan the investigation themselves, in writing before carrying it out, or to test the feasibility of doing so. We are interested in sampling writing that falls into this 'problem solving'

Illustration 1

One way to determine the velocity of the wind is with two people — one with a stopwatch and the other with a starting pistol. When person B sees the gun give off a puff of smoke as a result of the gun being fired, he starts the stopwatch. However, when he actually hears the sound of the gun being fired, he stops it. If for example the time on the watch is 1.5 seconds, then the velocity of the wind at that time is $100 \text{ m} / 1.5 \text{ sec}$. But usually, the time is not usually more than 2 seconds. If this experiment was repeated with the distance between A and B repeatedly varying, then at least three things can be found out:

- 1) The further away "A" is, then the time between "sight and sound" grows.
- 2) The nearer "A" is to "B", then the time between "sight and sound" shortens.
- 3) If "A" was to stand about 1 or 2 metres from "B", then the time between "sight and sound" would be virtually nil.

But what if it was a windy day? The following method could be used if it was a windy day or not:

"A" and "B" do as previously described, and take "sight and sound" time. They then switch places and take another time. The velocity of sound will be the average of the two times

category from any area of the curriculum in which it occurs.

In neither survey however has this category been well represented. For example, in 1982 only 16% of scripts (out of a total number of 700+, from 91 schools) were sent in as illustrative of this category. The work that we did receive was predominantly from mainstream science and home economics, and was characterised by standard accounts of experiments (aim, apparatus, method, results), or by work plans for home economics, often simply a work sheet filled in giving ingredients and cooking/preparation times for meals. The system of recording much so-called investigative work in school science (aim-method-results-conclusion) obliterates the questioning investigative basis of actual scientific inquiry in which the segmented structure of a report addresses questions and problems (Lindsay, 1984):

- what do we seek to discover/hypothesise?
- how do we set about operationalising the inquiry?
- what selection of results do we decide to report?
- how does the experimental outcome relate to our first questions?

In scientific reports and papers it is also customary to acknowledge/refer to other relevant work in the field. Explicit recognition of a community of thinkers

and writers is not included in the standard school 'practical'. Such work plans and formal write-ups are predicated upon the idea of discrete, non-recursive stages which will issue into a successful product; they make no provision for error or revision, and allow no scope for deviation or individual adjustment in the face of unexpected outcomes.

There did appear to be some areas of the curriculum in which the skills of planning and recording what was done were more closely integrated. This was demonstrated by work from Rural Studies, Craft and Design, Computer Studies and (fieldwork) Biology. (I stress here that I am referring to a minority of cases). A piece of work from Rural Studies was the report of several months' observational study of birds in local habitats, another was a long investigative account of greenhouse-growing complete with diagrams. Some of the work in Design and Technology was specifically labelled 'research before practical work' with the stated aim: 'collect ideas, compare one solution with another and decide which the pupil thought answered the question' (in this case, the design of a wine rack). Mainstream science subjects provided few variations from standard format, or occasions to work on a hypothetical investigation. The following account of a pupil's plan to determine the velocity

of wind is an illustration of a less conventional approach. Illustration 1

Overall, work collected in this category testifies to the use of writing to record particular items of knowledge in specific subject areas. Such writing affords little scope for individual variation in expression, and implicitly discourages any liberties in experimental design. At least two-thirds of pupils were given an outline plan to work to, used notes (copied from the board or dictated), work sheets, or combinations of all these aids. Teachers commented that the work followed the 'standard format' of experiments, the 'specific rules' for the subject concerned or was done as 'set by the exam board'. Teachers had also given suggestions concerning tabular layout, design format, techniques of measurement and sequencing of procedures.

Introduction and input to writing

Teachers were asked to say what had lead up to the writing, in terms of input such as discussion, reading resource pack, etc. At secondary level, at least two-thirds of practical work had been preceded by 'discussion' or 'reading and discussion'. However, the nature of these discussions can best be inferred from teachers' comments about their themes: 'review of previous work', 'methods and expected results', 'theory and method', 'rules for --2. The reading done as a preliminary exercise was reading of the associated textbook(s). What is actually being called discussion in these circumstances is more accurately thought of as general class teaching of the 'chalk and talk' variety. In the pre-writing phase as in the writing itself, the picture that emerges is one in which practical work is directed and prescribed, with little scope for engagement on the part of pupils. Very few had been involved in a process described 'research, investigation and decision making', or had had the experience of working with materials in order 'to get to grips with it themselves'. Very few schools mentioned varied inputs such as photographs, films, videos and documentary material, or visits to sites of geographical or historical interest.

Writing and learning

Teachers of all subjects were asked 'how

Illustration 2

A	B
1. white and yellow	Black and red
2. bigger body	smaller body
3. smaller wings	bigger wings
4. different pattern	diff. patterns.
The moths are the same but moth A is bigger than moth B and they have different patterns. and different abdomens and they have moth B has a bigger head than moth A and moth B has bigger antennae and moth A is white & yellow and moth B is black & red and moth B has got bigger wing than moth A	

does this particular piece of writing exemplify the relation between writing and learning in the school subject concerned?' Their answers may be predicted from the above description of the work collected. (One answer, more breathtaking than most, was 'I've no idea — does any science teacher?'). With great unanimity, over one quarter gave answers to do with the use of writing as a synthesis for reading or class discussion, commenting, 'writing ensures that some material lodges in the memory'/'consolidates oral classwork'. Another swathe of teachers saw writing, as geared to examination requirements: 'we are dominated by O-level', or saw the purpose of writing in terms of its usefulness as a revision aid. Roughly one in ten teachers gave replies that related more to the process of pupils' development as thinkers and learners, noting that writing helped in understanding, in selecting relevant materials, or aided in the organisation of ideas. Notions about the use of writing as something that might enhance pupils enjoyment of learning were expressed by about 2% of teachers.

Ways of writing about technical subjects: continuous prose or point form?

Good technical explanations succeed at many levels; not simply by means of the clarity of the prose but also because the

message-bearing responsibility of a written text can be shared with or subordinated to graphics (White, 1987). Technical writing affords an opportunity to break away from the standard essay format of sequenced paragraphs characteristic of narrative or descriptive prose.

For many children in our sample, 'writing' still means continuous prose in the essay tradition; yet variations on this model (such as subheadings, numbering, underlining of varied layout) make the reader's task much easier when a series of steps has to be followed, or where essential information has to be given in discrete stages. Children seem wary of using numbered points in 'finished' writing; although numbers may be used in the initial draft stage, these tend to be obliterated by paragraphs when the writing is for real.

An example of an eleven year-old unable to capitalise on his initial set of notes is shown below (the task was to write about differences between a pair of tropical moths). The observations recorded in column format have a potential clarity and order, proceeding from the most salient differences, that of colour, through size of body and wings, to differences in patterning of colour markings. By contrast, the prose paragraph begins by blurring a sense of difference, mixing considerations of size and colour, with the crucial point

relating to colour lost in the string of remarks about bigness. Illustration 2

Writing or drawing?

Although it might be expected that in the work of younger pupils elements of 'drawing' might be more common, they appear as a group to be as uncertain about the use of diagrams in a written text as do the older pupils.

A characteristic of younger writers' work is the inclusion of drawings as an optional extra, more in the way of illustration, than as material integral to the clarity and purpose of the writing. This is perhaps a legacy from initial writing instruction when children are given a chance to draw, sometimes as a time filler. Quite soon in the literacy education of children, drawing becomes synonymous with 'art', something distinct from continuous prose, which is 'writing', although spontaneous attempts at written communication by many children contain both elements.

Analyses of many scripts has shown that a great deal of pupils' writing is characterised by its formal inflexibility, and uncertainty as to the selection and appropriate use of graphics. Even amongst the better writers it was evident that decision about the use of graphics were taken in an ad hoc fashion, as pictures suddenly appeared mid-paragraph for no particular reason.

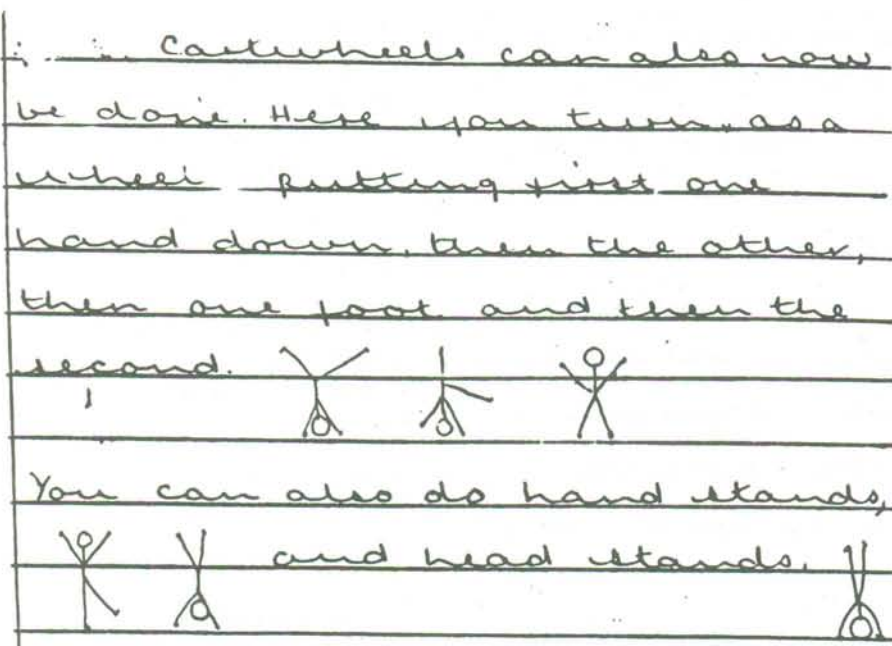
Across the whole range of performance, it was noticeable that diagrammatic content was meagre in proportion to text, and too often crammed into a tiny space, often without labelling or identification, as if 'drawing' was a decidedly inferior component and not at all related to 'writing'.

The following examples written by 15-year-olds are taken from otherwise competent explanations of gymnastic techniques and the process of milking respectively. Illustration 3 and 4

Creating links between writing and other semiotic systems

Consideration of examples like those given above reminds us that development of a range of writing skills should not be the sole responsibility of the 'English' teacher: there are aspects of text structure which would surely benefit from the expertise of teachers of art or graphic design. It would be

Illustration 3



encouraging to think that an off-shoot of the current enthusiasm for technology in education went some way towards recognising the link between writing (itself a highly abstract visual system) and other graphic arts. Too often a piece of written work is 'marked' for the verbal information it contains without corresponding attention to its style or format, or conventionalised graphics/symbols are presented without mediation through language.

Additionally, the increased interest in technological questions which characterises many current discussions might serve to enhance the image of practical (i.e. scientific or technical) writing in the eyes of English teachers, and to undermine the thoughtlessness of the frequently invoked dichotomy between functional and creative uses of language. Of all the formal and organisational aspects of technical writing it may be said that their selection is determined by functional criteria, but saying that is not to undervalue the investment of creative energy in making that selection.

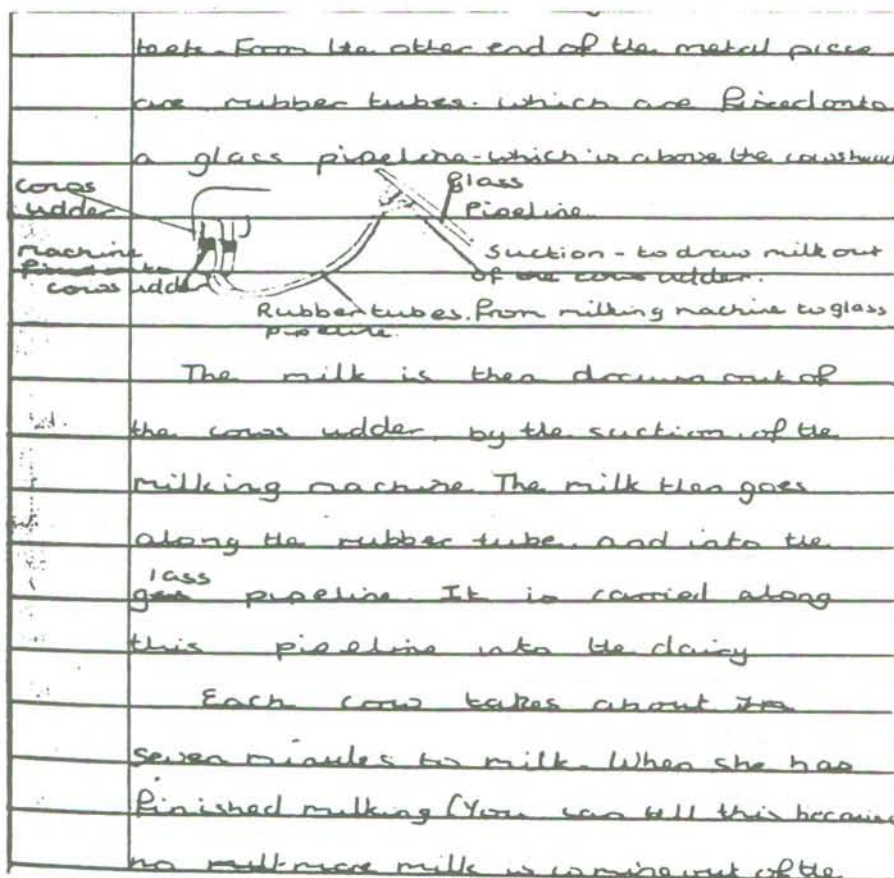
A similar point can be made concerning the linguistic choices open to technical writers. What resources are available for managing a series of references to the same or closely allied subjects without producing a piece of monotonously repetitive writing? How is the reader to be addressed? Are personal pronouns to be avoided in the interests of 'impersonality', often thought of as a criterial feature of scientific writing? Attention to the forms of language used is not an optional extra at any level of text construction.

Sources and models for technical writing

Throughout many years of schooling, the reading and writing of stories is a popular and much practised activity, but narrative writing is only one of many uses of written language (White, 1986). While secondary school pupils undoubtedly 'process' formidable chunks of non-narrative prose, how much of this is ever read with the critical attention customarily given to fiction,

poetry or drama? Technical or scientific texts tend not to figure on CSE/GCE English reading lists, although we know that factual and informative literature forms a stable part of boys' voluntary out-of-school reading, at age 15 especially. If language work in school does not engage these interests, then the experience of many pupils is perhaps down-graded or, more seriously, never developed. This applied particularly to girls pursuing arts subjects and less likely in the course of their casual reading to have to deal with technical writing. Teachers of subjects other than English, working with the language specialist, have a responsibility to educate pupils in the particular reading and writing demands of their fields. Unless there is an understanding of and commitment to the role of language in all areas of learning, the result is that 'doing well at English' comes to mean being expert in other than technical registers. Language and technology need to go together across the curriculum of communication skills are really to be enhanced.

Illustration 4



Summary of problems

1. Few schools have anything like a policy for writing across the curriculum which would ensure that a diverse range of occasions for writing were provided, drawing upon, as distinct from reinforcing, the subject knowledge of many areas of study. Pupils therefore have few models to work with when it comes to producing extended pieces of writing on their own; the exception to this being narrative fiction.
2. The English lesson remains the central focus for writing and is, at secondary level, the main provider of opportunities for extended writing in which pupils may explore at some length an argument, hypothesis or theory. Unfortunately, the compartmentalisation of subject knowledge means that pupils are set these worthwhile writing assignments in something of a content vacuum. Language demands which are made by technical subjects, such as the need to understand precisely a set of instructions or to communicate information on how something works, are rarely the subject of specific teaching.
3. In most parts of the curriculum

represented in our sample, there was a heavy emphasis on didactic learning. Pupils seemed to have few occasions on which a legitimate use of writing might be to question or genuinely research some area of their learning. In this context, the popularity of fictional narrative as a writing task is easier to understand, since this genre gives the illusion to some pupils that they are able to exercise their imagination with a freedom not allowed elsewhere in schoolwork.

4. The tight control exerted by teachers

over the shape and substance of written work makes it difficult for pupils to bring to bear on their schoolwork experience derived from outside school. Reference to such experience would seem to arise naturally in discussions of how to set about a problem solving exercise and, in 'real' problem solving tasks, provide a pool of expertise on which all participants draw. It hardly needs pointing out that the prestige of the mainstream sciences with their specific modes of discourse makes it difficult for language teachers and

teachers of other practical subjects to sustain innovations in language use beyond their classroom doors.

Changes in the writing curriculum

The problems outlined above have been noted by other researchers and teachers concerned with language, development, and with the role of language in learning. For example, a great deal of work has been done to improve the initial writing experiences of children using what has become known as the 'process or workshop approach', which stresses the recursive stages in the production of a written text; collaboration, redrafting and evaluation in the light of feedback from an audience are all features of process classrooms (Bates, 1986).

As might be expected such an approach is more easily contemplated in the primary school where an integrated day is in theory a possibility. Finding ways of either continuing the approach or introducing it to later years of schooling is more problematic. Two kinds of initiative are noteworthy here.

1. The process/workshop approach to early writing, with features such as records, plans and progress notes kept by pupils, has had the effect of giving many children a foothold in the written language and establishing themselves as communicators. One way of continuing this impetus has been through the systematic keeping of journals. Such writing might be done with a specific reader in mind (a direct line to the teacher, for example), or might be undertaken basically as a means by which the pupil sorts out some area of learning.

Teachers have reported on the success of journal writing from disparate contexts and with different age groups, even with groups of teachers themselves. One teacher commented:

Five year olds, whose only previous experience of extended writing had been retelling a story, chose subjects as diverse as news items seen on television, how their scabs fell off and how the gears of a car work . . . Several children who had previously been thought to have limited writing ability produced work of considerable length and fluency.

Margaret Wallen,
National Writing Project, Dorset

Illustration 5

Group Notes Before

names _____

What are we trying to find out?



What is our plan of action?



What do we think will happen

Similar work has been reported from the University of California, Bay Area Writing Project. Mary K. Healy describes the approach as 'based on the proposition that if students were encouraged to see writing in its initial stages, as the record of their first tangible connections with a subject, and as the changeable exploration of the field to be written about, then writing in school might lose some of its awful finality and gain in usefulness to the student writer' (Healy 1981). In this project, journal-writing activities were

introduced in social studies, maths and English. They served the double purpose of helping students to realise the limits of their understanding as they tried to write explanations of what they were in the process of learning, and gave the teachers insight into the problems that such an activity posed. Using this information alongside that gained from performance on set work and tests, teachers devised work that was more suited to individuals' needs. The journal entries also provided the basis for small group discussion, giving for students an

opportunity to revise their explanations where these were unclear or incomplete. The examples that follow show the way pupils went about the task of explaining prime numbers to a younger child (ibid):

First I would give him/she two examples like, 7. 'What are the factors of 6?' He/she would probably say 1 and 7 and 7 if he/she was smart. Then I would say 'What are the factors of 3?' He/she would say there are two numbers in each. I would say that is a prime number because there are only *two* factors. Other numbers with *more than two* factors are called composite numbers.

11-year-old-girl

So, you want to know about primes, do you? Well, let's just only work on the primes between 1-12. A prime is a number in which no other numbers can be multiplied to make that number besides 1 and itself.

Here is the number 8. 8 is *not* prime. You know the factors of 8. 1, 2, 4, 8, 2×4 and 4×2 . 1×8 and 8×1 .

You see that 2×4 and 4×2 goes into eight.

But 11 is a prime number. No other factors besides 1 and 11 can make 11. So, you see that eleven is prime because only itself times 1 equals it.

11-year-old boy

2. The spread of journals as a viable means of learning through writing is one testimony to the reappraisal of the place of writing in school. In this country, some of the most enlightened classroom changes are being generated by teachers working with the National Writing Project. The project as a whole endorses assumptions about writing which are familiar to those working with the APU team — namely, that writing should be purposeful and be addressed to a reader: from our point of view, the interest is in the translation of these ideals into classroom realities. For example, teachers working with the NWP have suggested ways of splitting up the monolith of school writing, by offering pupils selective research tasks, in contrast to the lock-step approach of the traditional 'science' classroom; providing opportunities for speculation and hypothesis; using writing as preparation for an end product that is

Illustration 6

Group Notes

After

names _____

What changes, if any did we make in our plan of action?



What happened? Did the experiment turn out as we thought it would?



What do you think this experiment as shown you?



See if you can find any other investigations to do on this subject.

not itself writing; giving pupils a choice of ways of using the same information; and above all, by scrutinising and abandoning worksheets which militate against extended, searching writing, and, by analogy, against sustained thinking (ref. Richmond, 1986).

To conclude with a practical example of the kind of work that is being developed, I would like to refer to some materials produced by one Project authority, Sheffield (Harris and Horner 1986). This project began with a 'work sampling' exercise, gathering writing from classes at the end of primary school and the start of secondary school. Their findings replicate those of the APU survey. In response, teachers have re-examined the place of writing in particular curricular areas to see if more meaningful links can be made with the learning processes supposed to be going on. Areas chosen for attention are project work in history, group story writing in English, and Science work. This approach explicitly uses language as a means of bringing to consciousness ideas or presuppositions about a planned activity, thus giving pupils a personal starting point in what they intend to do. Language is likewise part of the reflective stage of the activity, as pupils look back on what they have done, and prepare to communicate or evaluate the outcomes. Illustration 5 and 6

These examples illustrate a simple but dramatic shift of emphasis from the model of the pupil as an empty vessel waiting to be filled with knowledge, and then asked to use writing as proof that sufficient saturation has been achieved, to the recognition that already as competent users of language, pupils are in possession of knowledge of their own and are able to use their language as a means of enhancing it. In this model of learning, writing has many functions. Interacting with talk, with reading, with developing thoughts, and finding expression in actions as well as by means of words on the page, in this context writing comes to serve a real communicative function.

Acknowledgements

The author wishes to thank the Assessment of Performance Unit (Department of Education and Science) for permission to use material from published reports and from the pamphlet, 'Writing by Design', in press. Thanks are also due to the National Writing Project team in Sheffield for generous access to materials.

References

- Bates, Richard (1986) *The Writing Process*. In *Avon Articles* Issue No. 1, September 1986. County of Avon Public Relations and Publicity Department.
- DES (1984) *Language Performance in Schools: 1982 Secondary Survey Report*. London: DES.
- DES (forthcoming) *Language Performance in Schools: A Review of Language Monitoring, 1979-1983*. London: DES.
- Harris, John and Sue Horner (1986) *Writing at the Transition: The First Year*. London: SCDC.
- Healy, M.K. (1981) *Learning to Write: An Approach to Writing in Three Curriculum Areas*. In C.H. Frederiksen and J.F. Dominic (eds.) *Writing: The Nature, Development and Teaching of Written Communication, Vol. 2, Writing: Process, Development and Communication*. Hillsdale, NJ: Lawrence Erlbaum.
- Lindsay, David (1984) *A Guide to Scientific Writing*. Cheshire: Longman.
- Richmond, John (1986) *A Policy for Writing*. Mimeo. London: SCDC.
- SEC (1985) *Report of Working Party, Craft, Design and Technology. Draft Grade Criteria*. London: SEC.
- Sheffield City Polytechnic/Sheffield LEA/SCDC (1986a) *Writing at the Transition: Progress Report*. London: SCDC.
- Sheffield City Polytechnic/Sheffield LEA/SCDC (1986b) *Thinking into Writing, Book two, Choices: Pupils Framing Questions*. London: SCDC.
- Wallen, Margaret (1986) Journals 5 to 13, A Dorset Experiment. In *About Writing* (The SCDC National Writing Project Newsletter), No. 3, Summer.
- White, Janet (1986) *The Assessment of Writing, Pupils Aged 11 and 15*. Windsor: NFER-Nelson.
- White, Janet (in press) *Writing by Design*. APU Language pamphlet. London: DES.

ENVIRONMENTAL IMPROVEMENTS LIMITED

Name:
 Position:
 L.E.A.:
 Address:

 Tel:

NATURE OF ENQUIRY

Catalogue ☐
 Design & Planning Service ☐
 C.D.T. Trolley for Primary/
 Secondary Schools ☐
 Representative to call ☐

SIDECT

ESPI

(TICK BOX)

Please send me details of:

- ☐ Resources Box
☐ Teaching Aids
☐ Careers
☐ Schools-Industry Links
☐ Video Film
☐ Girls Careers Poster
☐ Safety Material

Name
 School/College
 Department
 Address

 Postcode

SIDECT

CROUZET

Please send me your stepper motor information pack

Name
 Position
 Company
 Address

 Telephone

SIDECT