The recontextualising of pedagogic discourse: a case study drawn from an inservice mathematics education project

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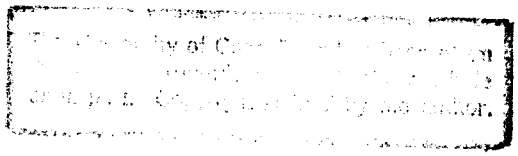

Abstract

The recontextualising of pedagogic discourse: a case study drawn from an inservice mathematics education project

The dissertation is concerned with the production of a systematic account of the recontextualising of pedagogic discourse across two contexts: mathematics INSET provision and school mathematics teaching. Drawing on the work of sociologists Basil Bernstein and Paul Dowling, an attempt is made to construct a theoretical model which is applied to produce a reading of the interactions between an INSET provider and a teacher, and the teacher and school students.

The dissertation opens with a description and discussion of the conceptualising of the research project, the production of data, and the use of the literature survey and theoretical resources in the production of a methodology.

The second chapter presents a review of the literature on INSET in which three chief components of conceptions of good INSET practice are highlighted: teachers should define their own needs; INSET should be concerned with the professional development of teachers, where professionalism implies an exclusion or marginalising of academic concerns; and INSET should be school-focused. The chapter moves on to consider NGO-provided INSET and concludes with a discussion of INSET in terms of Bernstein's categories *horizontal* and *vertical discourses*.

In the third chapter elements of Bernstein's code theory and Dowling's language of description are appropriated to construct a model which contextualises the study, produces an account of the transmission and acquisition of pedagogic discourse which attends to the interactions between transmitters and acquirers, and generates data for analysis. The chapter concludes with a summary of the model.

Chapter 4 is devoted to an analysis of written materials from an INSET course which the teacher attended as well as the interactions between the INSET provider and teacher. An analysis of the use of wall displays and the arrangement of the classroom is produced in chapter 5, followed by an analysis of the interactions between the teacher and students. The analysis focuses on the way in which the utterances of the transmitter and acquirer are redescribed to produce pedagogic texts.

The dissertation is concluded in chapter 6 which opens with a discussion of the resources and strategies implicated in the recontextualising of pedagogic discourse after which a summary of the analysis is produced. The last section of the chapter discusses the limitations of the research and the model.

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Abbreviations

ANC	African National Congress
AR	The plane of Acquisition Recontextualising
BA	Bachelor of Arts
BEd	Bachelor of Education
BPrimEd	Bachelor of Primary Education
BSc	Bachelor of Science
CASME	Centre for the Advancement of Science and Mathematics Education
CED	Cape Education Department
COUNT	Cooperative Organisation for Upgrading Numeracy Training
CPE	Centre for Productive Education
DEC (HoA)	Department of Education and Culture (House of Representatives)
FDE	Further Diploma in Education
GAP	General Approach Plane
GPP	General Pedagogic Plane
HDE	Higher Diploma in Education
HKS	Horizontal Knowledge Structure
IDT	Independent Development Trust
INSET	Inservice education and training
IPI	INSET Policy Initiative
MCPT	Maths Centre for Primary Teachers
MEd	Master of Education
MEP	Mathematics Education Project
NGO	Non-governmental Organisation
OHP	Overhead projector
OHT	Overhead projector transparency
PRESET	Preservice education and training
RUMEUS	Research Unit for Mathematics Education, University of Stellenbosch
SCP	Specific Code Plane
SPP	Specific Problem Plane
TR	The plane of Transmission Recontextualising

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Chapter 1

Conceptualising the research project

INSET is widely referred to in South Africa as a mechanism for addressing the country's pressing educational needs. This notion is expressed in the following extract from a document prepared for the INSET Policy Initiative, a body which seeks to encourage collaboration between INSET providers:

> Education in South Africa is at present facing the challenge of undoing years of apartheid policies. The effects of these policies have been widely felt in the areas of teacher education and teacher development. Schools contain many teachers who have been trained under the narrow and authoritarian philosophy of Fundamental Pedagogics, or who are not fully qualified in their field. INSET becomes fundamentally important in this regard, both as a strategy to update and upgrade teacher knowledge, and as a means to introduce new ideas and skills to teachers in the field.
>
> (Robinson & Versfeld, 1994: 2)

Government, through structures like the IDT, capital and foreign donor agencies have contributed large amounts of money to INSET funding (Khan, 1993), indicating a widespread support for the views expressed above.

A fundamental assumption of INSET provision is that INSET providers can collectively effect a large scale transformation of teaching practices which will benefit schooling, commerce and industry in general, and tertiary educational institutions by developing in students, through their teachers, competencies and abilities which enable them to perform more successfully across different contexts. However, Khan (1993), in a comprehensive review of local initiatives in science and mathematics education, points to a number of problems in INSET provision, one of which is that there is no necessary transference of knowledge from INSET provision to the classroom, or to schooling in general:

> **Also questionable is the basic premise that implementers can effect change as they go around the field selling their wares. Even if the implementers were brilliant teachers themselves, it does not follow that this talent is transferable through the peripatetic method.** [...] Furthermore, cascade methods have failed spectacularly throughout the world. Teacher leaders, implementers, field educators, whatever the

> name may be, cannot effect miracles. **Their message is subject to dilution the further downstream in the education chain it goes, especially where there is no coherent programme for INSET leading to recognisable attainment.**
>
> (Khan, 1993: 39. My emphasis.)

Khan's misgivings about the assumption of transference of knowledge from INSET provision to the classroom are echoed by a number of academic researchers who argue more generally that there is no necessary coherent transference of knowledges and practices across contexts. The work of Bernstein (1990, 1994), Carraher (1991), Carraher *et al* (1985), Dowling (1993e), Lave (1988), Lave *et al* (1984) and Walkerdine (1988), for example, all suggests that there is a necessary transformation of the knowledge which is assumed to migrate intact across contexts. The assumption that knowledge remains stable across contexts is commented on by Lave (1998: 9) as follows:

> Cognitive psychology accounts for stability and continuity of cognitive activity across settings through the psychological mechanism of learning transfer. That is, knowledge acquired in "context-free" circumstances is supposed to be available for general application in all contexts, widely transportable but relatively impervious to change in the course, and by the process, of travel and use. The central role of learning transfer reflects the functionalist assumption of literal culture transmission that informs broad conceptions of socialization and more specifically, the conceptualization of relations between school and everyday practice.

The general validity of arguments against the assumption of knowledge continuity and stability across contexts is supported by a recent research study (Galant (1994)) which examined the transference of pedagogic knowledge and practices from INSET provision to school mathematics teaching. Like Galant's study, this study is also concerned with the transference of pedagogic knowledge from INSET provision to school mathematics. However, the central interest of this study is to go some way towards providing a theoretically principled account of what is transferred and how, across the contexts indicated above. My interest in researching the transference of knowledge across contexts derives from my being employed by a mathematics INSET project as well as an engagement with the work of Bernstein and Dowling. As an INSET provider, the question of transfer is central to my work.

Teachers apparently transfer contents from INSET courses and materials to their classrooms and thereby, it is often assumed, transform their teaching practices into that privileged by INSET providers. However, the work of theorists cited above suggests that a transformation of the transferred knowledge must take place. So, how are the knowledges transformed? Further, if a transformation of knowledge does take place, how are INSET providers able to read the transformed knowledge as equivalent to that which they privilege?

Rather than use the terms "knowledge" and "transfer", I will use the terms "discourse" and "recontextualising" which are used by Bernstein and Dowling. For Bernstein and Dowling recontextualising refers to the process by which contents of a discourse are delocated and relocated to a different discourse. Bernstein (1994) has argued that the "pedagogic device" should be a central object of analysis in the sociology of education. He defines the "device" as follows:

> [A] pedagogic device can be considered as a set of hierarchical rules, distributive, recontextualizing, evaluative, which constitute its internal grammar. [...] The pedagogic device makes possible the transformation of power (that is, its basis in social relations and their generating sites) into differently specialized consciousness (subjects) through the device's regulation and distribution of 'knowledges' and of the discourses such knowledges presuppose.
>
> In this sense the pedagogic device is the condition for culture, its productions, reproductions, and the modalities of their inter-relations.
>
> (Bernstein, 1990: 209-10)

For the purposes of a necessarily limited study such as this has to be, I have focused on one aspect of the pedagogic device: the recontextualising rules. Of course I cannot simply cut out one aspect and consider it in isolation from the others which constitute the device, especially as one level is derived from the one before and they are all interconnected. The other rules (distributive and evaluative) are present in the study but they are not the central focus.

An important assumption in this study, derived from the work cited earlier, is that there is always a transformation of contents of a discourse across contexts. Bernstein (1990) refers to pedagogic discourse as a discourse of instruction embedded in a discourse of order, or regulation, in which the regulative discourse is dominant.

Following from this definition of pedagogic discourse is an expectation, or assumption, that the regulation of consciousness will feature most strongly in recontextualising, and this regulation is concerned with establishing privileged meanings within and across the contexts of INSET provision and school mathematics teaching. If the regulative is dominant in pedagogic discourse, then it is the regulative which must be given priority over the instructional in the recontextualising of pedagogic discourse. These two assumptions can be brought together to generate a hypothesis: in the recontextualising of pedagogic discourse from INSET provision to school mathematics teaching, it is the regulative features of the pedagogic discourse of the INSET providers which will be prioritised over the instructional, but these regulative features will necessarily be transformed when realised in school mathematics teaching.

The task of this project is to move towards the construction of a theoretical model which enables a systematic description of the recontextualising of pedagogic discourse across the contexts of INSET provision and school mathematics teaching at the micro-level of interaction between agents in pedagogic relationships. The research study does not claim to have achieved the construction of a model of sufficient generality and coherence to enable it to be transported away from its empirical focus. The development of a model of greater generality and validity is left as a future project.

The purpose of the remaining part of this chapter is to describe in detail how the research was conceptualised and conducted. I shall begin with a general description of the activities of the inservice mathematics project under study after which I shall describe the collection of data. The last section of the chapter will discuss the role of the literature survey and the selection of theoretical resources in the production of the research methodology.

1.1 The organisation of INSET provided by the Project: an apprenticeship model

The inservice mathematics project, which is based at a university, has been in existence in various forms since 1986. The inservice project consists of primary and secondary school units and an administration unit. Workshops, short and long courses, as well as school-focused INSET work is offered by the project to schools in "disadvantaged communities". The teachers with whom the inservice project works approach the project on a voluntary, individual basis. The study focused on the activities of a secondary INSET provider and a secondary school teacher who attended one of the courses which the inservice project's secondary unit (hereafter referred to as the Project) offered.

An INSET provider is assigned a teacher and begins to work with the teacher on a one-to-one basis. The provider visits the teacher's classroom as a participant observer, prepares lessons with the teacher, assists the teacher in the production of workshops, provides the teacher with teaching resources (apparatus, student tasks, etc.), sometimes supervises the teacher's writing on aspects of teaching and/or learning mathematics and occasionally co-authors a paper with the teacher. Most of the teachers with whom the Project interacts in this way attend, or have in previous years attended, a mathematics education course, aimed at the professional development of teachers, which is offered by the Project. In addition to the range of activity sketched above, the Project organises a mini-conference, attended only by the Project and the teachers on the course, at which the teachers present papers on topics which are of interest to them. The mini-conference is held over a few days at a venue at which the teachers and Project workers sleep over for a number of days. Project workers and teachers live together, sharing meals, recreation periods and discussing issues in mathematics education.

The Project also has in place a programme of secondment; teachers are released from their teaching duties in school for a year to work in the project and are involved in the same range of activities as the permanent Project workers.

The reader will recognise from this description of the Project's inservice activity that it is significantly different from most pre-service teacher training programmes. The Project enters the school in a manner which is rather different from that of pre-service teacher training institutions, using the teaching activity it observes *and participates in* as a resource in its inservice work. The activity of the Project functions as a forum for the collection, analysis and dissemination of teachers' pedagogic discourse amongst the teachers with whom it works. Some of this work is made available to a wider teacher readership through the publication and sale of teachers' writings (e.g. Coombe (1994, 1995) and the Project's *Newsletter*).

With formal pre-service teacher education programmes (e.g. HDE, B.Prim.Ed.) and inservice programmes (e.g. B.Ed.) the training institution enters the classroom only briefly to assess practice teaching, or sometimes not at all as is mostly the case with the B.Ed. The Project, on the other hand, uses the classroom as an integral part of the training of teachers; that is, the classroom is used not only as a site for the evaluation of the teacher but, importantly, as a site for the demonstration, by INSET providers, of various features of good practice and as an integral part of the apprenticeship of teachers to project conceptions of good practice.

There is, within the Project, the recognition that the recontextualising and (re)production of pedagogic knowledge by teachers is valid, an indicator of which is the publication and dissemination of such knowledge. This is generally not a feature of formal courses: the writings of trainee and experienced teachers are considered useful only for formal assessment and little else. In fact, built into the project's work with teachers is a guarantee that their writings will be published (Coombe (1994) and Colyn (1993 & in press) are examples). Apparently, with respect to what constitutes valid pedagogic knowledge as the programme unfolds, the pedagogic discourse of teachers and INSET providers comes to be considered as equally valid. That is, teachers, like INSET providers, can and are invited to enter into pedagogic relationships (as transmitters) with other teachers (acquirers): their colleagues, teachers who have just entered a relationship with the Project, audiences at workshops or talks, and so forth. Insulation between categories (INSET provider/teacher) is

reduced, each category is less specialised and control is located more with the acquirer, indicating a weakening of classification between the categories (Bernstein, 1990: 99). This is not a claim that differences between project worker and teacher disappear but merely to point out that teachers' (re)production of pedagogic discourse, which is the result of the recontextualising and reproduction of pedagogic knowledge, is considered valid by the project and is disseminated to other teachers. The limits of communicative potential are such that the pedagogic discourse of teachers is embraced. The regulation of the form of legitimate message is effected as much by teachers as by project workers; location over control of the rules of communication are shared.

1.2 The collection of data

In order to generate data which would enable me to examine the recontextualising of pedagogic knowledge as it occurs in interactions between pedagogic agents, I decided to collect four sets of data covering: the secondary INSET course which the teacher attended; the interactions between the INSET provider and the teacher during planning sessions and post-lesson discussions; the use of wall displays in the teacher's classroom; and the interactions between the teacher and her students during lessons.

Video records were made of the interactions of the INSET provider (Mark Edwards) and a teacher (June Smith) with whom he worked. The video records of the planning sessions show June and Mark planning lessons on the introduction of the cartesian co-ordinate plane. The particular planning session which is focused on in this study involved a discussion of a suitable approach to introducing the plane and the use of appropriate manipulatives. The post-lesson discussions were used to reflect on what happened during the lessons.

I also made video records of June teaching. Both Mark and June attended an INSET course for junior secondary school mathematics teachers which was offered by the Project. This course was also attended by the other INSET providers employed by the

Project. Each of the INSET providers were assigned one or more teacher with whom they had to work in the schools.

1.3 The INSET course

The collection of data on the INSET course was done to provide a context for the study. On the course, which ran from April to October in the form of weekly sessions (except during school holidays), the INSET providers and teachers were co-participants. The course was led by the most senior secondary school INSET provider who had the responsibility of planning the course as well as co-ordinating the activities of the other INSET providers.

I was given access to the notes of the course leader for the purposes of research. The notes contain outlines of the course sessions as well as copies of all the materials that were handed out to teachers as well as copies of the tasks they were required to do. The course materials consisted of a variety of tasks, often called "activities" or "investigations" as well as more substantial handouts covering aspects of the history of mathematics, extracts from a mathematics dictionary and articles on the teaching and learning of mathematics. The aims of the course are expressed in a letter of invitation (prepared by the course leader) which was sent to all the secondary schools in greater Cape Town:

> The only requirement is that teachers should be committed to examining the mathematics that they teach, their teaching practice and the experience of students in their classes.
> [...]
> The course will look at essential topics in the junior secondary maths syllabus in order to
> - deepen our understanding of these topics
> - look at different ways of teaching the topics
> - develop new curriculum materials
> - understand and reflect on the effect of different teaching methodologies and materials on our role as teachers and on students' experience of learning mathematics.
>
> [...]
> The course will seek to explore how we as teachers can contribute to a new education system which counters the inequalities and injustices of the past.
> [...]
> I will be responsible for structuring the sessions but will be very receptive to ideas for improving and adapting what we do. In general the sessions will not be run as lectures but as forums where we all participate in the activity or discussion planned for the day. Teachers will be asked to go back to their classrooms to try out at least one set of ideas.

> Teachers will be asked to keep a regular written record of their working during the course in the form of a journal or diary. A [Project] staff member will be available to support teachers' work inside and outside the classroom.
>
> (Extract from letter of invitation)

From the stated aims of the course as well as the range of material found in the course notes it would appear that the course was designed to involve teachers in a programme of intensive reflection and discussion of mathematics teaching, as well as to expand their repertoires of teaching strategies and to encourage them to read and discuss mathematics which was beyond the scope of the school syllabus. For example, articles on Fermat's last "theorem" were discussed and handed out to teachers. In one session which I attended the teachers were introduced to some elements of group theory through a discussion of isomorphisms. Some of the other sessions dealt with transformations and Diophantine equations.

One of the requirements of the course was that teachers should prepare a paper for a closed, residential three day mini-conference which was held at the culmination of the course. The conference was attended by the INSET providers and the teachers.

Appendix 1 shows some of the material which I extracted from the course notes. I decided to extract the material because it gives the reader an indication of the Project's views of good teaching practice. The Project's view of good practice is important because it informs the work of both Mark and June. Also in the same appendix I show a table which lists all the tasks given to teachers on the course. The table indicates whether or not apparatus (or manipulatives), worksheets and groupwork were required for each of the tasks. The table was produced because the nature of the tasks and the manner in which they are to be presented feature strongly in the marking out of the new from the old and the "good" from the "bad". The appendix also shows a statement of good practice made by the course leader. A copy of the statement was given to all the teachers on the course. The only samples of teachers' writings which were found in the course notes were brief listings of their hopes and fears on participating in the course. These writings are reproduced in full in Appendix 1 because the addressing of teachers' expressed needs is seen in the

INSET literature generally and by the Project, as an important element of good INSET practice.

1.4 The production of video records

I video recorded the interactions between Mark and June over four sessions. Two of the sessions were devoted to the planning of lessons; the other sessions were post-lesson discussions. June and Mark met regularly to discuss the content and form of lessons. In the sessions which I recorded, Mark would bring along a proposal which listed contents in the form of "activities" (student tasks) and the sequence in which the tasks were to be given to the students. He and June would then proceed to discuss his suggestions. In the post-lesson discussions, Mark and June would discuss a lesson which Mark sat in on. Both the lessons which I video recorded were attended by Mark. The video records of both lessons which were recorded were used to generate tables which show comparative proportions of teacher and student speech. While I recorded the planning, implementation and reflection cycle over two lessons, I ended up focusing on one cycle, which involved the introduction of the cartesian plane to students. I transcribed the first planning session, lesson and post-lesson discussion for the purposes of a detailed analysis of the interactions between Mark and June and between June and her students. This generated sufficient data for my purposes.

During my visits to June's classroom I noticed that most of the space on the pinboards in the classroom was taken up by colourful wall displays and in addition to the verbal interactions, I decided to explore to what extent the displays might be used as a resource for the establishing of privileged meanings. I decided to make a photographic record of the wall displays, an analysis of which I include in the discussion of the way in which the classroom arrangement was used in the structuring of transmission and acquisition. Reproductions of the wall displays are shown in an appendix.

I decided to interview June about her use of the wall displays. Unfortunately we were unable to arrange a suitable meeting time and I had to conduct the interview by telephone, taking notes as she answered questions.

1.5 The literature survey and selection of theoretical resources

I undertook a survey of the literature on INSET provision. Most of the articles I read focused on organisational aspects of INSET provision and on producing definitions of good INSET practice. While the organisation of INSET and definitions of good practice do have some value in informing a discussion of the recontextualising of pedagogic discourse, little was revealed which focused directly on my problem. In my use of the INSET literature I chose to focus on how the conceptions of good practice, teachers' professional needs and school-focused INSET impact on the recontextualising of pedagogic knowledge. Discussion of these three issues appear to be of central interest to INSET providers in general and to the Project in particular.

The initial consideration of a research project to examine the recontextualising of pedagogic discourse emerged from reading work produced by sociologists Basil Bernstein and Paul Dowling. Both authors, initially Dowling and more recently Bernstein, have been important sources of analytical tools for much of my thinking about mathematics education. Bernstein and Dowling, using different methodological frameworks, have considered recontextualising in their theorising the structuring of pedagogic discourse. I have appropriated elements of Bernstein's and Dowling's work in an attempt to fashion a theoretical model which enable me to examine the recontextualising of pedagogic knowledge through a focus on interactions between transmitters and acquirers. An important feature of the methodology used in this study is the generation of a theoretical model which is used to produce and analyse data.

This chapter described the conception and development of the research project as well as the contribution of the literature survey, empirical work and theoretical resources in generating a research methodology. Chapter 2 discusses the literature on INSET and

draws attention to three pervasive concerns echoed throughout the literature: the definition of good practice, teachers' professional needs and the support for school-focused INSET. A theoretical model for the production and analysis of data is constructed in chapter 3. The work of chapters 4 and 5 is the production and analysis of data. In chapter 4 I discuss an analysis of data derived from the INSET course and the interactions between the INSET provider and teacher. In chapter 5 I analyse the use of the wall displays and classroom furniture as well as the interactions between the teacher and students. Chapter 6 starts off with a discussion of the resources and strategies implicated in the recontextualising of pedagogic discourse and then moves on to a discussion of the model and the analysis, pointing out shortcomings and directions for future work.

Chapter 2

A survey of the literature on INSET

A search through the literature on INSET reveals very little that can be described as sociological. Contributions to research and professional education journals seem, for the most part, to detail descriptions of the successes and failings of various INSET programmes with a view to working towards definitions of "good practice" or "effective" INSET. After a brief sketch of the institutions providing INSET, I focus on conceptions of "good practice" in literature on INSET in South Africa and internationally; I then move on to an examination of non-governmental organisation (NGO) and project-provided INSET in South Africa, and finally to school mathematics INSET in South Africa. The literature survey includes references to academic journals as well as policy statements and other public utterances which feed into a conception of "good practice" in the South African context at the present time. While these sources are of different status, I believe that this move is justified because the constitution of "good practice" in INSET, as will be revealed below, is strongly informed by the views of policy makers and teachers.

The chapter is concluded with the use of Bernstein (1994) to describe NGO-provided INSET in terms of vertical and horizontal discourses. This categorisation then enables the generation of hypotheses about the recontextualising of pedagogic knowledge within the context of school mathematics INSET provided by NGOs, as well as providing a backcloth to the theoretical work done in chapter 3.

2.1 Categories of INSET providers

The provision of INSET can be described, broadly, in terms of three categories: provision by national and local government; provision by universities, colleges and other tertiary educational institutions; and provision by NGOs.[1]

[1]Robinson & Versfeld (1994) indicate five categories: higher education institutions; education departments; NGOs; teacher organisations; teachers and teacher mentors. However, work by local teacher organisations, teachers and teacher mentors on INSET rarely appears in the research literature.

2.1.1 *Provision of INSET by national and local government*

This category refers to INSET organised and provided by education departments through advisory services and through contract with outside agencies from the private sector[2], NGOs or higher education institutions (colleges, technikons, universities). INSET provision organised by (national or local) government and which depends on advisory services, the private sector and NGOs is rarely the focus of description or analysis in the literature. Locally relationships between education departments and NGOs have been sporadic and based on relationships between individual officials, like subject advisors and inspectors, and NGO staff. Much of the British literature on INSET focuses on the provision of INSET through local government contracts with higher education institutions. For example, one finds that such contractual relationships exist between LEAs and universities in the United Kingdom (Mortimore & Mortimore, 1989) and between the Department of Education and Training (DET) and various science and mathematics NGOs locally (Kahn, 1994).

2.1.2 *Provision of INSET by higher education institutions*

This type of INSET refers to inservice diplomas and degrees in education (FDE, BEd, MEd) and more generally distance or part-time bachelors degrees and undergraduate diplomas (BA, BSc, etc.) as well as non-award-bearing courses and other school-focused inservice education programmes offered to school teachers and organised by higher education institutions.

2.1.3 *Provision of INSET by NGOs[3] and Projects*

Literature on NGO-provided INSET in education journals and other education publications is extremely sparse. Locally, a number of papers on various themes in mathematics and science education, written by NGO staff, appear in conference proceedings and journals (*Pythagoras*, *Mathematics Teaching*, *Perspectives in Education*). While the production of conference papers and journal articles are part of some NGO's activities, the papers generally do not report directly on the workings of NGOs. Brief descriptions of the range of activity, publications (where they exist) and staff of local mathematics and science education NGOs appear in Levy (1994) which

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[2]Locally in South Africa, for example, we have Master Maths—an organisation which specialises in tutoring high school students—providing upgrading of teachers' high school mathematics qualifications for the DET.

[3] The term NGO is often used in the South African literature to refer to projects which are not NGOs; see Levy (1994).

is not much more than a directory of NGOs. Since NGOs (especially locally) have often been defined as in opposition to state-provided education (Kahn, 1994), one might need to look more broadly at literature on general sociology and politics, and where obtainable, public documents generated by NGOs themselves through project evaluations and in-house publications. However, Kahn (1994: 38) warns that for local NGOs

> [w]ork pressure has been such that there has been little time to document the processes being developed, and ideas frequently leave projects with their developers.

A recent set of INSET policy proposals (Robinson & Versfeld, 1994) prepared by the INSET Policy Initiative (IPI) aligns the work of INSET NGOs with the South African government's *Reconstruction and Development Programme*.[4] Since the inservice project, whose work with teachers will be an object of study in this dissertation, is a member of the IPI, I will look at the IPI document in some detail later because Robinson & Versfeld detail prescriptions for good INSET practice to which its members are expected to subscribe.

2.1.4 Summary

For the most part the education literature reports on INSET programmes linked to tertiary institutions rather than INSET provided exclusively by governmental departments or NGOs.

2.2 Research on INSET

In an examination of the research literature on INSET Daresh (1987: 4) claimed that the

> primary objective of these previous works was not directed toward an analysis of the research design and characteristics of work in the field *per se*. Rather, the major emphasis in earlier summaries was directed toward the identification of effective practices and recent trends related to the planning and implementation of professional development programs.

[4]The ANC in its "policy framework for education and training" defines INSET as follows: "The term 'professional development of teachers and trainers' refers to processes of education combined with experience by which teachers and trainers are enabled to enquire into and reflect on their work and roles, deepen their specialised knowledge, improve their effectiveness as facilitators of their students' learning, and prepare themselves for positions of greater responsibility and leadership. These processes are often referred to as 'in-service education of teachers' (INSET)."

Most (84%) of the research studies on INSET reported on by Daresh were found to be directed towards the solution of educational problems rather than the testing or construction of educational theory. Furthermore very few papers on INSET in educational journals report any original research.

> Methodologically, the existing status of research is heavily based on descriptive surveys of the desired content and procedures for staff development and inservice education, as described by teachers, administrators, and other participants. It can also be generalised that most research at present is atheoretical and tends to make use of only one data collection technique, the questionnaire.
>
> (Daresh, 1987: 9)

A number of studies conclude that INSET as an activity has a meagre research base (Swenson, 1982) and is theoretically incoherent (McLaughlin & Berman, 1977; Henderson, 1978). While these studies are fairly old, there is little in the more recent literature that shows coherent, theoretically informed research in INSET.

Justification for the existence and continued need for INSET proceeds as follows: schooling is failing to apprentice students to various academic disciplines as well as failing to provide industry, and the world of work generally, with appropriately skilled workers (Lally et al, 1992). The problem, it is asserted, is that teachers are themselves not apprenticed, or are weakly apprenticed to various subject disciplines, so they cannot be expected to apprentice their students to these disciplines (especially in mathematics and science). Furthermore, the weak apprenticeship of teachers exists because preservice training courses are inappropriate for various reasons, and fail in their attempts to train teachers adequately in the *teaching* of subjects as well as failing to apprentice them to academic disciplines. Another factor highlighted is the low transfer of knowledge across contexts. (Eraut, 1982; Keiny & Dreyfus, 1989; Mortimore & Mortimore, 1989; Showers, 1988; Sparks, 1983; Van Tulder & Veenman, 1991)

> The link between INSET activities and educational practice is important, The participants need help in transferring their acquired knowledge and skills to classroom practice.
>
> (Van Tulder & Veenman, 1991: 46)

Inservice education is therefore required to correct the problems that are the legacy of poor or inappropriate preservice education. Besides poor preservice education, new educational innovations and curriculum changes require teachers to be "upgraded" (ANC, 1994; Robinson & Versfeld, 1994; Rollnick, 1994) so that their teaching practices and vision of education is more closely aligned with current conceptions of "good practice" in higher education institutions or as defined by education authorities.

For a variety of reasons therefore, INSET comes to be viewed as a necessary means of improving the "instructional performance" of teachers:

> An important assumption made here is that staff development and INSET may no longer be viewed as 'frills' in which schools might engage if and when some extra money becomes available. It is, instead, an essential concern that needs to be addressed on an ongoing basis in all schools.
>
> (Daresh, 1987: 3)

It is not surprising that much of the INSET literature is directed towards the production of prescriptions for effective INSET provision because INSET programmes are generally dependent on the voluntary participation of teachers, many of whom have already received some preservice training, already have jobs and are not dependent on non-award-bearing INSET for promotion or salary increases. Award-bearing INSET programmes (degrees and diploma courses offered by tertiary institutions) are important to teachers for promotion and salary increases but the organisation and content of the programmes are generally non-negotiable. Furthermore, award-bearing INSET, especially courses which emphasise academic work, are very often viewed as irrelevant to classroom practice by teachers. Effectiveness, especially for non-award-bearing INSET, then comes to be defined in terms of teacher and school participation in programmes and such participation is strongly influenced by the perceived relevance of programmes. The stronger the match between programme content and teachers' expressed or perceived needs, the more likely the programme is to be read as relevant by teachers. For example, in their study of INSET provision in England and Wales, Mortimore *et al* relate INSET failure to a mismatch between provision and need:

> Both long and short INSET tended to be provided away from the 'coal face' of the classroom, by 'experts' not necessarily aware of particular teachers' or schools' needs and of the importance of matching provision to needs.
>
> (Mortimore & Mortimore, 1989: 134)

2.2.1 Summary

The research literature on INSET is substantially devoted to descriptions of organisational features of INSET provision with a view to determining which types of organisation might increase teacher participation in programmes, especially those which offer non-award-bearing courses. The quest for organisational models which facilitate the reproduction of INSET activity leads to prescriptions for "good practice" in INSET, a description and discussion of which is elaborated in the next section of this chapter.

2.3 *Conceptions of good practice in INSET*

While the conceptions of good practice in INSET include numerous features, many of which emerge from the specific contexts of INSET provision, I want to draw attention to three more general and pervasive inter-connected features: conceptions of teachers' needs, teachers' professional development, and school-focused INSET.

2.3.1 *Needs assessment*

Teachers, it is generally argued, have to articulate their own needs rather than have their needs prescribed by INSET providers because they best understand the context in which they work (Bolam, 1988; Daresh, 1987; Esu, 1991; Griffin, 1983; Hall & Loucks, 1978; Hutson, 1981; Lally, 1992; Lawrence, 1974; Robinson & Versfeld, 1994). INSET providers are therefore to take their cue from teachers who should participate in the planning and implementation of programmes, a first stage of which is "collaborative needs assessment":

> The importance of appropriate planning and the strategy for the implementation of inservice education for teachers cannot be overestimated. Prior assessment of needs will give an insight into the problem to be addressed by the inservice education in terms of its contents.
>
> (Esu, 1991: 193)

Kruger *et al* (1990: 142), however, assert that the (primary science) school teachers who participated in their study did not really know what they needed ("conceptual knowledge" of science) and that their expertise resided in their knowledge of children and working in classrooms ("craft knowledge") rather than in their knowledge of the content they are required to transmit; consequently, INSET providers should insert what is lacking in teachers' practices and knowledge:

> The task of INSET [should be] the integration of new subject knowledge (conceptual, scientific) with teachers' implicit, personal theories of teaching (their 'craft knowledge'), which is the basis of all their purposeful action in the classroom context.
>
> (Kruger, Summers & Palacio, 1991: 135)

Nevertheless, they too agree that teachers should be included as partners in the planning and implementation of programmes.

2.3.2 Professional development of teachers through INSET

Within the literature on INSET there is a consistent construction of a professional-academic dichotomy. Inappropriate preservice teacher training (which often includes academic courses) is offered as a motivation for INSET and the major concern of INSET then is the professional development of teachers. The explicit employment of educational and related theory by teachers as a set of principled resources for interrogating teaching practice is therefore generally excluded from INSET. The academic comes to be associated with "theory" while professional development is associated with knowledge of direct "practical" relevance to teachers. In mathematics INSET this is often realised in the "modelling" of lessons and the preparation of curriculum materials which consist of student tasks which can be used by teachers:

> In the way in which I communicate the content and design learning activities, I would try to espouse a sort of model of teaching and learning that I would hope they would use in the classroom.
>
> (Glover, 1994: 232)

"Action research", however, is seen as a research paradigm which might sit more comfortably with the professional concerns of teachers (and INSET providers) because it is assumed to provide teachers (and INSET providers) with resources for systematic reflection on practice (Noffke & Zeichner, 1987; Stevenson, 1991). The development of such systematic introspection is seen as one potential mechanism for the reproduction of INSET:

> By developing the capacity to articulate a reasoned justification of the contributions of action research to professional development and school improvement, it was assumed that practitioner students would be equipped to become better advocates for increasing the attention given in inservice education to self-directed inquiries by teachers.
>
> (Stevenson, 1991: 280)

Since learning is also associated with reflection on knowledge, so teachers on INSET programmes must be given the space to reflect and must be given tasks that encourage reflection:

> Like other practitioners, teachers learn from their practice. By approaching the problem from within, and reflecting-in-action, they develop their theories-in-action ...
>
> (Keiny & Dreyfus, 1989: 54)

Generally professional development as conceived within INSET defines the academic as absent from, or at best peripheral to, the needs of teachers. In line with this tendency to exclude the academic, some INSET providers employ "expert" teachers to

teach on their programmes. Ben-Chaim *et al*, for example, report on the use of "master teachers" who were

> exemplary teachers from other schools who were well-versed in all aspects of mathematics teaching and who were also experienced in conducting in-service activities ...
>
> (Ben-Chaim, Fresko & Carmeli, 1988: 270)

2.3.3 School-focused INSET

Professional development of teachers is best served by INSET programmes which are extended over time and which work with teachers in their classrooms rather than involving them only in one-off sessions (Showers, 1983; Sparks, 1983). Learning associated with change in practice is the result of acquisition within the context of use, the classroom (Eraut, 1982). Even though instructors and teachers may be convinced that the latter have acquired the necessary knowledge and skills on courses, misunderstandings may become apparent only when they teach, especially when asking and answering questions. Teachers therefore need to be instructed and evaluated in the classroom (Skemp, 1985, 1987). For such extended school-focused INSET to be successful the support and involvement of school administration and school policy is required (Stallings & Mohlman, 1981).

Reports on the success and failings of INSET provision point to the co-operation of teachers as a crucial determining factor (Daresh, 1987; Lally et al, 1992) which presumably includes the willingness of teachers to have INSET providers enter their classrooms. It would seem that in order for INSET providers to get into teachers' classrooms that they would have to accept the conditions which teachers and school administrators might place upon such evaluative intrusions.

School-focused INSET can be directed at isolated individuals, groups of individuals, a whole subject department or the whole school. In general school-focused INSET involving groups of teachers, preferably the whole subject department or whole school is strongly marked as a feature of good practice (Keiny & Dreyfus, 1989; Miles, 1964; Skemp, 1985, 1987; Smylie, 1988). Reasons given for this preference are: teachers' professional development is optimally achieved in a group (Miles, 1964; Smylie, 1988) since the influence of INSET is greater when teachers are able to share ideas about instruction and experimentation (Little, 1981); especially where INSET clashes with the existing ethos of a school or department, it is difficult for individual teachers to introduce and maintain changes in their practices (Skemp, 1985, 1987); INSET providers are able to get a better idea of the priorities and needs of a department or

school (Esu, 1991) as well as being better able to assess the difficulties of change within a "complex social and political" structure such as a school (Moreso *et al*, 1984); since student success is a critical indicator of teacher success, school-focused INSET enables providers to assess more accurately the impact of changes in teaching practice on student performance and competence (Joyce & Showers, 1983; Showers, 1983).

2.3.4 Good practice within the INSET Policy Initiative (IPI)

I reported above that my empirical data is constructed out of interaction with a project which is a member of the IPI. The IPI is a general grouping of INSET providers who offer INSET provision across a range of secondary and primary school subjects, including mathematics. The Project contributes to the IPI's prescriptions for good INSET practice which have to be formulated in general, rather than subject specific terms because of the diverse interests of its members. This feature of the IPI will be returned to in the conclusion to this chapter. I therefore consider it useful to examine the IPI draft policy document briefly.

Robinson & Versfeld (1994: 11), referring to local NGOs[5], claim that

> NGOs are widely acknowledged as providing much of the most effective INSET in South Africa. They have tended to interact directly with specific school communities and so develop understandings of the context within which teachers work. They are generally well-placed to provide INSET which is appropriate and relevant.

While the above extract is from a document prepared by INSET workers for INSET NGOs and does not justify any of the claims made, it does agree on a number of points with conceptions of effective INSET in the literature.[6] Robinson & Versfeld, (1994: 4-5), list, in a table (Figure 2.1), "characteristics of good INSET". A scan of the table will confirm that the "characteristics", especially the notions of direct interaction with whole school communities, respect for the specificity of different teaching contexts, and having appropriateness and relevance defined by the schools and teachers, are in accordance with the features of good practice outlined in previous sections.

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[5] Although the term "NGO" is constantly used in the IPI document, many of its members are not legally defined as NGOs . See Levy (1994) for legal classifications of various projects.

[6] See Kahn (1994) for a view of NGO activity in South Africa which is in general agreement with Robinson & Versfeld.

Robinson & Versfeld go on to prescribe the key components of appropriate learning that should be observed within INSET: learning by reflection and action because an "experiential, problem-based approach allows for self-reflection, resourcefulness, self-esteem and confidence building"; integration of knowledge, skills and values because "where theory informs practice a teacher is able to be more independent in her/his classroom work"; learning in context because in "school-focused INSET, the realities of the school provide the context for learning" (1994: 6-7). Again, there is no justification for the statements made here but perhaps one should not expect justifications to appear in an in-house document, the contents of which were presumably debated.[7]

EMPOWERMENT	ACCOUNTABILITY
Good INSET:	**Good INSET:**
• builds teachers' capacity and resourcefulness	• conducts itself responsibly and professionally
• enriches classroom practice	• is committed to sustained processes
• involves teachers in decision-making and policy-formation	• is clearly planned
• addresses teacher morale	• has clear roles for those who provide it
• develops ownership and responsibility for INSET within each school	• engages in ongoing evaluation
• is challenging	• engages in debate about criteria for evaluation
• is learner-centred and experiential	• is accountable to its users and funders
• builds on existing knowledge and skills	
FLEXIBILITY AND ACCESSIBILITY	**NETWORKING**
Good INSET:	**Good INSET:**
• responds to teachers' needs and changes with them	• collaborates and cooperates with other INSET providers
• is accessible in language and location	• links with PRESET
• is aware of the context in which it functions	• keeps abreast of local and global educational developments

Figure 2.1 (Source: Robinson & Versfeld, 1994)

There are many points of agreement between the conceptions of good practice in the INSET literature generally and that of the IPI. One crucial difference between INSET in general and NGO-provided INSET in South Africa is that the NGOs are seen by the ANC (1994) as important potential contributors to the reconstruction of mass education in a post-apartheid South Africa. However, this political support and encouragement requires of the NGOs that they are seen to align themselves with the

[7] Robinson & Versfeld, in a disclaimer, say: "the document is not intended as a 'nuts-and-bolts' document which sets out in detail the implementation of policy. Rather, it presents an overview of our thinking and a conceptualising of issues. In this way it can act as a springboard to further discussion and negotiation around approaches to the key question of in-service teacher education." (p. 1)

ANC's proposed utilitarian education policy which is expressed as follows with respect to mathematics[8] and science education:

> The development of an indigenous technological capacity requires that we produce more scientists and technologists. To enable [this], science and mathematics education and training, both school-based and work-based, must be transformed from a focus on abstract theories and principles to a focus on the concrete application of theory to practice. It must ensure that students and workers engage with technology through linking the teaching of science and mathematics to the life experiences of the individual and the community.
>
> (ANC, 1994: 84)

What this means for NGOs (especially for those providing mathematics and science INSET) is that not only are their activities to be delimited by the context-specific needs of teachers and schools, but that the mathematics and science curricula they reference also present the contents as localised.

2.3.5 School mathematics INSET provided by NGOs and Projects

In this section I will examine the conceptions of good practice within the context of INSET provision by mathematics projects and NGOs. This entails a shift in focus from a consideration of good INSET practice generally to good teaching practice for teaching of school mathematics as defined by INSET providers.

Current views on mathematics teaching, expressed by NGOs and other school mathematics INSET providers, appear to be gravitating towards a "constructivist position"[9] which stands in opposition to the "traditional teaching" which is thought to characterise the dominant teaching practice:

> There has been a significant shift towards a constructivist position within the mathematics education community internationally and nationally in the 1980s and early 1990s ... At the national level this shift is particularly obvious in the Department of Education and Culture: House of Assemblies (DEC (HOA); the old "whites only" structure). It is also evident within non-governmental progressive projects such as the Mathematics Centre for Primary Teachers ... and COUNT ... The work of researchers at The Research Unit for Mathematics Education, University of Stellenbosch (RUMEUS) has been instrumental in this shift and forms the theoretical and empirical basis for the DEC(HOA) innovation ...
>
> (Parker, 1995: 2)

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[8] See Dowling (1994) for a discussion of the policy proposals for mathematics education.

[9] The constructivist position is marked by differently named "approaches" in the field: the "constructivist approach", the "new maths", the "investigative approach", the "problem-centred approach" and often by "approaches" which are categorised as "learner-centred".

The "traditional" curriculum is described as authoritarian (Breen *et al*, 1994; Patchitt *et al*, 1994), non-democratic (Bopape, 1994), emphasising rote-learning and memorisation of meaningless procedures (Smith, 1994; Patchitt *et al*, 1994), and presents mathematics as compartmentalised and disconnected (Smith, 1994). Teachers working within this system are described as under confident, under-exposed to alternatives and restrained from developing (Breen *et al*, 1994), suffering low morale (Bopape, 1994) and excluded from having a voice in the production of the curriculum (Patchitt *et al*, 1994).[10] Parker elaborates the key oppositions that are generated:

> The 'constructivist' notion of the subject (the teacher/the child) is set up as the negation of the traditional conception. The oppositions are direct: teacher as regulator/authority versus teacher as facilitator/equal; knowledge as given versus knowledge as created; the child as regulated versus the child as autonomous self-regulator; the passive absorbing child versus the active thinking child.
>
> (Parker, 1995: 16)

The constructivist position generates a core set of pedagogic prescriptions which constitute good teaching practice and which, even if only implicitly because it is set up in opposition to the "traditional approach", presumably is non-authoritarian, democratic, presents mathematics as meaningful and inter-connected, generates teacher confidence, development and boosts morale. Human, Olivier & Lampen (1994), who are associated with RUMEUS, list the key features of the "problem-centred approach" in point form:

- The teacher is effectively experienced by the students *not* to assume the role of being a sources [sic] of logical knowledge, or an adjudicator of answers, [sic] Students are induced to accept responsibility for their own learning, and for individually and/or cooperatively assessing the validity of their proposed solutions to problems.
- Individual and cooperative problem-solving and social interaction providing for reflection on problems, proposed solutions and methods of solution is the dominant learning activity. [...]
- When students are working on problems they consistently experience the production of a sensible, justifiable solution and *not* adherence to perceived prescriptions as the primary purpose of their actions.
- In cases where it is unlikely that students will produce certain items of mathematical in problem-solving situations, text materials ... serve as an auxiliary source of mathematical information.
- The material is organised with a view to enable students to make sense of new material. This implies that timely provision is made for the development of concepts and conceptual schemes which provide the cognitive context for making sense of later material. (pp. 251-2)

[10] It is not unproblematic to put the various projects alongside each other as though they present a unified position. However, the features which are highlighted in the discussion of the traditional-constructivist opposition are shared by all the projects. Some projects refuse to refer to themselves as constructivist and might even see themselves as in opposition to both constructivist and "traditional" positions.

The descriptions of "approaches" adopted by NGOs and projects, presented in Levy (1994), have many points of agreement with the description of the "problem-centred approach" as is indicated in the following sampling of extracts from descriptions of the Maths Centre for Primary Teachers, the Centre for Productive Education and M & T Focus (Maths and Technical Education Consultants), respectively:

> The centre attempts to promote an approach in which the teacher's role is to analyse the students' needs and then provide appropriate experiences through which the students construct and assimilate mathematical relationships, and develop and apply relevant strategies to problem solving. The approach consists of supporting teachers in: (a) setting up mathematical activities and problems that are related to the children's everyday lives. (b) encouraging active participation, investigation and discussion on the part of the children. (c) encouraging pupils to talk their way through problems, firstly in the language with which they are familiar and then gradually linking this to English and to mathematical language. (d) helping students to progress from pattern recognition derived from several examples to making conjectures and progressively refining these. These conjectures are then tested to see if they work. (e) leading the children to understand how they can use the generalisations they have formulated to solve similar problems. (f) promoting collaborative rather than competitive attitudes towards learning.
>
> (Patchitt *et al*, 1994: 237)

> With the investigative approach, the child's experience of mathematics in the classroom is entirely different. Instead of being required to sit and passively receive the teacher's methods, the learner is required to be active, investigating how he or she would solve real problems in maths. By discussing possible methods of solution amongst themselves, pupils not only get new ideas and become clearer about, say, division, they also communicate their thinking to other people.
>
> (James, 1994: 213)

> The two main ingredients of ... a learner-centred approach are the **problems or tasks** that are set for the students and the **social interaction** between students. The teacher should assume a facilitative role, providing a variety of well structured learning experiences through the posing of relevant, real-life problems enabling the learner to construct the methods of addition, subtraction, multiplication and division based on a sound number-concept. Furthermore, own methods and group interaction should be encouraged to build a deep and lasting understanding of numbers and computation.
>
> (Hallendorf, 1994: 224. Emphasis in the original.)

The enormous impact of the "problem-centred approach" on mathematics curriculum development was demonstrated at a recent workshop (9 and 10 February 1995) organised by the Western Cape Education Department. The task of the workshop was to design and draft a "provincialised syllabus" around the core national syllabus. Throughout the workshop Alwyn Olivier and Hanlie Murray of RUMEUS were constantly asked to evaluate the arguments of participants. A department official even went as far as explicitly aligning the official curriculum with the "approach" after which she thanked Olivier and Murray for their work. The response from many of the participants was applause — the only time any statement was applauded over the two days. In the official documentation, produced by the department and handed out to

participants, one finds, presumably for decorative purposes, the reproduction of cartoon characters which populate the textbooks written by Olivier *et al*!

Parker (1995), in her critique of constructivism in mathematics education in South Africa, argues that the growing hegemony of constructivism generates a new form of oppression, disguised as emancipation, because it effectively disrupts student apprenticeship into mathematics and instead traps them in the local and particular. Dowling (1993b: 35), also questioning its democratic pretensions, has characterised constructivism as an "ideology of monoglossism" in which the teacher, who ceases to be transmitter of knowledge, must problematise assimilation through the generation of cognitive conflict which is assumed to be reconciled by the student, as though a specific mathematical rationality will necessarily always prevail. That this is not always so can be seen in the following extract which appeared as a footnote in Davis (1994: 143):

> On page 60 of UG2 [User Guide 2] a learner is required to solve a problem (which deals with the setting up of a vegetable stall) and is asked to justify his [sic] answer ... [H]e claims that he likes to sell vegetables because they are important for our bodies and are cheaper than meat. The examiner's response is: "His justification is not appropriate."

The response of the examiner referred to in the extract also draws attention to the (necessary) negative assessment of the learner if s/he does not introject the projection of mathematics onto the non-mathematical.[11]

In this section I have attempted to show that the "constructivist position" or "problem-centred approach" is moving to a position of dominance over what has generally come to be known as the "traditional approach". In addition, I have alluded to differences between the various other "approaches" which are also defined as in opposition to the "traditional approach". Within teacher training institutions, education departments, INSET provision as well as party political rhetoric we are witnessing, despite differences in the pedagogic discourses of various agents, the formation of an anti-traditional alliance. The "traditional approach" is seen as authoritarian, undemocratic and educationally unsound. Significant features of the new, presumably more libertarian and educationally sound pedagogies are characterised by new forms of the regulation of transmission and acquisition of school mathematics: teachers become facilitators, knowledge is to be constructed by active students who are to become self-

[11]Davis (1994) is an analysis of an examination syllabus produced by the Independent Examinations Board as set out in a user guide for teachers of adults. P. Human of RUMEUS featured prominently on the syllabus committee who drew up the document which has a strong "problem-centred approach" orientation.

disciplined rather than have discipline imposed on them. New pedagogic mechanisms are to facilitate this transformation from the "bad" to the "good"; for example, an embedding of mathematical contents in tasks which reference the everyday and the non-mathematical; the encouragement of student discussion and exploration of contents through the use of groupwork rather than teacher exposition; and the encouragement of student-generated rather than teacher-prescribed solution procedures.

An anti-traditional alliance can be formed because the indicators of good teaching practice are defined in terms of the existence of specific non-traditional forms of regulation — rapidly becoming the new tradition — rather than the ability of agents to demonstrate theoretically coherent arguments for pedagogic choices (through which significant differences between pedagogies might well emerge, to the detriment of the alliance). This lack of theoretical coherence and crude understanding of the regulation of pedagogic discourse also has as an outcome the construction of both the new and traditional pedagogies as imaginary because their complexities are glossed over when they are condensed into their more visible (and gross) regulative features.

In much of the rhetoric surrounding the anti-traditional pedagogies agents claim that a significant feature of their "approach" is the weakening of regulation rather than acknowledging the imposition of new forms of regulation, as is demonstrated in the following extract from a promotional video made by a primary school at which the "problem-centred approach" has been adopted:

> Problem-centred mathematics, which is also referred to as the alternative, or socio-constructivist approach, differs from traditional methods of teaching in that it believes that, with the proper guidance, children can construct their own knowledge. In adopting this stance, it breaks completely with traditional methods of teaching. **Instead of children been told how to solve problems, the approach advocates that they be allowed to develop their own solution strategies to these problems. The teacher's task is to help the pupils to understand the problem, but once she has done that, the pupils must solve the problem themselves.**
>
> (Fairview Primary School, 1993. My emphasis.)

In a sense, agents have to make such claims because explicit regulation still has strong connotations of anti-democratic and authoritarian practice attached to it. A subsequent extract from the same video aligns the "problem-centred approach" with the call for democratic practice both in and out of schools:

> The call from various quarters today, and not just from educational quarters, is that education should be democratised. A fundamental aspect of this call is the kind of values we build into our education system in the future. Mechanical rote-learning, as reflected in the algorithms we teach in our schools today, must be replaced with methods

> that develop an enquiring and critical mind. [...] **These values are also consistent with the aims of problem-centred mathematics. As we see it then, problem-centred mathematics is in line with the democratic demands of our time.**
>
> (Fairview Primary School, 1993. My emphasis.)

Mathematics INSET practices therefore unfold in a general arena in which a strong dichotomy between "traditional" and anti-traditional "approaches" has been established. The anti-traditional "approaches", despite differences, appear to have in common (or appear to read as equivalent their insertions into schooling of) new forms of regulating the transmission and acquisition of school mathematics contents, which are defined in opposition to "traditional" regulative practices and which become indicators of "methodology". Attention to teaching methodology rather than academic discourses is seen as the key element in the professional development of teachers and it is around this concern that the proponents of the new "approaches" unite in opposition to the "traditional".

2.4 Summary of the chapter

I include in this section a discussion of vertical and horizontal discourses and knowledge structures which draws on the recent work of Basil Bernstein (1994). This discussion will serve as an introduction and background to the contextualising of my study and to highlight aspects of the literature survey as well as inform the development of a theoretical framework for the production and analysis of data. Here Bernstein's work is of great heuristic value, enabling me to advance some tentative hypotheses which allow me to begin to map out the theoretical concerns of my study.

2.4.1 Horizontal and vertical discourses

Bernstein (1994) distinguishes between different forms of knowledge which he labels *vertical* and *horizontal* discourses and defines as follows:

> The form of knowledge usually typified as everyday, oral, or commonsense knowledge has a group of features: local, segmental, context dependent, tacit, multi-layered, often contradictory across contexts but not within contexts. Today the objects of such knowledge are likely to be volatile and substitutable with each other. [Such a discourse is called] a horizontal discourse. ... A vertical discourse takes the form of a coherent, explicit, systematically principled structure, hierarchically organised or it takes the form of a series of specialised languages with specialised modes of interrogation and specialised criteria for the production of texts.
>
> (Bernstein, 1994: 3-4)

Pedagogic discourse is a bricolage constructed from both vertical and horizontal discourses. For example, in the regulation of student behaviour in a mathematics

classroom the teacher (and student) might draw on, say, the code of conduct of the particular school, common-sense and tacitly held notions of what it means to be a child of a certain age, class, gender and "race"[12], as well as pedagogic prescriptions derived from various teaching methodologies and the mathematical contents to be transmitted. Pedagogic discourse, in the case of school mathematics, is therefore constituted by weaving together recontextualised elements of both the everyday (horizontal, non-specialised) and the academic (vertical, specialised). Bernstein (1994) indicates two categories of vertical discourse, those exhibiting hierarchical and horizontal knowledge structures respectively. The former "gives rise to an explicit, coherent, systematically principled and hierarchical organisation of knowledge [...] as in the natural sciences" while the latter gives rise to "a series of specialised languages, each with its own specialised modes of interrogation and specialised criteria as in the humanities and social sciences" (p. 7). Furthermore, discourses exhibiting a horizontal knowledge structure, can have strong or weak grammars. Strong grammars are indicated by "explicit, formally articulated concepts, relations and procedures" whereas weak grammars are indicated by less formal articulation of concepts, relations and procedures (p. 10). I shall now use Bernstein's categorisation of discourses to argue that INSET can be characterised as exhibiting a horizontal knowledge structure with a weak grammar.

In its focusing on the organisational features of INSET provision with a view to maximising teacher participation in programmes, INSET providers are led to the position where, in order the reproduce INSET activity, they have to organise such activity around the immediate, context-specific concerns of teachers. Such organisation might conceivably prevent INSET providers from explicitly elaborating pedagogic principles because it is not indicated as a "need", as was indeed the case recently when a teacher working with the Project discussed in this report, refused to participate in discussions on methodology — and stopped attending the course — but wanted only to be taught the syllabus content dealing with circle geometry; the specific provider who was assigned to do school-focused INSET with the teacher felt obliged to acquiesce. The acquirer (the teacher) in this instance was able to prescribe to the transmitter (the INSET provider) what content was to be transmitted and how.

More generally, if the dedication to organising INSET around teachers' needs, which are constructed as "professional" in opposition to "academic", and the participation of teachers in the organisation of INSET programmes is taken seriously, then the form of knowledge which is generated through INSET must indeed emerge as "volatile and

[12]See Rist (1970) for example.

substitutable" (Bernstein, 1994) at the level of the articulation of INSET practice with teaching practices. That is, at the level of interaction between INSET providers and teachers as well as in teachers' recontextualisings of the contents of INSET, practices might reveal structures which are more comfortably associated with horizontal discourses rather than with vertical discourses which exhibit horizontal knowledge structures and weak grammars. While INSET providers might (potentially) see their activity as strongly grounded in one or more vertical discourse, current conceptions of good practice in INSET make it extremely difficult to include as part of INSET the apprenticeship of teachers to vertical discourses because the professional concerns of teachers are defined in a manner which marginalises or excludes the academic. The drive towards context-specificity and a focus on specialised, local teacher needs ("relevance") is structurally built into the dominant conceptions of good practice in NGO and project-provided INSET through the inclusion of school-focused INSET as a central pillar.

While INSET providers may have access to various specialised "languages" (Bernstein, ibid.) which inform their activity, features of these languages are transmitted tacitly through the modelling of lessons and the organisation of the pedagogic space and student tasks, and explicitly through exposition by INSET providers. However, as in the case of pedagogic discourse associated with the "problem-centred approach", the language is recontextualised to INSET and to classroom activity where it is transformed and condensed into sets of pedagogic procedures which signify good teaching practice: the teacher should be a facilitator; students should work in groups; the teacher should encourage discussion; knowledge should be accepted as individually constructed; and the student should be self-regulated and active. The encouraging of teachers, education department officials, producers of curriculum materials and many INSET providers to associate clusters of pedagogic procedures and forms of classroom organisation with "approaches" or "methods" which are associated with one or more languages — the "constructivist approach", for example — is given impetus by the evaluation of teachers which focuses on performances in the classroom; that is, teaching methodology. In Bernstein's terms this focus on methodology reveals the dominance of the regulative principles of pedagogic discourse over the instructional. Apprenticeship to the language(s) from which the initial recontextualisings were made become unnecessary because it is instead significant features of the "approach", realised in the organisation and procedures employed in the classroom — in the regulation of transmission and acquisition — which signify legitimate practice. It is really only when the contents being transmitted are not recognisable as that which is to be

transmitted (for example, when a mathematical error is made) that the evaluation of teachers focuses on their knowledge and understanding of the content.

Both good practice in INSET and good teaching practice therefore emphasise certain procedures and forms of organisation. The pedagogic discourse which is generated within the two contexts of INSET provision and school mathematics teaching arranges and distributes the recontextualised contents of the discourse to be transmitted — mathematics, in this study — with reference to specified procedures which are seen as derived from various erudite languages (developmental psychology, for example) as well as with reference to procedures and forms of organisation which inhabit the institutions in which transmission and acquisition are to take place. Pedagogic procedures and forms of organisation are potentially highly substitutable as can be seen in the battles for dominance between proponents of various "approaches", "traditional" and anti-traditional, to teaching the same prescribed contents in mathematics, but can be read as relatively stable for long periods of time because schooling is subjected to governmental control.[13]

As pointed out early on in this chapter, INSET in general has been described in the literature as having an extremely weak theoretical base. Alongside a lack of theoretical coherence is the generation of a dominant conception of good INSET practice which argues for the organisation and implementation of INSET programmes to be governed by teachers' professional needs. The professional needs of teachers are understood to exclude induction into the vertical discourses which are implicated in the (re)production of pedagogic discourse although various vertical discourses might be referred to in order to authorise pedagogic prescriptions. Good and bad mathematics teaching practice are indicated by the existence of a variety of pedagogic procedures and forms of classroom organisation rather than by theoretically coherent elaborations of the pedagogic choices which are to be made. The lack of theoretical coherence makes it possible for teachers to read the various "approaches" as essentially identical: the "approaches" can all be referred to as either "traditional" on the one hand, or "constructivist", "problem-centred", "learner-centred", "new maths", "investigative" and so forth, on the other, and such categorisations of "approaches" are informed by looking at classroom organisation and procedure.

[13]Core curricula are prescribed by central government through an education ministry; local elaborations of the core curricula are prescribed provincially; general provincial and national procedures for the assessment of teachers and students are instituted and so forth. The putting into place and changing of curricula for a national education system is a highly complex, time consuming and expensive operation which means that once significant curriculum changes have been made and the education system has been restructured, they remain in place for relatively long periods of time.

One last point needs to made with reference to the IPI. Bernstein (1994) marks out a distinction between what he calls "regions" and "singulars". Singulars are vertical discourses, like mathematics and sociology; regions are new discursive fields, like communications, into which elements of vertical discourses are recontextualised. A region focuses selected elements of vertical discourses around its own concerns, weakening the differences between vertical discourses and emphasises their common features, or constructs certain of their features as common. The IPI, which attempts to bring together INSET providers across a wide range of disciplines, can be thought of as functioning as a region which is attempting to produce a fairly general pedagogic discourse which can address the needs of a number of singulars. Many of the specific concerns of, for example, mathematics education must be suppressed in order to generate a pedagogic discourse which will be subscribed to by all. In this way the grammar of the pedagogic discourse of the INSET providers is weakened further.

Chapter 3

The generation of a theoretical model

In the conclusion to chapter 2 I introduced Bernstein's (1994) categories *vertical* and *horizontal discourses* and argued that pedagogic discourse within the contexts of INSET provision and schooling can be understood as exhibiting horizontal knowledge structures with weak grammars. In this chapter I introduce additional concepts from Bernstein (1994) and Dowling (1993a) to extend the discussion in chapter 2 and to build a theoretical model which will be used to locate my study and to generate tools for the transformation of information into data as well as for the analysis of the data.

3.1 The General Approach Plane & the Specific Problem Plane

Bernstein (1994) introduces two analytical planes to facilitate his discussion of horizontal knowledge structures: the *general approach plane* (GAP) and the *specific problem plane* (SPP). He defines the GAP and SPP as follows:

> In any one particular discourse the set or array of specialised languages which are operational varies across time and even space. Further [...] there may well be two interacting horizontal discursive planes. One could be called a general approach plane (GAP) and the other a problem plane. [...] The GAP is a space where meta languages are produced which attempt to provide a basic orientation, a language of description and the rules of its use, which legitimate how phenomena should be understood and interpreted. GAP theories are really theories about what counts as proper description of the specific phenomena of a particular horizontal knowledge structure (H.K.S.). The second discursive plane is produced by empirical study of particular problems or areas. We shall refer to this plane as the specific problem plane (SPP).
>
> (Bernstein, 1994 ms: 8-9. Emphasis in the original.)

The relationship between the GAP and the SPP can be diagramatically represented as follows (adapted from Bernstein, ibid.: 10):

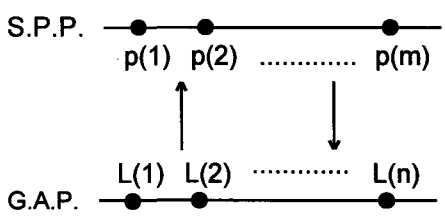


Figure 3.1

The p(i) and L(i) refer to specific problems and languages of description repspectively. My own study can be described with reference to this model. I am

attempting to produce a sociological reading of the recontextualising of pedagogic discourse from the context of INSET provision to the context of mathematics teaching in schools. The theoretical resources I draw on are located within a discourse (sociology) exhibiting a horizontal knowledge structure (ibid.: 9). More specifically, the theoretical resources which are used to formulate my research question, as well as produce and analyse data, are derived from languages of description (Bernstein and Dowling) which constitute the GAP.

3.2 Defining pedagogic discourse

Pedagogic discourse might be thought of as the articulation of a selection and contents from various discourses. These contents are selected, delocated and relocated to be brought into specific new/different relations with each other in the (re)production of pedagogic discourse and are necessarily transformed. School mathematics makes selections from canonised mathematics which are brought into relations with selections from other discourses (e.g. developmental psychology).

Bernstein's model of the relationship between the GAP and the SPP inspires a model for the diagrammatic representation of the relationship between pedagogic discourse and the various discourses which are implicated in its constitution as follows. Pedagogic discourse is constituted by bringing into new relations selections from both vertical and horizontal discourses. For example, in the teachers' notes to a chapter on geometry in Fitton, de Jager & Blake (1991: 89), the authors justify the sequencing and selection of mathematical contents by appealing to Piaget:

> Now we move from the exploratory experimental approach to geometric discovery ... towards the discovery of properties of geometric figures via thinking and logical reasoning. In terms of Piaget's theory of learning we are moving from the concrete operations stage towards the stage of formal operations.

When the textbook is used by teachers, it is inserted into the organisational structure of the classroom and schooling and becomes part of that structure. Teachers, and sometimes students, make selections from the contents of the book. The selections are woven together with the rules of order and expression: the students are arranged in particular ways; the teacher might work through a problem from the book and require students to do a series of similar problems from the book; when asking for help or indicating that they have completed the required work, certain procedures like the raising of an arm might be required and so forth; also, certain problems might be considered unsuitable for particular students. The organisation and regulation of activity in the classroom might be justified by appealing to the political as in the

extract from the Fairview Primary School video in chapter 2 where the "approach" in use was described as consistent with democratic practice. Of course, similar forms of organisation, procedures and justifications are employed in teacher education (PRESET and INSET) as well. For example, in teacher education, pedagogic prescriptions for the teaching of geometry might be derived from the work of Piaget and the van Hieles. RUMEUS at Stellenbosch University claims to have derived their pedagogic prescriptions, in part, from the work of Piaget and the van Hieles.

Vertical and horizontal discourses can be thought of as constituting a plane. I shall call this plane the *general discourse plane* (GDP) and indicate its elements by the following notation: V(i) and H(j) where V and H indicate vertical and horizontal discourses respectively. I indicated in chapter 2 that I would distinguish between the pedagogic prescriptions made by teacher educators (INSET and PRESET) which, generally, claim to be derived from various V(i) and the realisations of those prescriptions in school teaching. Two moments of pedagogic discourse are therefore indicated; one at the level of teacher education and the other at the level of classroom teaching. I now want to refer to the relationship between pedagogic discourse as constituted in the first moment and the GDP. Pedagogic discourses, which are (re)produced by bringing together elements of vertical and horizontal discourses, are conceptualised as residing in the *general pedagogic plane* and are indicated as P(i) which is necessarily different from the GDP.

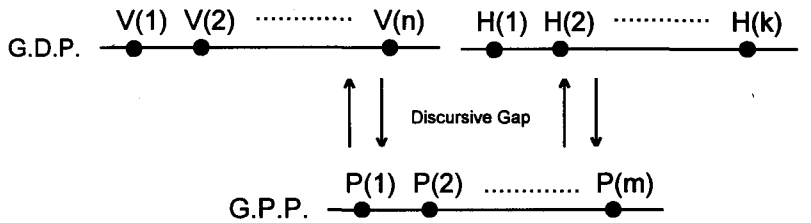


Figure 3.2

Here I want to distinguish between the GPP and specific transmission and acquisition realisations. The former consists of pedagogic prescriptions, or principles, (implicit and explicit) for the recognition and realisation of legitimate pedagogic texts while the latter refers to specific realisations of pedagogic action within pedagogic relationships. An example of a P(i) is the "problem-centred approach" developed by Human, Olivier and Associates. In Levy (1994: 250 -3), Human *et al* detail a number of principles which distinguishes their "approach" from other P(i). Amongst others, they list prescriptions for legitimate (good) practice and the recognition and realisations of legitimate texts; for example:

> The teacher is effectively experienced by the students *not* to assume the role of being a source of logical knowledge, or an adjudicator of answers. Students are induced to accept responsibility for their own learning, and for individually and/or cooperatively assessing the validity of the proposed solutions to problems.
> [...]
> Effective problem-centred learning is dependent on the utilisation of appropriate problems. The following are two of the required features: ...
>
> (Human et al, 1994: 251-2; emphasis in the original.)

Elswhere in Levy (1994: 255) Human *et al* point out that the "problem-centred approach" is derived from constructivist epistemology which they explain as follows:

> Constructivism is an epistemological paradigm claiming that knowledge exists in the minds of individual[s] and that the knowledge possessed by each individual is unique and personal, though substantial consensus may be established through social interaction. As a learning theory, constructivism claims that individuals construct their own meanings and organise their own knowledge irrespective of the actual conditions of learning [...] Constructivism predicts marked differences between the nature and quality of mathematical knowledge constructed in learning situations characterised by attempted transmission of knowledge by a teacher experienced as a prescriptive authority, and learning conditions characterised by inquiry[,] autonomous problem-solving and reflection facilitated through social interaction between peers.

The latter quotation demonstrates that the pedagogic prescriptions of the former quotation are derived from constructivism. Whether or not the pedagogic prescriptions are consistent with the referenced species of constructivism is beside the point here. This then indicates a P(i). Pedagogic action can now be planned and read with reference to the prescriptions which are also used to evaluate the transmission and acquisition of mathematical contents. Gaining access to transmission and acquisition realisations of pedagogic prescriptions requires one to engage with textual realisations of pedagogic action. Text is understood in a broad sense here, so that a video record of teaching and learning, a transcript made from audio or video tape, or an actual classroom scene are all texts which can be read with reference to pedagogic prescriptions.

Ernest (1991: 138-9), in his overview of "educational ideologies" (Figure 3.3), maps out features of five categories of social groups against categories which he claims inform the (re)production of pedagogic discourse. In my recontextualising of Ernest's typology I would refer to the "approaches" of social groups as different P(i). Human *et al* might conceivably be placed in one of the social group categories (which correspond to P(i)), or a new category could be created to accomodate them by combining elements from the existing categories. Agents in each of the categories of P(i) produce pedagogic prescriptions which they believe will reproduce their pedagogic discourse and presumably, the social group. In other words, they will

recontextualise elements from the GDP which will be rearticulated to produce pedagogic discourse at the level of the GPP.

Social group	Industrial trainer	Technological pragmatist	Old humanist	Progressive educator	Public Educator
Political ideology	Radical right, 'New Right'	meritocratic, conservative	conservative/liberal	liberal	Democratic socialist
View of mathematics	Set of Truths, and Rules	Unquestioned body of useful knowledge	Body of structured pure knowledge	Process view: Personalized maths	Social constructivism
Moral values	Authoritarian 'Victorian' values, Choice, Effort, Self-help, Work, Moral Weakness, Us-good, Them-bad	Utilitarian, Pragmatism, Expediency, 'wealth creation', Technological development	'Blind' Justice, Objectivity, Rule-centred Structure, Hierarchy, Paternalistic 'Classical' view	Person-centred, Caring, Empathy, Human values, Nurturing, Maternalistic, 'Romantic' view	Social Justice, Liberty, Equality, Fraternity, Social awareness, Engagement and Citizenship
Theory of Society	Rigid Hierarchy Market Place	Meritocratic Hierarchy	Elitist, Class stratified	Soft Hierarchy Welfare State	Inequitable hierarchy needing reform
Theory of the Child	Elementary School Tradition: Child 'fallen angel' and 'empty vessel'	Child 'empty vessel' and 'blunt tool' Future worker or manager	Dilute Elementary School view Character building Culture tames	Child-centred, progressive view, Child: 'growing flower' and 'innocent savage'	Social Conditions view: 'clay moulded by environment' and 'sleeping giant'
Theory of Ability	Fixed and inherited Realized by effort	Inherited ability	Inherited cast of mind	Varies, but needs cherishing	Cultural product: Not fixed
Mathematical aims	'Back-to-Basics': numeracy and social training in obedience	Useful maths to appropriate level and Certification (industry-centred)	Transmit body of mathematical knowledge (Maths-centred)	Creativity, Self-realization through mathematics (Child-centred)	Critical awareness and democratic citizenship via mathematics
Theory of Learning	Hard work, effort, practice, rote	Skill acquisition, practical experience	Understanding and application	Activity, Play, Exploration	Questioning, Decision making, Negotiation
Theory of Teaching Mathematics	Authoritarian Transmission, Drill, no 'frills'	Skill instructor Motivate through work-relevance	Explain, Motivate Pass on structure	Facilitate personal exploration Prevent failure	Discussion, Conflict Questioning of content and pedagogy
Theory of Resources	Chalk and Talk Only Anti-calculator	Hands-on and Microcomputers	Visual aids to motivate	Rich environment to explore	Socially relevant Authentic
Theory of Assessment in Maths	External testing of simple basics	Avoid cheating External tests and certification Skill profiling	External examinations based on hierarchy	Teacher led internal assessment Avoid failure	Various models. Use of social issues and content
Theory of Social Diversity	Differentiated schooling by Class Crypto-racist, Monoculturalist	Vary curriculum by future occupations	Vary curriculum by ability only (maths neutral)	Humanize neutral maths for all: Use local culture	Accommodation of social and cultural diversity a necessity

Figure 3.3: Ernest's overview of educational ideologies

Now any transmitter potentially has at his or her disposal various P(i) as well as dispositions which are shaped by previous experience and the local context in which transmission and acquisition unfold. If one examines various P(i) one finds that they have extremely weak grammars and there exists considerable overlap amongst the P(i). This was demonstrated in chapter 2 with reference to the various "approaches". At the level of classroom practice there is no reason to assume that pedagogic action is true to any P(i) because elements of one or more P(i) are delocated from the GPP and relocated within a pedagogic relationship: the elements of the P(i) are transformed in this disembedding from one or more sets of social relations and divisions of labour and their re-embedding within different social relations and divisions of labour. What is realised within a pedagogic relationship is therefore necessarily different from the

P(i). For example, Galant (1994) concluded in her case study of the recontextualising of pedagogic discourse from INSET provision to school mathematics teaching that

> [i]t appears that the teacher's recontextualising of [...] [mathematical tasks] from the inservice project does not have the effect that the practices of the inservice project intended with the same [tasks]. These are [tasks] and materials that were meant to facilitate pupil participation and to encourage "self-conjecturing" by students. We see instead how the [tasks] in the classroom regulate pupil participation and mask expository teaching.
>
> (p. 46)

The acquisition and transmission realisations will be referred to as constituting specific pedagogic codes[1] and they constitute the *specific code plane* (SCP). The relationship between the GPP and the SCP can be represented as follows:

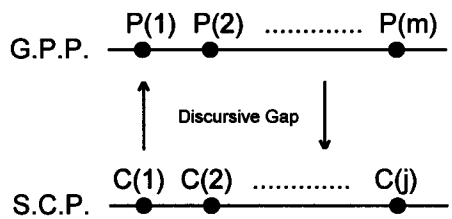


Figure 3.4

3.3 Context

The construction of the relationships between various planes necessarily introduces the need for a more rigorous definition of context because the marking out of the planes presupposes the recognition of different sets of social relations and divisions of labour. For example, in the school

> the social division of labour is constituted by the set of categories between transmitters (teachers) and the set of categories which constitute acquirers, whilst the social relations refer to practices between transmitters and practices between acquirers.
>
> (Bernstein, 1990: 22)

Similarly, in INSET the social division of labour is constituted by the set of categories between INSET providers (transmitters) and the set of categories which constitute teachers (acquirers); the social relations refer to practices between INSET providers and teachers. Bernstein's code theory, with its tools for the analysis and description of the regulation of relationships both between (^{e}) and within (^{i}) contexts provides a definition of context which will be used in this study:

---

[1] *[A] code is a regulative principle, tacitly acquired, which selects and integrates relevant meanings, forms of realisations, and evoking contexts* (Bernstein, 1990: 101; emphasis in the original).

> What counts as a context depends not on relationships within but on relationships between contexts. The latter relationships, *between*, create boundary markers whereby specific contexts are distinguished by their specialized meanings and realizations.
>
> Thus if code is the relationships between context and, through that, the regulator of relationships within contexts, then code must generate principles for distinguishing between contexts (classification) and principles, for the creation and production of the specialized relationships within a concept (framing). ... Recognition rules, a function of classification, create the means for distinguishing between, and so recognizing, the *speciality* that constitutes a context, and realization rules, a function of framing, regulate the creation and production of specialized relationships internal to that context.
>
> (Bernstein, 1990: 101-2; emphasis in the original.)

Within the code theory

> context is defined by its classificatory and framing values $\pm C^{ie}F^{ie}$, which regulate the *interactional principle* with respect to the selection, organisation (sequencing), pacing, and criteria of oral, written, or visual communication, together with the posture, and dress of communicants, and the *locational principle* with respect to the physical location and the form of its realisation (the range of objects, their attributes, and the relation to each other in space).
>
> (Bernstein, 1990: 107; emphasis in the original.)

Pedagogic prescriptions generated by a P(i) can be described in terms of classificatory (C) and framing (F) values, where classification refers to the degree of "insulation" between categories:

> Different degrees of insulation between categories create different principles of the relations between categories and so different principles of the division of labour. If there is strong insulation between categories, then we shall say there is a principle of strong classification, whereas if there is weak insulation between categories we shall say that this gives rise to a principle of weak classification. (Classification refers to the relations between categories, not to what is classified.) An change in the principle of classification will require a change in the degree of insulation. Alternatively, the maintenence of a given principle depends upon preserving the strength of insulation.
>
> (Bernstein, 1990: 24)

Framing, on the other hand,

> refers to the principle regulating the communicative practices of the social relations within the reproduction of discursive resources, that is, between transmitters and acquirers. Where framing is strong, the transmitter explicitly regulates the distinguishing features of the interactional and locational principles, which constitute the communicative context. Where framing is weak, the acquirer has a greater degree of regulation over the distinguishing features of the interactional and locational features that constitute the communicative context. This may be more apparent than real.
>
> (Bernstein, 1990: 36)

Transmission and acquisition realisations of pedagogic prescriptions can also be described in terms of C and F values. Such realisations occur within INSET provision as well as school mathematics teaching and learning. One can therefore write C and F

codes for a P(i) as well as for pedagogic action in INSET provision and the classroom. The GPP can be thought of as the plane of classification and framing prescriptions; the SCP as the plane of classification and framing realisations. For example, in the "problem-centred approach" pedagogic prescriptions require that there should be a weakening of classification between mathematics and the everyday;[2] problems should be "relevant", meaning that problems should have substantial everyday content as is shown in the following problem which Human *et al* (1994: 252) use as an illustration:

> Two bus services, Transit and Travelight, operate from Johannesburg to various towns in the Transvaal and Natal. To travel with Transit or Travelight, you have to pay a basic charges [sic] as well as a certain amount for every 50 kilometers.
>
> The basic charge for Transit buses in R14 and apart from this you have to pay R2 for every 50 kilometers.
>
> The basic charge for Travelight buses is R9 and apart from this you have to pay R3 for every 50 kilometers.
>
> Which bus service is cheapest?

Textbooks by Human *et* al for primary school mathematics list in their tables of contents sets of problems associated with topics. For example, the contents for "Fractions" are listed as follows in Human *et al* (1993):

Fractions	
13. Tea bags	**15**
14. How thick is paper?	**16**
15. Sausage puzzles	**17**
16. A party	**18**
17. A weekend camp	**19**
18. Cake puzzles	**20**
19. Discounts	**21**
20. A decimal snake	**22**

Items 13 to 20, as with all the other items listed on the contents page, are student tasks. There is essentially no elaboration of mathematical contents because the contents have to be "constructed" by the students through engagement with the tasks. No particular "solution strategies" can be prioritised by the teacher because this weakening of classification must also be accompanied by an apparent weakening of framing:

---

[2] I have chosen to speak about the differences between the everyday and the academic in terms of classification. Bernstein (1971: 206), however, describes the differences in terms of framing: "Thus we can consider variations in the strengths of frames as these refer to the strength of the boundary between educational knowledge and everyday community knowledge of teacher and taught." Atkinson (1985: 136), referring to the same quotation, has argued that in practice "this latter aspect of boundary seems equally a matter of classification and frame, since it is often related directly to the relative purity and strength of the membrane of curriculum contents. Empirical research tends to reflect this overlap and ambiguity."

> The problem allows checking of proposed solutions with references to the features of the problem. This feature not only facilitates immediate feedback but extends the "locus of control" of students in the sense that they can independently validate their proposed solutions and methods.
>
> (Human *et al*, 1994: 252)

Pacing as well as the criteria for what constitutes valid mathematics are apparently controlled by the students. The selection and sequencing of tasks are, however, controlled by the teacher or some other transmission agency: "Effective problem-centred learning is dependent on the utilisation of appropriate problems" (Human *et al*: 1994: 252). The students are to become autodidacts with the teacher organising the pedagogic space to facilitate for that to happen: acquirers are to become their own transmitters. Apparently, therefore, classification between transmitter and acquirer is weakened. One could argue that if this weakening of classification is actual rather than merely apparent, that anyone, not necessarily a mathematics teacher, who was given a set of rules for the organising of the pedagogic space and a selection of sequenced tasks could replace the teacher. The pedagogic prescriptions generated by the "problem-solving approach" can be described in terms of C and F values as follows:

(1) mathematics/non-mathematical	–C
(2) transmitter/acquirer	–C
(3) pacing	–F
(4) sequencing	+F
(5) criteria	–F
(6) selection	+F
(7) organisation of pedagogic space	+F

One can examine transmission and acquisition realisations of the prescriptions in terms of classification and framing values and compare these values with those of the prescriptions. Galant (1994: 46) argued that the social relations pertaining in the classroom had a significant effect on the transmission and acquisition realisations of pedagogic prescriptions and that there was a "disjuncture between the teacher's classroom practice and her verbal construction of good practice". The teacher's verbal construction of good practice detailed many of the pedagogic prescriptions privileged by the INSET providers but when recontextualised to the classroom these prescriptions were realised in forms different from those intended by the INSET providers. For example, prescriptions which called for a weakening of framing (–F), when recontextualised, were realised as +F.

3.4 The production of data

In the present study I distinguish between *information* and *data*. Information is to be located at the level of the relationship between the GPP and the SCP. In other words, I construct data by reading the relationship between pedagogic prescriptions and acquisition and transmission realisations of such prescriptions. Data are produced by a reading of information. Such reading, which is informed by a review of the INSET literature and an engagement with various L(i) (that is, the languages in the GAP), acts selectively on the information and transforms it into data. An engagement with different L(i) might conceivably produce different data.

Pedagogic action within both the context of INSET provision as well as classroom teaching can be understood as GPP/SCP relations. They are, however, different and I introduce two more planes to mark out this difference. The analysis of empirical instances of pedagogic discourse produces two data planes which I shall refer to as the plane of transmission recontextualising (TR) and the plane of acquisition recontextualising (AR). TR and AR are products of analysis and are relational. The production of TR and AR requires the necessary prior identification of transmission and acquisition texts. For example, the extracts from Human *et al* (1994) referred to above are transmission texts. With respect to teacher education (PRESET or INSET), the realisations of pedagogic prescriptions in the classroom (or teacher training examinations) are acquisition texts. However, within the classroom, transmission realisations are transmission texts and acquisition realisations are acquisition texts.

The distinction between TR and AR can be thought of as articulations of the social division of labour which can be realised as both inter- and intrasubjective. An empirical distinction can be made between INSET provider and teacher: an arresting of signification can realise the division of labour as intersubjective. However, both INSET provider and teacher can be understood as "inhabiting" TR and AR. A pedagogic encounter between a teacher and an INSET provider can be read evaluatively with reference to a P(i), say the "problem-solving approach". The textual productions of the INSET provider are produced as acquisition texts by such readings.[3] The teacher, who is meant to acquire the pedagogic prescriptions transmitted by the INSET provider reads the textual productions as transmission texts. On moving into the classroom, the teacher's performance is read as an acquisition text by the INSET provider and as a transmission text by the students. This distinction can

[3] Think, for example, of a situation in which the performance of one INSET provider, working with a teacher, is observed by another INSET provider. The performance of the observed INSET provider can then be read by the observing INSET provider as an acquisition text.

be extended to students: when students are used as pedagogic surrogates by the teacher their performances can be read as transmission texts by other students while being read as acquisition texts by the teacher. The "inhabitants" of TR can be described as transmitters and those of AR as acquirers — human subjectivity is of necessity multiple (Dowling, 1993a).

3.5 A contextualising of the study

Transmission and acquisition texts are read with reference to pedagogic prescriptions which can be associated with one or more P(i). The P(i) are produced by recontextualising contents from V(i) and H(i). More than one recontextualising therefore occurs. My interest is in the recontextualising of pedagogic discourse, that is, the relationship between the GPP and the SCP, and therefore excludes consideration of recontextualising made directly from the GDP to the SCP. That is not to say that such recontextualising cannot occur, but merely that it is not an object of study here.

I want to indicate two subfields within the field of recontextualising: the subfield of primary recontextualising and the subfield of secondary recontextualising. The subfield of primary recontextualising demands of agents an engagement with various discourses in order to effect the initial delocation and relocation of a selection of contents; that is, the relationship between the GDP and the GPP. One can think of agents involved in the production of theories of instruction in mathematics education as acting at this level (Human *et al*, for example). The subfield of secondary recontextualising is constituted by the recontextualising of already recontextualised contents by teacher trainers and teachers.

In chapter 2 I argued that INSET provided by NGOs and projects focuses on attempts to transform teaching methodologies by offering teachers sets of pedagogic prescriptions. I also argued that the professional concerns of teachers are constructed in a manner which excludes or marginalises the academic. Teachers (and many INSET providers) are therefore not required to enter the subfield of primary recontextualising. As pointed out above, my data are transmission and acquisition texts and in this study transmission and acquisition texts, and therefore TR and AR, are to be located within the subfield of secondary recontextualising. I can now represent the location of my area of empirical investigation as in Figure 3.5.

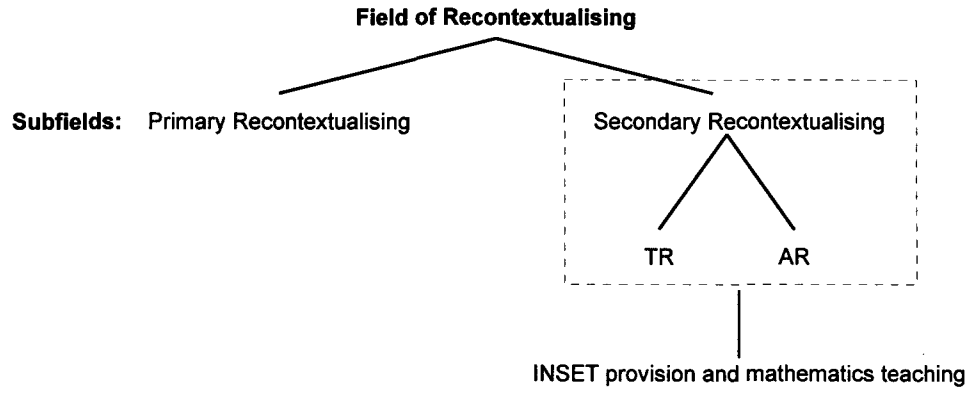


Figure 3.5

I shall now bring together the various relations sketched above to produce a unified picture of the argument so far (see Figure 3.6).

3.6 Metaphor, metonymy and the production of subjectivity

Dowling (1993a) rearticulates elements of Althusser (1971) and Eco (1976) to great effect to formulate a highly productive model of the pedagogic relationship between transmitter and acquirer. The model redescribes the pedagogic relationship in terms of the linguistic tropes, metaphor and metonymy, enabling Dowling to produce a number of theoretical propositions which are used to derive his sociological language of description for the reading of pedagogic texts. Eco's (1976) model of the relationship between metaphor and metonymy describes the poles of a metaphor as linked by a subjacent chain of metonyms. For Eco metonymic chains can always be constructed as is amusingly demonstrated in the following extract from *Foucault's Pendulum*:

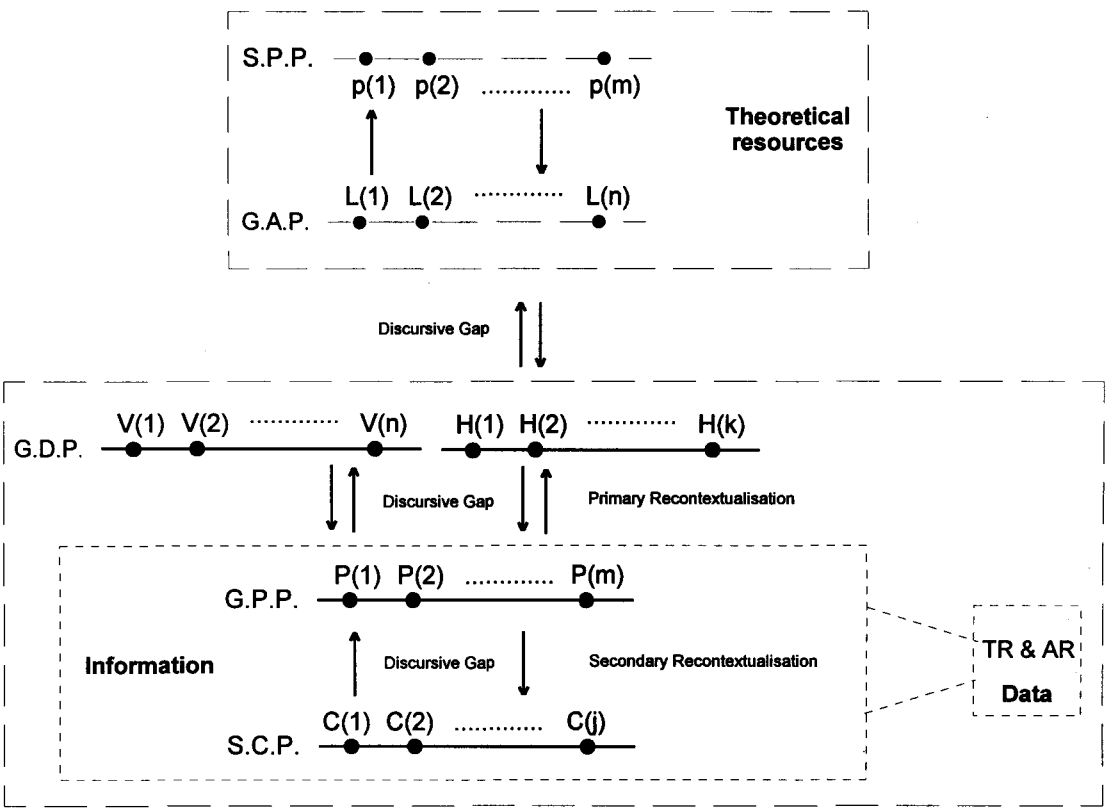
> Nebulae, Laplace; Laplace, Kant; Kant, Königsberg, the seven bridges of Königsberg, theorems of topology . . . It was a little like that game where you have to go from sausage to Plato in five steps, by association of ideas. Let's see: sausage, pig bristle, paintbrush, Mannerism, Idea, Plato. Easy. [...] I had a strict rule, which I think the secret services follow, too: No piece of information is superior to any other. Power lies in having them all on file and then finding the connections. There are always connections; you only have to want to find them.
>
> (Eco, 1989: 225)

The empirical texts which were implicated in the generation of Dowling's language and which were objects of his analysis were school mathematics textbooks outside of their actual use in classrooms:

> A text, in this project, is to be understood as closed. It is an utterance or set or sequence of utterances made within the context of a particular activity [...] **The significance of**

the closure of the text is that its analysis is not concerned with the interactional; the ideal reader is effectively exhausted by [the reading of the text] and is thus rendered passive.

(Dowling, 1993a: 90. My emphasis.)



S.P.P. - Specific Problem Plane
G.A.P. - General Approach Plane
TR - Plane of Transmission Recontextualising
AR - Plane of Acquisition Recontextualising
G.D.P. - General Discourse Plane
G.P.P. - General Pedagogic Plane
S.C.P. - Specific Code Plane

Figure 3.6

The empirical texts which are the objects of my analysis are produced through my readings of the interactions between INSET providers and teachers, and teachers and students. Of course, the transcripts and photographs whose production and reading becomes my data, are closed by such readings; the readings, however, have to attempt to grasp the interactional. I shall attempt to fashion a model which enables such readings of pedagogic texts by extending and adapting elements of Dowling's model of the transmitter-acquirer relationship.

Dowling produces ten theoretical propositions, two of which are of immmediate interest here:

Theoretical Proposition 8 (TP8)

> Subjectivity in relation to specific activities are achieved by pedagogic action, which establishes metonymic links between the pedagogue and the to-be-pedagogised. Pedagogic action may be visible or invisible depending upon the accessibility to the to-be-pedagogised of the regulating principles of the activity. Visible pedagogic action renders the principles available via metonymic rather than (or at least as well as) metaphoric links. This may be achieved ostensively or verbally, depending on the degree of discursive saturation.

Theoretical Proposition 9 (TP9)

> Successful apprenticeship to an activity is achieved (metaphorically) upon the completion of a one-hundred-and-eighty-degree rotation of the apprentice who thereby 'moves' from 'outside' to 'inside' the activity and becomes its Subject.
>
> (Dowling, 1993a: 85-6)

In the following section I shall attempt to adapt Dowling's model for my purposes by introducing the trope synecdoche. In his language of description, Dowling (1993a) describes the production of subjectivities in terms of textual strategies and textual resources. In the final chapter I shall attempt to define strategies and resources which facilitate the description of the recontextualising of pedagogic knowledge.

3.7 Synecdoche, redescription and the production of subjectivity

Muller & Taylor (1994) use the term *redescription* in a manner which I find useful for my study:

> Description, redescription and canonisation occur within the framework of two fundamental legislative signifying mechanisms: condensation and displacement. Condensation is the centripetal dynamic of social meaning, the lifeline of social cohesion where different interpretations are blended to form a single meaning. Displacement, on the other hand, is the centrifugal dynamic of social meaning, a mechanism of divide and rule, with different interpretations not supressed, but held in a kind of suspension, disarmed and rendered ineffective. While one of the two mechanisms may predominate at any one time, neither can occur without the other.
>
> (Muller & Taylor, 1993: 314)

I will use *redescription* to refer to the transformation of utterences (verbal or written), in pedagogic encounters, of one agent by another. The redescriptions which I am most interested in here are those which work towards condensation.

Eco (1979) highlights the need for a language which is shared by addresser and addressee in a communicative context:

> To organise a text, its author has to rely upon a series of codes that assign given contents to the expression he [sic] uses. To make his text communicative, the author has to assume that the ensemble of codes he relies upon is the same as that shared by his

> possible reader. **The author has thus to forsee a model of the possible reader (hereafter Model Reader) supposedly able to deal interpretatively with the expressions in the same way as the author deals generatively with them.**
>
> (Eco, 1979: 7. My emphasis.)

If "text" is interpreted in the broad sense which I indicated earlier, then Eco's argument applies to verbal utterences, cinema, art and so forth. The addresser (or author) corresponds to the transmitter in this study; the addressee (or reader), to the acquirer. It is, however, the case that pedagogic action has to achieve the transmission of contents, the acquisition of which depends on the activity-specific communicative competence of the acquirer. Pedagogic action therefore has to simultaneously transmit to the acquirer (or apprentice - Dowling) contents as well as the means for recognising and manipulating the contents. Eco's argument suggests that the transmitter has to forsee a model of an acquirer who can decode the utterances of the transmitter. The model acquirer will be refered to as the *ideal acquirer* here.

In Bernstein's (1990) terms successful apprenticeship is facilitated by the transmission and acquisition of recognition and realisation rules. Pedagogy is, however, of necessity extended over time: the transmitter cannot instantaneously make available to the acquirer the principles of his/her pedagogising, neither can the acquirer so grasp them.[4] What has to happen is a continual redescription of the activity of the acquirer by the transmitter which transforms that activity into pedagogic texts. The principles of such redescription can be relatively explicit or implicit in the pedagogic relationship and therefore relatively more or less accessible to the acquirer (and, in many instances, the transmitter). The acquirer has to learn to facilitate the redescription of his/her activity so as to be recognised as the (re)producer of legitimate acquisition texts. Of course the acquirer simultaneously learns how to be a (re)producer of illegitimate texts because the recognition and realisation rules which are essential for the (re)production of legitimate texts announce themselves through readings that (re)produce differences between texts, legitimate and illegitimate. Both transmitter and acquirer are therefore faced with the task of accessing recognition and realisation rules to facilitate the redescription of texts as legitimate (or illegitimate) transmission and acquisition texts. The acquirer is to infer from the evaluations executed by the transmitter what the characteristics of an ideal acquirer are (in Eco's terms, a "Model Reader"). The transmitter, through evaluative acts performed on the textual (re)productions of the acquirer, transmits (implicitly and explicitly) over time, the topography of an ideal acquirer.

[4]Even if the principles were fully available to the transmitter.

The ideal acquirer (and the ideal transmitter - Eco's "Author") are never complete in any given pedagogic act. The transmitter redescribes *elements* of the performance of the acquirer as legitimate or illegitimate with reference to an ideal acquirer; the acquirer has to learn to redescribe his/her own performances likewise.

My use of the notion *ideal acquirer* glosses over the differential distribution of competence and "ability". In a sense, there are many ideal acquirers who may be constructed and hierarchically positioned with reference to "race", gender, class, sexual preferences, physical or mental "disability" and so forth. While it is a serious shortcoming of the model developed here, I am not able to introduce into it categories for the description of the differential distribution of competence and "ability" in a study of limited scope such as this is. That is left as a future project.

Metaphorically, the redescription of elements of performances of the acquirer are realised by reading them as *parts* of an imagined *whole*: the redescribed elements stand in synecdochic relation to the imagined ideal acquirer. Documents detailing syllabus requirements, for example, often specify which contents of a subject (say, mathematics) a student of a certain age and of a certain "ability" should know. The successful performance in an examination based on the specified contents then becomes part of the image of the ideal acquirer. Syllabus details often also specify significant attributes of the ideal acquirer as is demonstrated in the following extract from the aims of a syllabus for standards 5 to 7 ordinary grade mathematics:

> To enable pupils to gain mathematical knowledge and proficiency
> To develop number sense, the ability to compute by using mental methods, written methods and/or the calculator and to judge the reasonableness of results by means of estimation
> To develop insight into spatial relationships and measurement
> To increase the ability to apply mathematics in daily life
> To develop mathematical insight
> To enable pupils (individually or in groups) to solve routine and non-routine problems
> [...]
> To develop the ability to understand, interpret, read, speak and write mathematical language
> To develop an appreciation of patterns and relationships in mathematics
> To provide basic training for future study and careers
> To devleop a love for, and an exploratory attitude towards mathematics
> To develop an appreciation of the important place of mathematics and its widespread applications, in other subject and our world
>
> (CED, 1991: 2-3)

The performances of the acquirer (and the transmitter) are to be evaluated against the prescribed mathematical contents as well as the aims, although the aims are often ignored in practice. Nevertheless, the aims list some of the attribiutes of the ideal

acquirer, and the authors of the document, or teachers who observe the aims, have to develop some way of establishing indicators of attributes of the ideal acquirer. In many instances student performance in examinations will be the chief indicator used and the most successful students will be attributed the features of the ideal acquirer. The features of the ideal acquirer then become condensed into the grade awarded to a student, but this need not always be the case as is demonstrated in Walkerdine *et al* (1989) where boys, who were not performing as well as girls on average in tests, but who "broke set", were considered by teachers to possess greater mathematical abilities than girls. The teacher reads certain aspects of the performances of students as indicators of features of the imagined ideal acquirer.

For Dowling (1993a) the ideal acquirer (successful apprentice) is in fact the transmitter (or pedagogue - TP9), where successful apprenticeship is achieved through the establishing of metonymic links between transmitter and acquirer (TP8). In this model it is the production of synecdoches which enable the establishing of the metonymic links. If, as in Eco's model, one accepts that metaphor is the short circuiting of a metonymic chain, I suggest that the production of the metonymic chain is delimited by the specific activity (in Dowling's sense) and so requires synecdoches which are produced subject to its classificatory principles.[5] Since the production of synecdoches involves redescription, it necessarily involves interpretation of the performances of the acquirer which have to be contextually legitimate:

> In the Peircean line of thought it can be asserted that any community of interpreters, in the course of their common inquiry about what kind of object the text they are reading is, can frequently reach (even though nondefinitively and in a fallible way) an agreement about it.
> [...]
> **But, even though the interpreters cannot decide which interpretation is the privileged one, they can agree on the fact that certain interpretations are not contextually legitimated.**
>
> (Eco, 1990: 41. My emphasis.)

The establishing of metonymic links between transmitter and acquirer involves the projection of recognition and realisation rules by the transmitter *and* the introjection of those rules by the acquirer. The term "projection" can be used to refer to the reading of pedagogic texts by both transmitter and acquirer as is implied by Harland:

---

[5]In the literature synecdoche is often defined as a species of metonymy, as a type of displacement (Atkinson (1990); Culler (1975); Dowling (1993a); Eco (1984); Jakobson (1956); Lakoff & Johnson (1980); Silverman (1983)), and is therefore implied in Dowling's model. For example, "We are including as a special case of metonymy what traditional rhetoricians have called *synecdoche*, where the part stands for the whole ..." (Lakoff & Johnson, 1980: 36. Emphasis in the original.)

> [T]he synthesis of objects involves an act of *projection.* When we collapse a multiplicity of profiles and images onto a single object, we discount the effects produced by our own personal viewing positions and viewing conditions. [...] It is as though one squeezes sense-impressions together only by simultaneously squeezing them out onto a new plane of existence.
>
> (Harland, 1993: 18. Emphasis in the original.)

I, however, need to distinguish between transmitter and acquirer (because I wish to refer to transmission and acquisition texts) as well as to reference the P(i) which, in a sense, delimits and informs the production of the "new plane of existence" in order to reproduce itself. I will therefore maintain the terms "projection" and "introjection" which are used in a manner following Klein (1957).[6] Projection and introjection of recognition and realisation rules are achieved through the redescription of the performances of the acquirer (and transmitter) by the transmitter and acquirer. Redescription is itself facilitated by the production of synecdoches. Two species of synecdoche are therefore postulated in this model: projective and introjective synecdoche. Projective synecdoche involves the redescription of elements of the performances of the acquirer in terms of features of the ideal acquirer by the transmitter. Introjective synecdoche involves a similar redescription by the acquirer of his or her own performances.

In his analysis of the production of ethnographic texts, Atkinson, drawing on Lodge (1977), describes synecdoche as generated by deletion:

> The poetics of the factual are typically (but not exclusively) based on those of metonymy ... and the figure of synecdoche may be employed, ... generated by deletion ...
> [...]
> Such a principle of deletion accounts for the device for the *production* of synecdoche: the maxim for reading such a text would seem to be the reverse procedure - 'filling in' the deletions in order to discover the whole which is implied or referred to.
>
> When we turn to the use of synecdoche in factual accounts, the same general principles apply. But here the intended or imputed relationship is one of *logical* selection or deletion, and hence of reasonable, rational inference. In both varieties the 'part' (or example, or appearance) may stand for the whole. In the factual account, the relationship may be treated as equivalent to that of evidence or justified inference. The realist account may approximate to either the more literary or the more factual mode. The part-for-whole substitution may, for instance, be read as a 'symptom' or to imply a logical sequential organization (so that cause or motive is inferred).
>
> (pp. 51-2. Emphasis in the original.)

---

[6] "The more often gratification at the breast is experienced and fully accepted, the more often enjoyment and gratitude, and accordingly the wish to return pleasure, are felt. This recurrent experience makes possible gratitude on the deepest level and plays an important role in the capacity to make reparation, and in all sublimations. **Through processes of projection and introjection, through inner wealth given out and re-introjected, an enrichment and deepening of the ego comes about.** In this way the possession of the helpful inner object is again and again re-established and gratitude can fully come into play." (Klein, 1957: 19. My emphasis.)

There is a suggestion in the extract that the observed world is given — "factual" — and so the production and reading of synecdoche respectively requires a deletion and a filling in of facts. This is different to my use of the trope which sees synecdoche as implicated in the reading, in the production of texts, not merely through the deletion of "facts", but in their production. I will use Barthes' reformulation, in *S/Z*, of the relationship between connotation and denotation which was proposed in *Mythologies* to emphasise the links between the P(i) and the production of pedagogic texts and subjectivities:

> [O]f the two systems, denotative and connotative, one turns back on itself and indicates its own existence: the system of denotation; **denotation is not the first meaning, but pretends to be so; under this illusion it is ultimately no more than the *last* of the connotations (the one that seems both to establish and close the reading)**, the superior myth by which the text pretends to return to the nature of language, to language as nature ...
>
> (Barthes, 1974: 9. My emphasis.)

Pedagogic action establishes privileged meanings by referencing the GPP, or sets of pedagogic presciptions recontextualised from a P(i): the wealth of connotations which are potentially present in transmission and acquisition texts are suppressed so that only certain meanings are established as denotations and hence as legitimate. The establishing of specific denotations acts on both the mathematical content and subjectivity. Through the lens of sets of pedagogic prescriptions elements of the performances of subjects are isolated to produce synechdoches which facilitate redescriptions of performances through the establishing of privileged denotations from the "mist of connotations" (Brown, 1994), to produce pedagogic subjects. Acquisition texts are read for evidence of the introjection of legitimate texts; transmission texts are to be read as projections of legitimate texts. A sense of pollution and purity must be developed in the acquirer and is achieved by the projection of denotations by the transmitter and their introjection by the acquirer. Denotations can be established relatively explicitly or implicitly. Within a pedagogic relationship projective and introjective synecdoche articulate with each other to establish both *what* constitutes transmission and acquisition texts as well as *how* texts are to be constituted. I have already indicated, in my discussion of Human *et al*, that the *what* and the *how* of pedagogic discourse can be described in terms of classification and framing respectively.

3.8 Visible and invisible pedagogies

Metaphor is often defined with reference to synecdoche, as in Culler, for example.

> Metaphor is a combination of two synecdoches: it moves from a whole to one of its parts to another whole which contains that part, or from a member to a general class and then back again to another member of that class.
> [...]
> The move from member to class to member is the most common procedure for interpreting metaphors.
>
> (Culler, 1975: 180-1)

Culler's conception of metaphor is too narrow for my purposes and instead of being used more generally, is associated here only with synecdochic articulations of signifying elements. Since, in this model, there is always a redescription of performance, there is also always a production of synecdoches. Corresponding to Dowling's distinction between metaphoric and metonymic articulations of signifying elements in *TP5*, I suggest that articulations can remain at the level of synecdoche or become more fully metonymic:

> *Theoretical Proposition 5 (TP5)*
>
> > Articulations between signifying elements of an activity may be metonymic or metaphoric. The distinction concerns the visibility or explicitness of the denotations and connotations which establish the articulation. Metonymic chains render visible, or explicit, metaphorical relations.
> >
> > (Dowling, 1993a: 85)

Bernstein (1990) describes two general modalities of pedagogy: visible and invisible. Visible pedagogies have "explicit rules of regulative and discursive order" whereas in invisible pedagogies "the discursive rules (the rules of order of instruction) are known only to the transmitter, and in this sense a pedagogy of this type is (at least initially) invisible to the acquirer, essentially because the acquirer appears to fill the pedagogic space rather than the transmitter" (p. 71). Here, articulations of contents which remain only at the level of synecdoche can be described as invisible pedagogies. Alternatively, where the articulation of contents move from synecdoche to metonymy, visible pedagogies are established.[7]

[7]See the distinction drawn between visible and invisible pedagogies in Dowling (1993a): "Pedagogic action may be visible or invisible depending on the accessibility to the to-be-pedagogised of the

3.9 Summary

I will now summarize the main findings of this chapter which will be used in the following chapter to produce and analyse data.

1. Pedagogic discourse is a recontextualised discourse. There are two subfields within the recontextualising field: the primary and secondary recontextualising subfields. Selections are made from vertical and horizontal discourses to produce pedagogic discourses at the level of the GPP to constitute the primary recontextualising subfield. Pedagogic discourses at the level of the classroom (SCP) recontextualise pedagogic prescriptions from the GPP as well as make selections from horizontal discourses to constitute the secondary recontextualising subfield.

2. Pedagogic discourse within the contexts of INSET provision and school teaching are part of the secondary recontextualising subfield. The pedagogic discourse within the secondary recontextualising subfield exhibits horizontal knowledge structure with weak grammar.

3. Pedagogic contexts can be defined by their classification and framing values which can be used to detect transformations of pedagogic prescriptions as they are recontextualised from the GPP to the SCP.

4. Pedagogic action constructs one or more transmitters and one or more acquirers. The textual productions of the transmitters are called transmission texts; those of the acquirers, acquisition texts. Any empirical pedagogic subject can move between the categories of transmitter and acquirer. Human subjectivity is multiple.

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regulating principles of the activity. Visible pedagogic action renders the principles available via metonymic rather than (or at least as well as) metaphoric links." (p. 86)

5. In a pedagogy there is always a redescription of the utterances (textual or verbal) of the transmitter and the acquirer.

6. Pedagogic discourse constructs one or more (imagined) ideal acquirers who stand in synecdochic relation to empirical acquirers. Subjectivities are produced via the production of synecdoches which inform the redescriptions of utterences to produce pedagogic texts and pedagogic subjects.

7. Pedagogies can be invisible or visible. Articulations between signifying elements which are substantially synecdochic indicate invisible pedagogies; articulations which move from synecdoche to metonymy indicate visible pedagoies.

In the next chapter I shall use the points summarized here to produce an analysis of the recontextualising of pedagogic discourse. In the final chapter I draw attention to categories of pedagogic resources and strategies which are implicated in the (re)production and reconextualising of pedagogic discourse in INSET provision and school teaching.

Chapter 4

An analysis of INSET provider-teacher interaction

In this chapter I analyse two sets of data: those derived from the INSET course and the interactions between the INSET provider and teacher during a planning session. This analysis prepares the ground for chapters 5 and 6. In chapter 5 I analyse the interactions between the teacher and students and in chapter 6 I highlight strategies and resources implicated in the recontextualising of pedagogic discourse.

4.1 The INSET course

4.1.1 Teachers' expression of their needs

At the start of the course teachers were asked to list their hopes and fears about the course (see Appendix 1). From their responses I have extracted a list of needs expressed by the teachers, who felt that the course should:

1. address problems which are encountered by them in their classrooms;
2. provide practical ideas for teaching;
3. enable them to enhance students' interest in mathematics;
4. present ideas which would assist them to make mathematics more relevant and meaningful;
5. develop their knowledge of teaching skills and different approaches to teaching various topics by exposing them to effective teaching methods, enabling and motivating them to experiment with different techniques or methods;
6. be a forum for sharing teaching experience(s) with one another;
7. enable them to accumulate or develop mathematics teaching resources.

Through their "hopes and fears" teachers invite the Project to consider professional development as a vehicle for the solving of pedagogic problems. From the description of the course below, the reader will see that the Project tries not to respond to the teachers' problems with procedures. However, the contents of the course are more often than not recontextualised to the classroom as procedures as Galant (1994) pointed out.

4.1.2 Good practice

Features of what constitutes good practice for school mathematics teaching are transmitted and acquired both implicitly and explicitly; implicitly through the organisation of pedagogic space, structuring of transmission texts and the redescription of the performances of the acquirer (which is simultaneously a less visible form of evaluation); explicitly through the exposition of features of good practice and visible evaluations of the performances of the acquirer.

Task	Apparatus	Worksheet/s	Group/s
1. Boxes (a)	none	no	no
2. Boxes (b)	cardboard squares	yes	yes
3. Activity One	none	yes	?
4. Activity Two	none	yes	?
5. Activity Three	geoboards, dotted paper	no	yes
6. Activity Four	tiling mats	yes	yes
7. Activity Five	none	no	?
8. Counting dots	chalkboard	no	?
9. Triangle Area	dotted paper	yes	?
10. Substitution	none	no	?
11. Rectangles	video, dotted paper	no	?
12. Equivalent transformations	none	yes	?
13. Parallelogram angle properties	various tessellations on paper	yes	yes
14. Rigidity	?	?	yes
15. Geoboard rhombi (a)	geoboards, elastic bands	no	no
16. Quadrilaterals through diagonals	geostrips, string	yes	yes
17. Geoboard rhombi (b)	geoboards, elastic bands	no	yes
18. Bodymaths	participants	yes	yes
19. Ordering of quadrilaterals I	geoboards, elastic bands, dotted paper	yes	yes
22. Parallelogram area	cardboard model	yes	?

Table 4.1 (continued on the following page)

Task	Apparatus	Worksheet/s	Group/s
20. Ordering of quadrilaterals II	none	yes	yes
21. Shapeguess	none	yes	yes
23. Number line	participants	no	yes
24. Barter game	coloured, marked cardboard tokens	no	?
25. Number line game	?	no	?
26. Silent game	none	no	no
27. Chinese mathematics & negative integers	?	yes	?
28. Chinese counting	coloured discs	yes	?
29. Saunderson & negative numbers	none	yes	yes
30. Introduction to angle concept I	acetate sheets, drawing pins, rulers	yes	yes
31. Introduction to angle concept II	acetate sheets, drawing pins, rulers	yes	yes
32. The line	acetate sheets, drawing pins	yes	yes
33. Angles	acetate sheets, drawing pins	yes	yes
34. Angles: Complementary & supplementary	acetate sheets, drawing pins	yes	yes
35. Investigation with two lines	acetate sheets, drawing pins	yes	yes
36. Dissections	video	yes	?
37. Pythagoras	dotted paper	yes	?
38. Pythagorean puzzle	scissors, diagrams to be dissected	yes	?

Table 4.1 (continued)

Summary of information

The question marks indicate that the information was unobtainable.

Total number of tasks:	38
Number of tasks requiring apparatus:	22
Number of tasks presented as worksheets:	25
Number of tasks which require work in groups:	19

Table 4.1 shows a list of thirty-eight tasks which were encountered by teachers on the course. Alongside each task is an indication of whether apparatus, worksheets or groups were used. Of these tasks at least[1] twenty-two (57,9%) required apparatus, twenty-five (65,8%) were presented in the form of worksheets, and 19 (50%) required the participants to work in groups of two or more. There is a strong suggestion from this data that, whether transmitted implicitly or explicitly, the presentation and organisation of mathematical tasks, in the Project's conception of good practice, must include the use of apparatus and groups with the tasks presented in a form different from textbook presentations. These features of organisation and presentation of tasks are therefore projected as features of the ideal acquirer. It follows that evidence of the introjection of the features must be available in acquisition texts when either teachers or INSET providers evaluate classroom activity.

The conclusion arrived at above is supported by the following discussion of the use of a particular task "Squares" (see Appendix 1) early on in the course, to set up an opposition between two teaching styles; the first style is typified by a teaching which requires students to work in isolation and silence from verbal instructions, while the second requires students to work in groups from written instructions (worksheet/"investigation") with apparatus. The teachers are asked to respond to the two teaching styles in terms of the emotions they experienced when working on the task after which they move on to detailing positive and negative experiences of learning mathematics.[2] Figure 4.2 shows the reported responses of teachers at a workshop in 1992 to the task.[3] A written record of the responses of the teachers on the course was not available but the course co-ordinator indicated that their responses were very similar to those recorded in Figure 4.2. Even so, I am not inferring anything about the teachers who participated in the INSET course. Figure 4.2 is an illustration of good practice which emerged from the Project's interaction with a group of teachers.

While one cannot know to what extent the strong negative and positive reactions to the two teaching styles were prompted by the person leading the workshop, the summary presents a very clear statement of which teaching style is more easily accommodated within the Project's conception of good practice. Most of the other

[1]Not all the information pertaining to the organisation and use of every task was available, so the percentages indicated might well be under estimated.

[2] This focus on affective issues in teaching and learning received much attention on the course. Figures A1.1 and A1.2 in Appendix 1 show two more tasks which focus attention on teachers' personal experiences of mathematics teaching and learning.

[3]The summary was produced by teachers at a workshop on 13 May 1992. This summary was found in the co-ordinator's course notes.

features listed are echoed in the more explicit statements of good practice by the course co-ordinator shown in Figure 4.3.

SUMMARY OF OUR IDEAS ABOUT THE "SQUARES" EXERCISE	
Instructions read by teacher. Individual activity	**Worksheet, apparatus and group activity**
Emotion words	Emotion words
apprehensive, anxious, confused, lonely, unsure, lost, expected to fail, wanted to look at neighbour's work, needed support	relaxed, at ease, comfortable, insight, confident
Teaching style / Methodology	Teaching style / Methodology
teacher was a dictator	pupil activity was high
bad preparation	used all the senses (touch, see, etc.)
students made to be passive	teacher respected pupil's work, feeling and effort
no communication teacher-pupils pupils-pupils	lots of communication teacher-pupils pupils-pupils
too fast	used apparatus/teaching aids
no strategy to accommodate mixed ability	the open activity stimulated thinking and creativity
not clear	the instruction was clear because it was written down
the answer was right or wrong	there was a good strategy to accommodate mixed ability

Figure 4.2: Reported teacher responses to the "Squares" task

In the pedagogic discourse of the Project, the headings of the two columns in Figure 4.2 become condensations of bad and good teaching practice respectively: "Instructions read by the teacher. Individual activity" is made to signify bad practice; "Worksheets, apparatus and group activity" is made to signify good practice. A glance at Figure 4.3 will indicate that the conception of good practice is more expansive and richer than the two headings, and my claim that the headings become condensations should not be read as an attempt to reduce that conception; I am pointing to the production of projective and introjective synecdoches which will resurface in later analyses.

What kinds of teaching do I value?

1. Teaching which develops a happy and open *classroom atmosphere/culture* where students are not frightened by the teacher, pressured by time, confused by inappropriate tasks and where they feel it is permitted to try something out partly because the task allows for their contribution and partly because they know their participation will be respected and valued whether or not they make a mistake.
2. Teaching which encourages students to *transform* a problem into one that they can deal with and which emphasises that much of our manipulation of problems is the selection of an appropriate transformation from a sea of possibilities and which emphasises why a particular transformation may be appropriate or not, what it changes and what it leaves unaffected.
3. Teaching which is linked to students' *previous knowledge* in a way which is appropriate and useful and which does not trivialise the mathematics or mislead the students.
4. Teaching which emphasises the *connection and relationship* between different mathematical objects and tries to break down the conventional compartmentalisation of knowledge.
5. Teaching which lets students "in" on the *historical development* of mathematics, so that they do not see it so much as eternally true as constructed through debate by people who argued and disagreed and struggled in different cultural contexts to develop the discipline known as mathematics.
6. Teaching which, wherever possible, shows where a rule or convention came from or discusses why it was seen as necessary by mathematicians - this is not so much because students always need to know "why" in order to "do" but so that a culture of the importance of *justification of an idea* or use is developed in the classroom.
7. Teaching which involves students in practical or investigative activities which provide a *firm base for more abstract exploration* and leads to questions about generalisation.
8. Teaching which enhances students' ability to *visualise* a problem and encourages them to "see" things from different perspectives.
9. Teaching which encourages students not only to make but to test and finally (if appropriate) to prove *conjectures*.
10. Teaching which *equips students to participate* in the schooling system of which they are a part, to compete successfully in examinations and to adapt to new circumstances of learning or work with flexibility and imagination.

Figure 4.3

Although there were no school students present at the workshop, the teachers describe the features of the "good" and "bad" styles with reference to "pupils". What has been transmitted and acquired then, are the features of "good" and "bad" teachers as well as features of the ideal student acquirer and the ideal classroom.

The task which was used ("Squares") focuses attention on the regulation of instruction rather than on the mathematical content. What emerges from the task, through a redescription of the performances of the teachers, is a set of pedagogic prescriptions which can be used to construct both the ideal teacher and student acquirers. In the next section I shall show, with reference to transcripts of interactions between an INSET provider (Mark) and a teacher (June), how pedagogic prescriptions are employed to effect the transmission and acquisition of pedagogic discourse.

4.2 Interactions between INSET provider and teacher

4.2.1 Pedagogic prescriptions

An initial viewing of the video record of the first planning session revealed that writing was used as a device in the attempt to establish privileged meanings. Writing was used as a device for the arresting of signification, pointing to a strategy for the establishing of privileged meanings in interactions between transmitters and acquirers. The establishing of privileged meanings also seemed to be central to the recontextualising of pedagogic discourse and therefore a focus on the strategies and resources used in the establishing, or the apparent establishing, of privileged meanings become important. I needed to identify which meanings were privileged by the Project and the INSET provider and examine the nature of the recontextualising of those meanings in INSET provider-teacher interactions and teacher-student interactions.

In the first planning session and the post-lesson discussion, extracts of which are shown in Appendix 2, Mark details a series of pedagogic prescriptions (good practice). I have isolated these prescriptions and labeled them P1, P2, ... , P11.

> P1. The use of the idea of equivalence which is linked to the importance of transformations in mathematics. The importance of the use of transformations as an element of good practice is listed in point 2 of Figure 4.3:

> Teaching which encourages students to *transform* a problem into one that they can deal with and which emphasises that much of our manipulation of problems is the selection of an appropriate transformation from a sea of possibilities and which emphasises why a particular transformation may be appropriate or not, what it changes and what it leaves unaffected. (Emphasis in the original.)

P2. When introducing students to algebra, an appropriate strategy is to have students consider arithmetical statements (equations) initially, from which they then move on to the development of algebraic statements through the introduction of "unknowns" into arithmetic statements. One therefore starts off with having students work from "a complete statement in arithmetic ... as opposed to trying to complete the statement ..."

P3. Teachers have at their disposal efficient methods which should not initially be taught to students. Students have to refine their solution strategies from the cumbersome to the efficient in order to develop a sense of the efficient solution strategies being their own. That is, "efficient methods" should not be forced on students by the teacher. When students are exploring mathematical tasks the teacher should not dominate and should "only come in at the end to summarize" what has been achieved by the students.

P4. Mathematics needs to be 'contextualised'. That is, mathematics must be related to the non-mathematical and the everyday because that is where 'meaning' for mathematics is to be found. Also, an activity (worksheet/students task) can constitute a context. Here "context", sometimes referred to as the "physical context", appears to be indicated by the existence of manipulatives and/or references to the non-mathematical. However, not everything can be realised "physically". The prescribed syllabus content should emerge from a "flurry of [contextualised] activity" (gradient, y-intercept).

The creation of 'issues' depends on the prior production of a sufficiently rich 'context':

> June: I think that in the third lesson we make an issue out of gradient and y-intercept.
> Mark: If you want not make an issue of it, you should actually have generated enough context [for us] to make an issue out of it.

P5. Mathematical objects should not be defined. Definitions of objects should emerge from the investigation of mathematical situations. For example, no reference must be made to the terminology "cartesian plane" when students are given pegboards and asked to describe various points.

P6. A need should be established for the introduction and necessity of mathematical objects/concepts. The need for a reference point on the pegboard should be established, for example. Such need is based on students and teachers having to communicate mathematical concepts in a coherent fashion. Student activity should generate ambiguity and the resolution of ambiguity, under the direction of the teacher, by an arresting of signification, should lead to a single, shared understanding and definition of a specific mathematical object. The descriptions of pegs on the pegboard should progressively move from multiple descriptions to a single description.

P7. In the investigation of activities students should record their thoughts on paper.

P8. Groups should be used and the "point of focus" should be with groups rather than with the teacher.

P9. Questions can be described as exhibiting different 'orders': low order and high order. No definition of low and high orders are given but low order appears to refer to questions which require students to identify an aspect of a mathematical situation without having to reason mathematically, like looking at a set of lines and answering the question "Where do all the graphs meet?"

P10. Questions should be asked in such a way that students are not all led to focus on the same feature of a mathematical situation at the same time. So, rather than asking students "Where do all these graphs meet?" they should instead be asked "What do all of these graphs have in common?"

P11. Sense-making depends on visualisation:

> Mark: I want to be able to visualise it. It must make sense man.

4.2.2 Redescription in INSET provision

Extract 2.1.2, which is a direct continuation of Extract 2.1.1, shows June redescribing a teaching experience in terms of the pedagogic prescription, detailed by Mark, that students should be encouraged to move from their unique "cumbersome strategies" to more "efficient ways" of solving problems (P3): "... it's a pity I haven't got that on the board here. The same thing happened today ..." In her description of what happened June related that some students, when confronted with the problem of finding the value of x in the equation $3x - 5 = x + 9$, "removed the $3x$" while others "removed the five". Of the students who "removed the $3x$" first she says:

> But the point that I'm trying to get across is that they didn't remove the 5 first ... and then from there they worked. Do you understand what I'm saying? Now what they are doing here is they remove the 2x after a while and then add on that side. Okay. So now they are going to get 2x - 5 = 9. [...] And then afterwards they went on and then [...] got rid of the 5 and then added 5 there. So they had 2x = 14. And then they worked from there. [...] And then they just divided by two. So they compared their answers. So there's no fixed way of doing ... of ... they must first get rid of -5 ...

This can be read as an attempt by June to show Mark that her students are not coerced by her into following a single method for solving linear equations. Instead they are able to develop their unique strategies — "So there's no fixed way of doing ..." — which result in them all solving the equation. Mark's response is to positively evaluate June's redescription and encourage her to write about her experience:

> Now I think that this forms part of the argument you write about [...] that could possibly be very, very useful [...] you know. Letting them grapple with their own strategies which could actually take them up the garden path till they eventually they come to the answer [...] it's something that's theirs [...] as opposed to adopting or implementing something that we give them [...] which we feel is more efficient and probably is, but this is theirs ...

Extract 2.1.2 shows both transmitter and acquirer redescribing the pedagogic performance of the acquirer (which was not witnessed by the transmitter) in terms of the pedagogic prescriptions detailed by the transmitter. Such redescription transforms the activity of the acquirer into a legitimate acquisition text. Where the acquirer redescribes her own performance as her emphasising that "there is no fixed way" of solving equations, the transmitter redescribes her performance as a confirmation of

pedagogic prescription P3: "Letting them grapple with their own strategies which could actually take them up the garden path till they eventually they come to the answer ..." An *apparent* weakening of framing, it seems, is a necessary feature of good practice here. The choice of "strategies" by the students themselves is believed to enhance their participation in lessons and facilitate apprenticeship.

Following the episode discussed above, June tries to draw Mark into a discussion concerning the problems which students have with equations:

June: ... mmm. Another thing that was raised was if they have x = 2. One of the standard nine and ten teachers told me that he thinks they have a problem working with ... working like that ...
Mark: Like this.
June: Whenever they have 'x equals to' there's a problem. But ...
Mark: [Jeff?]
June: Ja
Mark: So I just, then just, this is something, I'll take this and I just want to keep that. It's another important part of the thing.
June: Because they can get to that stage there if they subtract 2x from that side ...
Mark: No, it's actually possible ...
June: Do you understand what I'm saying ...
Mark: ... but it's just that it's not something that we, we not telling them this is the way to do it ...
June: Mmm
Mark: ... or what have you. So that's ... let me just keep that over there. So that's important. This is where we're coming from. Maybe I can show what I was looking at. I was looking at that ...

Without waiting for her to elaborate on the problem which she raises Mark quickly redescribes what she is saying by appealing to P3 — "It's another important part of the thing [...] but it's just not something that we ... We not telling them this is the way to do it ..." — and then moves on with the planning.

Later in the planning session June argues against giving her students a task without some prior preparation:

June: No, no, no. **If you start off with letting them see the relationships first. Because how are they going to see, say for example, if you have three and nine, and four and sixteen and you build it up. So they [...] must get the rule first before they can get to that, because I feel then [...] they know exactly where it's coming from.** Because if you just give them something like that then ... [...] Do you understand []
Mark: Ja. Although the advantage ... Ja, I see what you trying to get at, like trying to get the rule ...
June: Ja.

Mark: ... when you might be able to use the physical apparatus here, ...
June: Ja, and I ...
Mark: ... but then not being able to formulate the rule. (My emphasis.)

In their encounter with a similar task as part of their work with the Project, teachers participating in a workshop were required to construct an algebraic expression which described the relationship between two sets of numbers. June feels that her students might not be able to construct similar algebraic expressions if they are not made aware of what to focus on. What June suggests is potentially a violation of P3 for which she compensates by appealing to P5:

So I think maybe we should start there with the rule, because that's where I start with the eights. I'm saying ... uhmm ... to get them into the ... into the idea of ... of what functions is, ne. [] **But not, now, mentioning it, you know, that's a function or things like that**, but so that they can see that there's a rule related to these two being connected. (My emphasis.)

In this extract the acquirer makes an attempt to transform a potentially illegitimate text into a legitimate acquisition text by grasping at one pedagogic prescription (P5) while denying another (P3); the acquirer redescribes her own pedagogic prescriptions in terms of those of the transmitter and so remains in touch with traces of the ideal acquirer. This is an illustration of the way in which the production of synecdoches are working within the pedagogic discourse: the acquirer can exchange one feature of the ideal acquirer for another and still claim to produce a legitimate acquisition text because both projective and introjective synecdoche focuses on only some features of the ideal acquirer at any one moment. Such a limited focus is facilitated by the generally tacit transmission of recognition and realisation rules within the pedagogic discourse of the INSET provider.

The strategy of redescribing her pedagogic performance in terms of a selection from the pedagogic prescriptions after she transformed the lesson plan, is used by June in the post-lesson discussion. The suggestions made by Mark during the lesson planning were not strictly followed by June and in the post-lesson discussion she redescribes her performance in terms of P3, P4, P5 and P6. A number of the tasks given to the students required them to devise a way of representing co-ordinate pairs, with one or

both co-ordinates negative, on the pegboard which had initially been used to represent co-ordinate pairs with only positive co-ordinates. These tasks are described by June as a deliberate attempt to introduce ambiguity and generate confusion (P6) — by apparently not defining mathematical objects (P5) and withholding method (P3) — which must be resolved, as well as providing a context (P4) and need for the introduction of the cartesian plane (P6):

> The first one ... It was meant to confuse them [...] because there was no reference point. [...] That is showing the need why I think the cartesian plane was introduced. So that they ... So that is why I needed to do map work because ... to bridge the gap. It's real maths now. Understand? It's bridging the gap so that they can see it's real. Because if you teach geography they don't see a relationship ... the relationship between geography and ... They never see the relationship. The geography teacher tells me "Look the children don't know anything about graphs. Why not?" But they don't see it like that. So what I'm trying to do, I'm bridging the gap. I'm trying to sort of link the maths to the other subjects and where it is relevant ...
> [...]
> [M]aybe tomorrow when I do speak to them about the cartesian ... I didn't tell them that. Did you see? I didn't mention. Did I mention it to them? Cartesian. [...] I didn't mention that word. I didn't want to do it because fancy words usually just scare them. I mean they just don't ... Tomorrow I'm going ... now that they've worked their way around plotting then I want to mention to them that it's called the cartesian plane. Then I want to have a look at that ... and also to explain to them that ...

The reader will have noticed that in many of the extracts from the transcript that sentences and phrases are often incomplete. This incompleteness is not a result of the transcription, but is a feature of the speech of both the INSET provider and the teacher.

4.3 Summary

In the above section I referred to transmission texts which are produced through explicit exposition of pedagogic prescriptions as well as through the redescription of the performances of the acquirer. Legitimate acquisition texts are produced through the acquirer's redescription of her own performances in terms of the pedagogic prescriptions of the transmitter. Such acquirer redescription should not be read as mere acquiescence because the acquirer makes selections from the pedagogic prescriptions which enable her to read her performances as legitimate acquisition texts. The redescriptions of both the transmitter and the acquirer are therefore

(re)productive of legitimate denotations which signify apprenticeship. Connotations are selected from the reading of pedagogic performance and transformed into the recontextualised privileged denotations of a P(i) through reference to a set of pedagogic prescriptions which function as condensations of the ideal acquirer.

The pedagogic prescriptions, which are themselves recontextualised from the P(i), are embedded in transmission texts which transmit the regulating principles of the P(i) relatively tacitly or explicitly. I would argue that the transmission texts referred to above transmit the regulating principles tacitly because they articulate pedagogic prescriptions in the form of procedures without justifying them through explicit reference to a P(i). Of course, even within vertical discourses with hierarchical knowledge structures, or horizontal knowledge structures with strong grammars, transmitters and acquirers might well share a common language which makes it unnecessary for utterances to be rigorously justified. However, as was argued in chapter 3 and earlier in this chapter, the discourse of INSET provision in this instance is characterized by a horizontal knowledge structure and weak grammar accompanied by weak classification and framing as well as the tacit transmission of regulating principles. The discourse is unable to attain a high level of specialization which marks it out as significantly specialised with respect to the everyday and common sense.

The pedagogic prescriptions which are generated within this instance of INSET provision do not form a coherent language of description and are therefore necessarily unstable when confronted with either the teacher's specific expressed needs or the teacher's appeal to her local context-specific experience. Consequently, the potential for the teacher to disrupt pedagogic prescription is great. Without much difficulty acquisition texts can be read as legitimate because the P(i) from which pedagogic prescriptions are recontextualised is a horizontal knowledge structure with a weak grammar accompanied by weak classification and framing.

An important strategy used in the recontextualising of pedagogic discourse is therefore the redescription of the utterances. The acquirer must make him/herself

available for apprenticeship via utterances which expose his/her consciousness to the transmitter. The acquirer displays, via utterances, a transformation of consciousness by participating in the redescription of his/her own performances.

In this chapter I have attempted to show that pedagogic prescriptions which feature in the Project's conception of good practice as transmitted on the INSET course, are recontextualised to the school-focused INSET work, represented here in the interactions between the INSET provider and the teacher; the pedagogic prescriptions which are (re)produced within the teacher-INSET provider interactions are recontextualised to the classroom but in a manner which is influenced by the teacher's and students' prior classroom practices.

Chapter 5

An analysis of teacher-student interaction

In this section I move to a discussion of school teaching in which I will discuss the locational and interactional aspects of its communicative context. The interactional and locational are, of course, both simultaneously incorporated semiotically into pedagogic discourse, but I have chosen to focus on the locational initially and then move to the interactional.

5.1 The locational features

For Bernstein, the locational and interactional features of a communicative context can be used as indicators of different pedagogic modalities:

> The stronger the tie between the temporal (interactional) and spatial (locational) features of the communicative context, the stronger will be its classification. The stronger its classification, the more likely that the array of objects, attributes, and their relation within the communicative context stand in a fixed relation to each other and so are specialized to that context.
>
> (Bernstein, 1990: 34-5)

My analysis of the communicative context will be used to describe the pedagogic modality realised in the classroom which can then be discussed with reference to the pedagogic prescriptions which emerged from the planning session.

5.1.1 Arrangement of desks

During my visits to the school I noticed that two arrangements of students' desks are used by the teacher; one in which the desks are arranged in single rows so that the students face the chalkboard and the other where the desks are grouped so that not all the students face the chalkboard. These different arrangements are shown in Figures 5.1 and 5.2. The arrangement shown in Figure 5.2 was used when video records of the teaching were made. The Figure 5.1 arrangement was in use when photographic records of the wall displays were made and when the teacher and the INSET provider were involved in the planning of the lessons. I asked the teacher when and why these different arrangements were used, to which she responded by saying that the selection of an arrangement depended on the mode of transmission. If the students were required to write a test or she wanted to test them verbally or wanted them "to think",

then the Figure 5.1 arrangement was used. The Figure 5.2 arrangement was to be used when the students were required to work from worksheets or use apparatus.

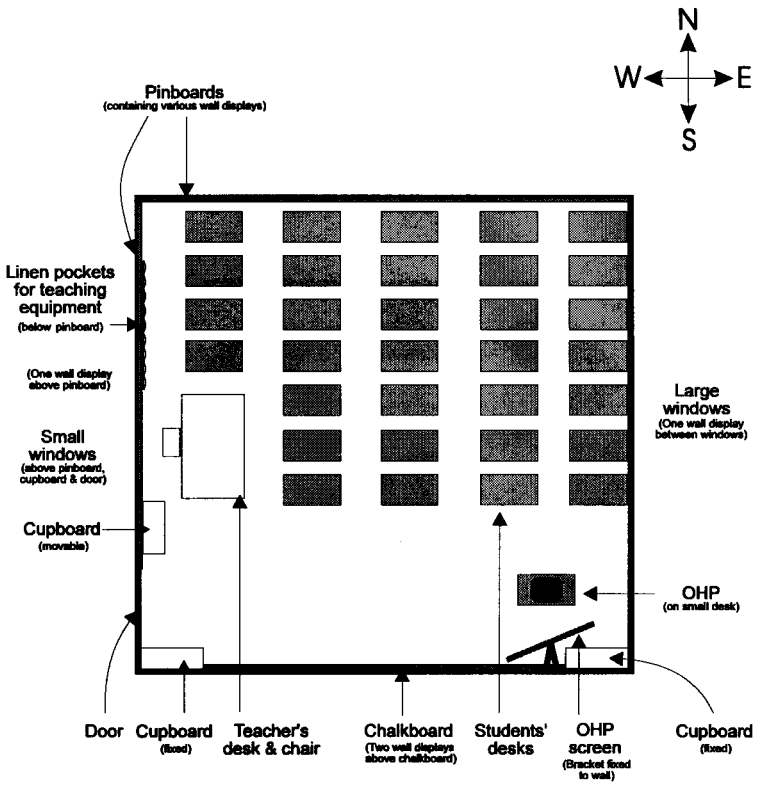


Figure 5.1

The teacher also claimed that groupwork (Figure 5.2) was a vehicle for the development of both mathematical and social skills: "mathematics is a language" and it is therefore important for students to "talk about what they are doing", to "put their thoughts into words"; groupwork encourages peer-tutoring which is important since "one learns best by trying to teach someone else"; groupwork also encourages the development of social skills that enhance students' abilities to "work better" and "think better together outside the class".[1]

From the description of the use of different arrangements it is clear that it is the teacher who regulates the choice of arrangement through the selection of transmission mode: it is not the students who elect to work in groups or individually, but rather the teacher who prescribes their positions. It will be shown below that, during the lesson which is discussed here, the teacher not only arranges the desks in groups prior to the students' arrival, but also instructs who to sit where. Recall that a feature of good practice within the contexts of INSET provision (the INSET course, for example) is

[1]All the quotation here are from the telephonic interview.

the use of groupwork and its use in the classroom becomes an indicator of good practice.

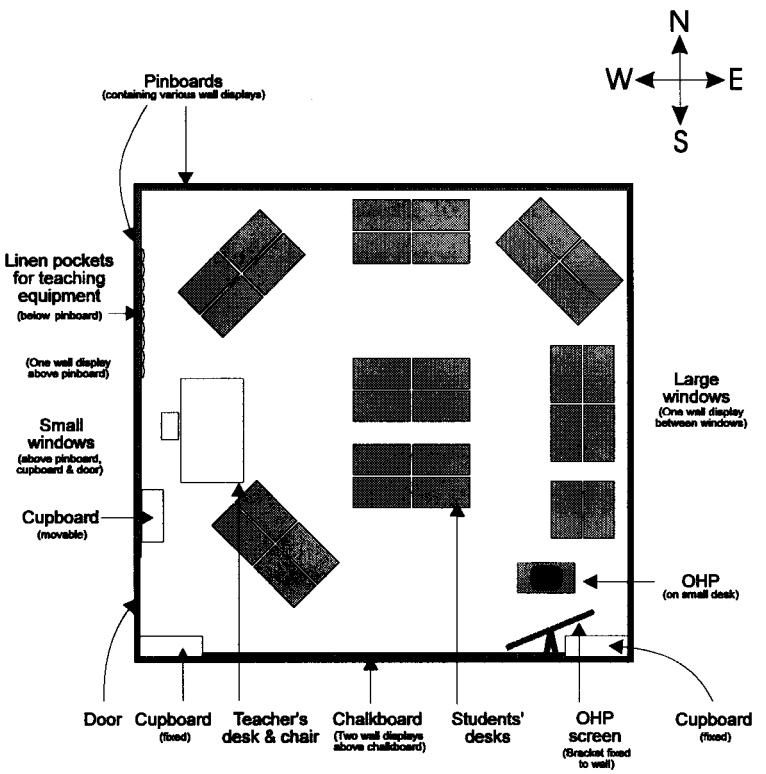


Figure 5.2

5.1.2 The linen pockets

Below the pinboard on the west wall (see Figure 5.3) one finds a group of linen pockets which contain number lines printed on cardboard and a collection of various student tasks. The tasks are in the form of standard exercises as well as puzzles and games. The puzzles and games are reproduced from mathematics olympiad examinations and from recreational mathematics books while the exercises, which are of varying degrees of difficulty and cover a variety of topics, are selected from different textbooks. Students who are judged to be weak by the teacher as well as those who finish their classwork fairly quickly are required to select cards from the linen pockets for independent work. This work is completed as homework when students fail to complete it in class and is marked by the teacher who keeps track of which cards are taken by students. The teacher indicated that two categories of

students use the cards most often; those to whom she refers as "slow learners" and "fast learners".[2]

The linen pockets are used to facilitate not only student acquisition of mathematics, but also as markers of "ability". Both "slow" and "fast learners" are encouraged to redescribe themselves by using the linen pockets and so participate in the establishing of a hierarchy of subjectivities in the class. A question which emerges from considering the use of the linen pockets, but which remains unanswered here is: are "slow" learners able to use the linen pockets to become "fast learners", or does the differential distribution of "ability" become fixed?

5.1.3. Wall displays

In his case study of visual displays in two schools Daniels makes a strong argument for accepting that displays are tacit relays of the structure of pedagogy:

> ... the research suggests that the grammar of the pedagogic practice of the school is both revealed and relayed indirectly by visual representations of significant texts.
>
> (Daniels, 1989: 123)

Within Daniels' study, and here, schooling is read as partially constituted by systems of signs of which wall displays are a component. The regulation of the signs which circulate through and constitute, the pedagogic relation, is a regulation of transmission and acquisition through the regulation of recognition and realisation rules. The signs brought into relation with each other to create wall displays as exemplars of legitimate texts become tacit relays of recognition and realisation rules for the (re)production of legitimate texts.

> [D]isplays are part of the system of signs that constitute the culture of schools. ... [T]hrough these acts of publicity the principles which regulate the curriculum are realised.
>
> (Daniels, 1989: 124)

A large number of wall displays inhabit the classroom. Most of the displays are exhibited on pinboards on the west and north walls (see Figures 5.1 and 5.2). The wall displays can be divided into two categories: teacher displays and student displays; that is, transmission and acquisition texts. Wall displays created by the teacher appeared on all the walls while those created by students appeared only on the

[2]This information was communicated by the teacher during the telephonic interview.

west wall (displays 4 to 9 in Figure 5.3). The student displays are products of a task. Display 1 in Figure 5.3 is a calendar.

5.1.3.1. *Student displays*

The students were required to work in groups to create displays of various quadrilaterals which were to be represented in media other than pen or pencil. The students used knitting yarn, coloured adhesive tape, paints, crayon, glitter and coloured card to represent the quadrilaterals. The displays were graded and pinned up.

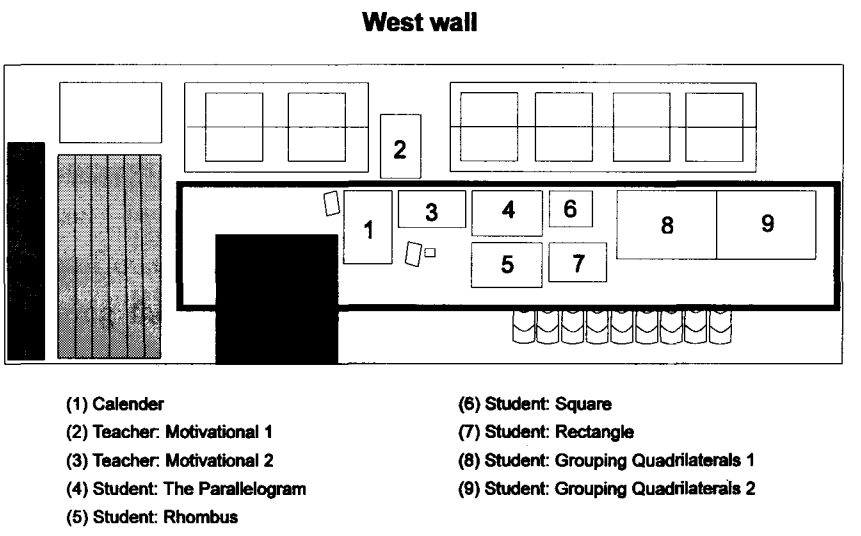


Figure 5.3

When asked why the students were not allowed to draw the quadrilaterals with pens or pencils the teacher responded by saying that she wanted the students to be original and creative. As an example of such originality and creativity she referred to students having produced real (non-mathematical) kites as representations of mathematical kites. For the teacher the students' production of wall displays realise a number of pedagogic objectives: students are encouraged to read their textbooks, to do research, to assume more responsibility for their learning and to develop a sense of ownership of the mathematics; the students are presumed, as a result of this activity, to become more confident and skilled mathematically; mathematics is presumed to "come alive" for the students and where topics like geometry were previously experienced as very abstract, they now become concrete.[3]

[3] Communicated during the telephonic interview.

seven geometry as a hierarchical mathematical structure. Four motivational displays appear: "He who errs in mathematics and does not set it right will err again!!"; "Positive attitudes are far more important than unfavourable circumstances!"; "Once the problem is solved the solution is obvious"; and "Success at maths begins with honest, hard work". Table 5.1 shows a categorization of the teacher displays.

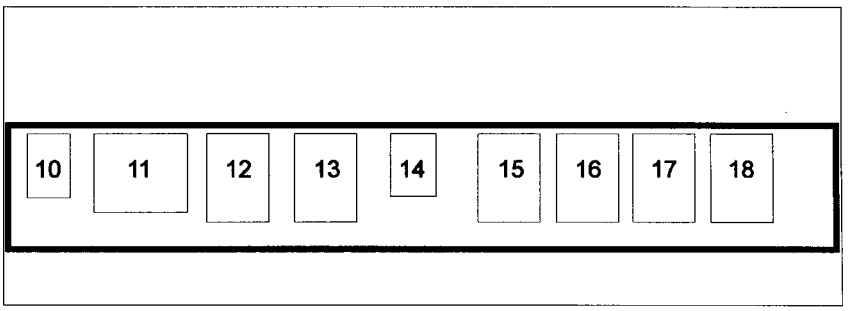
According to the teacher all except the motivational displays are periodically removed and replaced by others that are relevant to the syllabus topics being taught at any particular time and are an important part of the transmission of mathematics.

Display	definition	algorithm	mathematical structure	motivational
2				✓
3				✓
10	✓			
11	✓	✓		
12	✓	✓		
13	✓	✓		
14	✓	✓		
15	✓			
16			✓	
17		✓		
18		✓		
19				✓
20				✓
21	✓			
Total	7	6	1	4

Table 5.1: Categories of teacher wall displays

When asked to explain how the motivational displays are used the teacher revealed a careful consideration of the content and location of the displays. Displays 2 and 3 are the only teacher displays which appear on the west wall. The significance of this location for the teacher lies in selection of the west wall for displaying student tasks and grades.

North wall

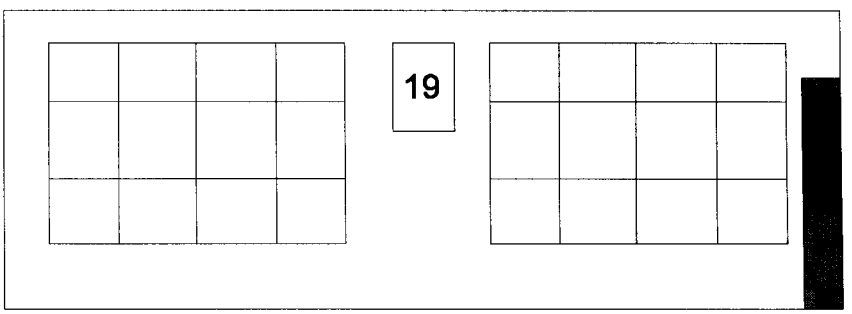


(10) Teacher: The Straight Line Graph
(11) Teacher: Function machine
(12) Teacher: Integers (multiplication & division)
(13) Teacher: Integers (addition & subtraction)
(14) Teacher: Products
(15) Teacher: An introduction to geometry
(16) Teacher: Building blocks of theorems
(17) Teacher: A method to tackle geometry
(18) Teacher: Surface area

Figure 5.4

The lists of student grades awarded for performances in tests are placed immediately below displays 2 and 3 ("He who errs in mathematics and does not set it right will err again!!"; "Positive attitudes are far more important than unfavourable circumstances!"). Display 20 is considered to be the most important of the motivational displays by the teacher and is placed above the chalkboard ("Success at maths begins with honest, hard work"). Display 19, which is placed between the large windows on the east wall, is so located says the teacher, because students look out of the windows when they think about how to solve problems ("Once the problem is solved the solution is obvious").

East wall



(19) Teacher: Motivational 3

Figure 5.5

The motivational displays function as regulative devices which encourage student self-discipline while the other teacher displays are reminders of important and appropriate mathematical definitions and algorithms and show an explicit focus on the transmission of carefully selected features of mathematical topics. There is little that

is decorative or enigmatic about the teacher displays and they serve to clearly mark out the classroom as a mathematics classroom. Furthermore, the teacher displays which focus on mathematics are not mixed with the student displays.

The categories of teacher and student texts are clearly differentiated. Where teacher displays appear alongside student displays they are motivational and appear to be regulative commentary on the work of students.

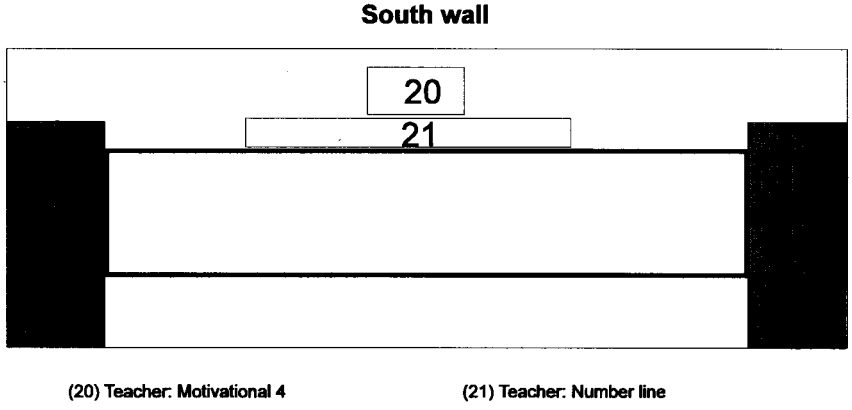


Figure 5.6

The teacher displays are therefore indicators of strong classification and strong framing: the teacher selects the content, media and location of the displays independently of the students and the displays reveal an intention to regulate student activity even when the teacher is silent or absent; location and representation are used to ensure that there is no blurring of the distinction between transmitter and acquirer with regard to the displays.

5.1.4 Summary

The arrangements of desks, the wall displays and the linen pockets are all incorporated semiotically into pedagogic discourse. There is very little blurring of distinction between transmitter and acquirer and the regulation and organisation of pedagogic space is explicitly controlled by the transmitter. In tasks where students are granted freedom to select what to do, that freedom is more apparent than real as is demonstrated in the discussion of student use of the linen pockets and their production of wall displays.

5.2 *An analysis of teacher-student interaction in the classroom*

In this section I analyse teacher and student interaction in one of the two lessons which I recorded on video. I have selected extracts from the transcript of the first lesson to analyse. In the extracts from the transcript the teacher's speech is indicated in plain text, the students' speech in italics. Since verbal student communication (with each other and with the teacher) is marked as a feature of good practice by the INSET providers, early on in the study I attempted to quantify the proportion of teacher and student speech in both the lessons. The results of that attempt are shown in the tables below.

	Teacher speech		**Student speech**	
	Class teaching	**Group teaching**	**Class interaction**	**Group interaction**
Time	21 mins 27 secs	8 mins 27 secs	7 mins 4 secs	18 mins 5 secs
%	48%	19%	16%	41%
Totals	29 mins 54 secs		25 mins 9 secs	
%	67%		56%	

Table 5.2: Categories of teacher and student speech for lesson 1

	Teacher speech		**Student speech**	
	Class teaching	**Group teaching**	**Class interaction**	**Group interaction**
Time	24 mins 13 secs	9 mins 43 secs	6 mins 53 secs	17 mins 14 secs
%	56%	22%	16%	40%
Totals	33 mins 56 secs		24 mins 7 secs	
%	78%		56%	

Table 5.3: Categories of teacher and student speech for lesson 2

The reader will notice that the totals do not add to 100%. That is because the teacher and the students were often speaking simultaneously. The proportion of student

speech is under estimated because the video camera was trained on the teacher most of the time and so student speech was often not recorded or was recorded as indistinct murmurs. The students were also working in groups and no independent recordings were made of the students' speech in their groups. Nevertheless, one can see that the proportion of student speech was relatively high.

Within the pedagogic discourse of the INSET providers, a high proportion of student speech is potentially an indicator of good practice and it is therefore important to the teacher that students speak in her classroom. Ultimately, however, the proportions of student and teacher speech do not tell us very much about the modality of pedagogic discourse. We have no idea, from just the proportions, of how speech operates in the (re)production and recontextualising of pedagogic discourse. Nor do we have any insight into how speech articulates with other resources, like the use of groups and wall displays, in the (re)production of pedagogic discourse. I will therefore move away from attempts to quantify aspects of the pedagogic discourse and attempt to produce a qualitative analysis of pedagogic discourse, drawing on the model set up in the previous chapter.

When the students enter the classroom they find the desks arranged as in Figure 5.2 above and some of them are directed to certain clusters of desks. Atlases, opened to show a map of Botswana, have been placed on the desks. The first task the students are asked to do, in pairs, is to locate the town Odiakwe. Once this has been achieved a few students are asked to describe the location of Odiakwe without pointing to it. The teacher orchestrates their attempts at description so that they fix on the use of longitude and latitude. Up to this point the teacher has not told the students what the topic under discussion is. The students are asked to put the atlases away and they are shown a pegboard.

The teacher places a peg in the board and asks the students to name the peg, to which they respond with names like "Koos", "John" and so forth. The teacher then asks the students to name the position of the peg. She hands out pegboards, each of which has a peg stuck into it in the same position, from one orientation, but off-centre, to the five groups of students and they are to agree within their groups on a naming of the position of the peg. The idea here is that, with the peg off-centre and the students not asked to look at the board from a specific orientation, that significant differences in the descriptions of the position of the peg will emerge. These differences will then be used to motivate for the introduction of a common reference point so that the students can produce congruent descriptions of the position.

Table 5.4 (below) shows the interaction between the students and the teacher in the left hand column. The right hand column shows what the teacher writes on the chalkboard in response to their contributions. The teacher has still not told the students what the topic is that they are dealing with. When looking at the tables, I will highlight various features of the teacher's redescription of student utterances.

Notice that in the exchanges between the teacher and the first group of students that when the students offer "south-west" as a description, the teacher asks them to quantify: "How many south-west?" The rest of the students who follow take up this requirement (the need to express their descriptions in number).

Teacher and student speech	Teacher writing
Right, okay. Right. Let us ... let us hear from you what you have ... down there. Okay, Kevin's group ... where's Kevin's group? Thabiet tell us ... how would you define the position of that dot? Thabiet, what did you decide as a group? *We used directions Miss.* Okay, now how would you describe the position? *South-west* How many south-west? *Three. Three north. Three holes up north and ...* Three holes up ... *And three holes east. Three holes to east.* And three holes east.	3 up ; 3 east
Right, you? *Six dots down Miss.* Six down. *And then four east. East across.* Four across. *Yes east.*	6 down ; 4 across
Right, Appolis? Appolis, your group there? Have you decided? ... Right, I'll get back to you now ... Simone? *Six up and four sideways.* Six up. *And four sideways.* Four sideways. Simone ... that is here ... sorry.	6 up ; 4 sideways
Appolis, your group? Okay. Justin's group? *Four down and sideways.* Four down. Four across.	4 down ; 4 across
Come now. *Four across and four up.* Right. Thank you.	4 across ; 4 up

Table 5.4

What we have here is a recognition by the students that one feature of a legitimate acquisition text in this context is the presence of number. Not only that, but two numbers must be indicated; one which locates the position of the peg with reference to the horizontal and another with reference to the vertical. While unstated at this point, this method of describing the position of the peg resonates with the descriptions of the position of Odiakwe through the use of longitude and latitude. The teacher does not record exactly what students utter, but transforms those utterances into writing. The transformation of student utterances to writing introduces another feature of redescription in which the teacher makes selections and begins to introduce features of the standard notation for writing coordinates. "We used directions Miss. South-west. Three. Three holes up north and three holes east. Three holes to east" becomes "3 up ; 3 east". The semi-colon is introduced and only single words indicating direction remain.

In response to the first group's contribution the teacher redescribes "north" as "up" but does not redescribe "east". The next group follow with "down", "east" and "east across" from which she selects "down" and "across". Here we find a movement away from geographical connotations and the rest of the groups do not offer compass directions. The third group use the term "sideways" which is recorded by the teacher, but when the fourth group also use "sideways" she redescribes it as "across". The final group of students use only "across" and "up". The sequence of successive redescriptions is shown in Table 5.5. While the first four groups indicate the vertical first and then the horizontal, the final group does the opposite. So where there might well have been a recognition by the students of a potential rule of vertical first (up/down) and horizontal second (across), the final exchange undoes that.

	Vertical	**Horizontal**
Group 1	north	east
Teacher	up	east
Group 2	down	east
Teacher	down	across
Group 3	up	sideways
Teacher	up	sideways
Group 4	down	sideways
Teacher	down	across
Group 5	up	across
Teacher	up	across

Table 5.5

In this series of exchanges between the teacher and students the latter begin to recognise what it is that is privileged, taking their cues from the teacher's evaluations of prior student utterances. By the end of the series of exchanges they see that two numbers are required accompanied by "up" or "down" and "across" (the order of which is unimportant) and separated by a semi-colon. In the following extract the teacher introduces another peg, differently coloured (red) which is to serve as a reference point. The students have to insert this peg in the hole at the bottom left of their pegboards and redescribe the position of the initial (blue) peg with reference to this new peg:

> Use your original position. Which was here ne? Leave your blue pegs in, just put in your red pegs. Just put in your red pegs.
> With reference to your red peg ... with reference to your red peg, give me the position of your blue peg.

As the teacher guides the students' descriptions of the red peg to what she desires she writes "0 ; 0" on the chalkboard. Here she has removed all references to "up", "down" and "across".

Teacher and student speech	Teacher writing
Let's have a look here. Let's all work from one point. If I put this red peg in over here, if it can go in. How many positions to the right did that peg move? Did it move to the right? How many positions to the right? *Four* Okay I'm putting it in over here now. Did it move any way? How many positions to the right? *None. No positions.* None. How many positions upward? *None.* None. So let's look at that now. Okay. So that peg hasn't moved. It's no positions to the right and no positions upward. Okay.	0 ; 0

Table 5.6

Here, instead of using the term "across", the teacher uses "right". She also uses the term "upward". Some of the students appear to be confused about what to do and the teacher moves to a group, showing the students how to describe the position of the

blue peg. In her interaction with the students she describes the position of the red peg as the "nought-nought" position:

> The nought-nought position ... I could have placed the peg in there ... Now how many positions from there do you move?
> Just record your findings.

When the students describe the position of the blue peg they use the terms, "right", "up" and "across". However, in the exchange with the last group of students, when both "across" and "right" are offered the teacher selects "right" so that a new term becomes privileged. By the end of the series of exchanges it is the terms "right" and "up" which become partial indicators of legitimate acquisition texts. Of course, since "right" is defined in opposition to "left", and "up" in opposition to "down", these terms are also implicitly attached to legitimate texts.

Teacher and student speech	Teacher writing
Right ... so ... let's just hear from you at the back Kevin. Kevin's group?	
Three to the right. and three up.	(3;3)
So it's three to the right and three up.	
Nino's group?	
Three holes up and three holes to the right.	(3;3)
Three holes up and three holes to the right. Okay.	
Simone?	
Three across up and three.	
[Laughter]	(3;3)
Three across and three up.	
Three across and three up.	
And Appolis?	(3;3)
Three across and three up.	
And Justin?	
Three across ... Three right and three up.	(3;3)
Three right and three up.	

Table 5.7

The teacher's written redescriptions of the students' utterances is now very close to the conventional notation for writing ordered pairs of numbers: for each of the contributions she writes down two numbers separated by a semi-colon, all enclosed in round brackets. The contribution of the second group of students ("Three holes up and three holes to the right") presents the teacher with a problem. On the video record she pauses thoughtfully for a moment and then says "Okay", perhaps deciding that

since the blue peg is positioned so that both co-ordinates are three, she cannot really make a plausible argument in this instance for announcing the horizontal before the vertical. The teacher deals with this problem by remaining silent on the differences between the two orderings and redescribes the students' contributions as identical, which she can get away with because both co-ordinates are three:

> Now, tell me now ... with reference to that point that I've given you, the original one over here, this ... this red one here, was it better now for you to be able to describe this? With reference to that point. Right. **So you see that over here now that you have come to a common agreement that you are going to move.**
> *Yes.*
>
> (My emphasis)

Immediately after this she selects the appropriate ordering — first the horizontal, then the vertical — to summarise the task:

> How many positions did it move to the right?
> *Three.*
> Three to the right.
> How many positions up?
> *Three.*
> Three up. Okay.

Up to this point then the teacher has, through a series of redescriptions of the utterances of students, begun to introduce them to a syllabus topic (cartesian co-ordinates) without announcing the topic or explicitly defining the objects being focused on. Figure 5.7 shows the content and layout of the teacher's writing on the chalkboard.

Groups			
1. Kevin	3 up ; 3 east (3;3)	5. Justin	4 down ; 4 across (3;3)
2. Nino	6 down ; 4 across (3;3)		0 ; 0
3. Simone	6 up ; 4 sideways (3;3)		
4. Appolis	4 across ; 4 up (3;3)		

Figure 5.7

The students are set another task in which they are to choose positions for the blue peg. The possibility of the students using different orderings to describe the positions of the peg is great at this point because the legitimate ordering has not been explicitly announced yet; the teacher seems compelled to announce the legitimate ordering:

> Now I want you to move that peg around ... just move it around. Right?
> *Ja.*
> And each one has a chance to move it. The next person that sits next to you must tell you where you have moved it. How many you moved it to the right and how many you moved it up. **Are we going to agree on moving to the right, we going to use** - Anthea at the back there! - **we going to use movements to the right, ne? As opposed to movements up. So we use that: movements to the right and movements up.** So okay, but just play around with it. Each one has a chance to ask the next person. So you move around ... Your ... your red one will remain stationary. Okay ...
>
> (My emphasis)

At this point the teacher cannot state that the ordering is a strict mathematical convention rather than merely her or her students' own arbitrary selection for the sake of convenience because she still refuses to announce the topic; after all, the students have to come up with their own methods rather than depend on teacher exposition. So the legitimate ordering has to be announced repeatedly but in such a manner that it is the students who appear to have produced legitimate acquisition texts themselves. One strategy the teacher uses to achieve this is to point to exemplary texts without explicitly announcing all the principles of their production:

> Take out a piece of paper, put your names on there and as a group you construct positions to move ne? You going to swap it around and you going to ask to move, to do that, what you are doing and you going to see whether they are able to do the movements. **Okay so now just formulate movements, for example, like this over here, for example, four to the right and three up, something like that.**
>
> (My emphasis.)

During the above elaboration of the task the teacher writes (4;3) on the board as she speaks. Some students are, however, still using the terminology that was marked as privileged during the first pegboard task and the teacher reminds them of their "acceptance" of the convention — right first, up second:

> You don't have to write across and up, **we've accepted** - thank you! - **we've all accepted now that moving right ... first; moving up, will be written ... second, ne? So you do**

that. So you write your number which you want them to move right, first; the number which you want them to move up, second.

(My emphasis.)

In the latter part of the lesson the teacher starts to introduce co-ordinate pairs containing negative integers. Again, as before, their is no explicit pedagogising of method and the students have to develop some means for representing negative co-ordinates on the pegboard:

Verbal	Written
Right, let me just give you a few points to find quickly. All of you, will you be able to find this? All of you now just stop what you are doing. See whether you can find that for me.	(6;0)
That one.	(2;1)
That one.	(4;8)
That one.	(-1;0)

Table 5.8

I argued above that the privileging of "up" and "right" as part of the legitimate (verbal) descriptions of the position of a peg serves to announce "down" and "left" simultaneously, albeit implicitly. When the students attempt the problem of showing the position (-1;0), negative integers are quickly associated with movement to the left because positive integers are associated with movement to the right. Similarly, the students' respond to subsequent co-ordinate pairs which have negative second co-ordinates by developing strategies to move down. The teacher reinforces the strategy of moving to the left for negative numbers by exploiting the implicit opposition (positive-right; negative-left) and by gesticulating as she asks the students to "explain" their strategies:

Okay ... uhmm, uhmm ... they said on this side that - thank you mister Edwards - Right. Have you all reached that stage where you have found four and eight and all the others. Then what are you going to do with negative one and nought?
[Students shout out directions - indistinct.]
You going to make that to the ...? [The teacher raises an arm and points to her left.]
Left.
Why to the left? Why not to the right?
You must give me an explanation.
Why? I want to know why! I don't want to hear any dilly-dally. Tell me why. Why must you go to the left?
Because the right is positive.
To the right you are going to? ...
Positive.

To the left? ...
Negative.

The teacher exploits the students' knowledge of the number line, a representation of which is strategically positioned above the chalkboard, to motivate for and legitimate the association of "movement" to the left (of zero) with negative integers and "movement" to the right with positive integers:

Where did you get that from? ... Moving negative you must go left?
Yes?
The number line.
[...]
The number line. Why?
Show me where. Show me where. Where's the number line?
The number line up there.
Oh here?
Yes.
This number line over here?
Yes.
Fine, so when you move to the left you're going to go? ...

After a series of similar exercises by means of which the students have been encouraged to rotate the pegboard to produce appropriate representations of pegs in positions which are described in terms of negative co-ordinates, the teacher brings the four orientations of the pegboard together on the chalkboard.

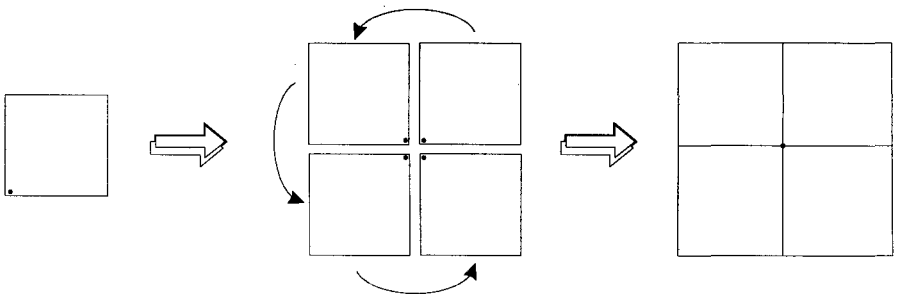


Figure 5.8

Figure 5.8 shows the move from the pegboard through a series of rotations to a diagrammatic representation of a cartesian plane. The teacher summarises the series of redescriptions of the pegboard and its rotations in terms of the representation of the plane which she has drawn on the chalkboard:

What in actual fact are you having over there?
A square.
Ja, on the outside. Is that a square. Doesn't look very much like a square. Okay, right.
What do you ... what are you ... what are you [] over there?
You saying over here if you go up, everything up is going to be? ...

Positive.
Positive, ne?
And every way to your right is going to be? ...
Negative.
To the left? ...
Positive.
To down?
Negative.
Is that your theory?
Let's see if it really is so.
Now where do you come on that? Who told you that?
So are you telling me you can name any of the points with reference to that now?
Yes.
To that red pin? Now what was the value of that red pin?
Nought.
Nought.
Okay. So if I'm drawing two lines here are you ... so what will be that point here?
Nought. Zero.
Zero.
Zero to the left ... I'm sorry, zero to the right ... and? ... zero up ... or down. So that point there ... that position there ... will be zero-zero.

Once the diagrammatic representation of the cartesian plane has been achieved the teacher moves to the OHP on which she places an OHT showing a standard (conventional) representation of the cartesian plane: two orthogonal axes marked x and y and showing graduations in integers, on a grid of parallel and perpendicular lines. The teacher calls out various co-ordinate pairs and the students direct her to the corresponding locations on the grid which she then marks. The lesson proceeds in this fashion until the teacher gives the students a task for homework as the bell goes.

5.2.1 Summary

The sequence of redescriptions which generates the cartesian plain from the pegboard is as follows:

pegboard

- ↓ A collection of locations for pegs.
- ↓ Each location can be described with reference to other locations in terms of direction.
- ↓ Each location can be described with reference to a single location (bottom left).
- ↓ All locations can be described in terms of pairs of numbers which indicate the horizontal and vertical dimensions of a location with reference to the bottom-left location ("nought-nought position or (0;0)").

- ↓ The pairs of numbers which indicate the horizontal and vertical dimensions of a location are indicated in an ordered way, horizontal before vertical, separated by a semi-colon and placed between brackets.
- ↓ By using the number line as an analogy, the locations can be described in terms of ordered pairs of integers one or both of which are negative by rotating the pegboard counter-clockwise.
- ↓ The collection of all rotations can be represented in diagrammatic form with (0;0) at its centre.
- ↓ The location of any pair of numbers (integers) can be indicated in diagrammatic form.
- ↓ Similarly, given any location in diagrammatic form, an ordered pair of integers can be associated with it.
- ↓ The integers which are associated with a specific location are listed along two orthogonal number lines which intersect at (0;0); these number lines are called the "x line" or "x-axis" and the "y line" or "y-axis", respectively.
- ↓ The first number of an ordered pair is called the "x value" and the second, the "y value".
- ↓ The ordered pairs of numbers are called points.

cartesian plane

In terms of Dowling's language the pegboard and the cartesian plane which it is eventually made to index stand in metaphorical relation. In my terms pegboard and cartesian plane stand in synecdochic relation: the pegboard and its initial orientation are constructed as part of the cartesian plain. Also, the production of a chain of synecdochies between the pegboard and the cartesian plane is constructed by selections made from the possible connotations which accompany student and teacher engagement with the tasks. For example, where the students offer terms like "north", "east", "up", "upward", "down", "right" and "south-west", the teacher selects "up", "down" and "right". Such selection begins to exclude the geographical connotations which were introduced at the start of the lesson. The selections are themselves then redescribed in a mathematical terminology and notation by the teacher to produce specific denotations. Little of this redescription is explicit for to make it explicit would undermine the pedagogic prescription that students have to construct knowledge for themselves. An admission that students are in fact coerced into accepting the "imposition of cultural arbitraries" (Dowling, 1993a) would, for the teacher at least, signify a failing.

Chapter 6

Discussion and conclusion

A fundamental assumption of the work done in chapters 4 and 5 is that in any pedagogic relationship there is always a recontextualising of knowledge in which transmitters and acquirers participate. Recontextualising is seen here as central to apprenticeship into a discourse and the (re)production of discourses. One task of this chapter is to draw out the resources and strategies used in the recontextualising of pedagogic discourse analysed in this study.

I argued above that pedagogic discourse in general exhibits horizontal knowledge structure with weak grammar. Further, pedagogic discourses in particular, P(i), can be thought of as located within a *general pedagogic plane*. There is thus some degree of specialising of contents and the regulation of contents of P(i), for without specialisation we would not be able to distinguish one P(i) from another. The P(i) produce sets of pedagogic prescriptions which can be described in terms of classification framing values. The pedagogic prescriptions are rules for the regulation of the contents which are to be transmitted (mathematics) as well as rules for the (differential) distribution of contents to acquirers with reference to one or more ideal acquirers; the rules can be relatively explicit or implicit. The P(i) are (re)produced through the textual productions of transmitters and acquirers. These textual productions constitute C(i), the realisations of pedagogic prescriptions (the SCP), which can be described in terms of classification and framing values.

6.1 Resources and strategies

Evidence of teacher apprenticeship to a P(i) is produced via the transformational readings of teachers' and students' performances into acquisition texts. Such readings are selective for not everything that is uttered by a student or teacher in a classroom, for example, will be considered as part of an acquisition text. In other words, the

recontextualising of performances acts selectively on performance. Student success is not necessarily read as evidence of teacher apprenticeship to a given P(i). For example, a teacher whose students are fairly successful might be described as a good "traditional" teacher by advocates of the new "approaches" and the success of the students may be attributed to the teacher's harsh, authoritarian teaching methods. For the teacher to be considered apprenticed to a given P(i), both s/he and the students have to display acquisition of the regulative principles and selection of contents privileged by that P(i). The teacher therefore has to access a set of resources and strategies which can be used to (re)produce acquisition texts.

There is a difficulty with separating out resources and strategies because strategies can be considered as resources. In fact, P(i) are substantially devoted to the transmission of teaching strategies which serve as resources for the expansion of teachers' repertoires of strategies. The separation of resources from strategies is therefore made only for the purposes of analysis.

Resources are defined as texts which are recontextualised to a C(i), the context of pedagogic action. Resources for the (re)production of pedagogic texts within the context of school teaching include: the pedagogic prescriptions of one or more P(i) (for example, constructivism); selections from one or more V(i) which can inform the production or interrogation of P(i) or C(i) (for example, sociology, psychology, linguistics, semiotics);[1] selections of contents of the V(i) or H(i) which are to be transmitted (mathematics, woodwork, physics, code of conduct of the school, etc.); the imagined ideal acquirers; the utterances of the transmitter; the utterances of the acquirer; and the physical location in which acquisition and transmission take place. Within the context of INSET provision an additional resource can be indicated: models of INSET provision (which would include definitions of good INSET practice).

[1] This source might be accessed only very rarely, or not at all, by teachers as well as many INSET providers.

The production of pedagogic texts can be described as action on resources via the use of pedagogic strategies. The chief strategy indicated was redescription which is concerned with the regulation and distribution of contents via the transformation of utterances; the use of acquirer tasks; the display of exemplary texts; and the regulation of the physical location of transmission and acquisition.[2] The use of resources and strategies outlined above was demonstrated in chapters 4 and 5.

6.2 Summary of the dissertation

The groundwork for the development of the analytical tools used in the dissertation began in chapter 3 with the literature survey. The literature survey revealed a preoccupation with models of good practice for INSET provision. I drew attention to three themes which are pervasive in the models of good INSET practice: teachers should define their needs rather than have INSET providers do so; INSET provision should focus on the professional development of teachers from which the academic is excluded or peripheral; INSET should be school-focused. I argued that NGO and project INSET provision appear to be driven to focus on the regulation of the transmission and acquisition of mathematics (methodology) rather than on facilitating teacher access to vertical discourses which could be used as principled resources for the structuring of pedagogic discourse.

Using Bernstein (1994), I concluded that pedagogic discourse exhibits a horizontal knowledge structure with a weak grammar, as well as weak classification and framing in project and NGO-provided INSET. Access to the regulating principles of the vertical discourses implicated in the (re)production of pedagogic discourse is generally not made available to teachers. On the basis of this observation I was able to indicate two recontextualising subfields: primary and secondary recontextualising. Project and NGO-provided INSET are agents for secondary recontextualising.

[2] Resources and strategies here are different from Dowling's usage of the same terminology. See Dowling (1993a).

This description of project and NGO-provided INSET should not be read as an accusation. I am merely drawing attention to what I perceive as a structural feature. However, a hypothesis emerged from this reading of NGO and project-provided INSET: what is most likely to be transmitted and acquired within the context of INSET provision are sets of pedagogic prescriptions, in the form of procedures, for the regulation of the transmission and acquisition of school mathematics. The question then is: what are the "mechanisms" implicated in the transmission and acquisition of the pedagogic prescriptions?

In order to answer the question posed above I had to identify the pedagogic prescriptions and their realisations. Evidence of the acquisition of pedagogic prescriptions was produced within two contexts: INSET provision and classroom teaching. In both contexts the division of labour was indicated by at least two categories: transmitters and acquirers, each of which are producers of performances which are read as transmission and acquisition texts. These two categories of text were described in terms of two planes: the planes of transmission and acquisition recontextualisings. The transmission texts reveal projections of privileged meanings, while the acquisition texts reveal introjections of privileged meanings (or failure to introject). In the context of INSET provision (interactions between INSET providers and teachers) the performances of teachers are read as acquisition texts by INSET providers. In the context of school teaching (interactions between teachers and students) it is the performances of teachers *and* students which are read as acquisition texts by providers.

The data for the analysis was produced by marking out clusters of information as transmission and acquisition texts where the unit of analysis was written or verbal utterances of INSET providers, the teacher and her students. If, as Bernstein (1990) argues, there is always a transformation of contents in recontextualising, then privileged meanings cannot simply be announced by transmitters and absorbed by acquirers. The meanings have to be produced within pedagogic relationships, through the interactions of transmitters and acquirers. For a specialised consciousness to be produced there must be strategies and resources available for its production. The

articulation of strategies and resources must indicate the *what* and the *how* of transmission and acquisition.

The principal strategy implicated in the recontextualising of pedagogic discourse in this study is redescription. Redescription acts on both the selection of contents and the regulation of the transmission and acquisition of those contents to produce pedagogic subjects. As used in this study redescription is under-theorised because the theorising of subjectivity is still incomplete. I pointed out in chapter 3 that a crucial lack in the model is the absence of a coherent account of the differential distribution of "ability" with respect to gender, "race" and class.[3] It must also be recognised that what I have described as "redescription" may be described in terms of different concepts in other models. Some advocates of the "problem-centred approach", for example, may claim that redescription as I have used it does not exist in their pedagogic discourse because student engagement with tasks serves to focus and bring out an essential mathematical rationality which always already inheres in human subjects and is made visible as the necessary result of encounters with appropriate tasks. My use of redescription is strongly associated with the (re)production of discourses through the subjugating of acquirers to the rules of a discourse and who thereby become its subjects. "Redescription" is therefore a descriptive tool of the model rather than an objective fact although it can be used to interrogate pedagogic discourses.

I also argued that in my appropriation of Dowling's model of the relationship between metaphor and metonymy, synecdoche could be productively employed in an attempt to grasp the interactional. Apprenticeship is dependent on the articulations of transmission and acquisition texts in which transmitters and acquirers attend to the availability of signs which can be redescribed as features of an ideal acquirer. Such redescription can remain largely implicit as in the instance of classroom teaching

[3] Dowling's (1993a) language of description provides an account of distribution which may be used to analyse pedagogic texts. Although the production of my model was informed by Bernstein, Dowling and others, there is no claim made here for its compatibility with their work. Further development of this study will necessitate a principled account of the differences between the methodological positions of Bernstein and Dowling as well as a more rigorous explication and justification of the methodology used in the study.

which was analysed in this study. Where the redescriptions remained implicit they were described as synecdochic. Where redescription is explicit, making available to acquirers the regulative principles of an activity, following Dowling (1993a), it is referred to as metonymic.

This study has demonstrated that redescription is a central feature of the pedagogic discourse examined. I claim that it is a feature of all pedagogic discourses in general. This is so even where there is apparently little verbal communication between transmitters and acquirers. The mere mark on a paper indicating a grade, as is often the case in distance education, constitutes a redescription. The acquirer might have a great deal of difficulty in inferring what an appropriate redescription might be but because there has been an evaluation, s/he will begin to alter her/his images of the ideal acquirer and of him/herself.

6.3 The analysis

From an analysis of the teacher's use of wall displays I concluded that the preferred modality of pedagogic discourse was a visible pedagogy. The INSET provider and Project, however, privileged an invisible pedagogy. The performances of the teacher had to show essential features of an invisible pedagogy in order to indicate her successful apprenticeship. She claimed to achieve an exhibition of apprenticeship via the withholding from students of the contents of the syllabus topic "cartesian co-ordinates", which the students then apparently constructed themselves. However, when one examines the interaction between the students and teacher it becomes clear that she constantly redescribes what they suggest. The students begin to participate in the redescription of their own performances once they are able to infer recognition and realisation rules for redescription from the teacher's implicit evaluations of their performances. The weakening of framing was more apparent than real.

While the recognition and realisation rules are transmitted tacitly, one can speculate about whether the regulation of the selection and articulation of contents possibly becomes more effective than the explicit announcing of definitions because the

students may experience their subjugation to school mathematics as less oppressive than previously experienced, and so become more willing to participate rather than resist. In the post-lesson discussion the teacher claims that standard eight students still have problems in using the notation for representing co-ordinate pairs of numbers to justify her fairly lengthy introduction of the topic to her students. Possibly the teacher has developed a more efficient set of strategies for the regulation of student consciousness than was previously available to her.

The teacher's arrangement of students in groups, her use of apparatus and apparent preference for discussion rather than exposition, are read by herself as well as the INSET provider as evidence of apprenticeship.

6.4 A summary of the limitations of the work

What the theoretical model which was used does is to enable a contextualising of pedagogic discourse. Is the pedagogic discourse examined concerned with primary or secondary recontextualising? If the pedagogic discourse is concerned with secondary recontextualising then there is a high probability of acquirers not being given access to the regulating principles of the V(i) which are implicated in the (re)production of the pedagogic discourse. The discourse is then more than likely to be realised mainly in the form of procedures.

The model has also stressed that the realisations of P(i) are produced through the performances of transmitters and acquirers, and that such realisations are, at least potentially, different from the prescriptions of the P(i). An examination of the realisations of P(i) therefore has to take into account the performances of both transmitters and acquirers, rather than focus on just one category. Bernstein's code theory can be used to detect and describe differences between pedagogic prescriptions and realisations via the production and comparison of classification and framing values. The production of synecdoches facilitates the redescription of performances of pedagogic subjects as well as, via such redescription, enables transmission and acquisition to be read as realisations (or non-realisations) of pedagogic prescriptions.

The dissertation has attempted to do two things. It starts from a theoretical framework, generates data and develops a model for the description of recontextualising. This model is developed both inductively, from the data, and deductively, from the theory. The second thing which the dissertation attempts to achieve is a demonstration of how the model can be used to read the data. However, I must say that I am not convinced that this has been achieved as tightly as it could have been. This is so because the model still requires the rigorous theorising of some of the concepts used in its development. I have already indicated the under-theorising of the ideal acquirer as a problem which largely ignores the differential distribution of "ability" and competence.

Another problem with the model is that it focuses directly only on condensation and only indirectly on displacement. In Muller & Taylor's (1993) terms, the model attends mainly to the centripetal and neglects the centrifugal "dynamics of social meaning" (p. 314). The dissertation has also not demonstrated clearly how the model might be used to read data derived from completely different empirical instances of pedagogic action to those considered here. Finally, a more coherent account of how the different levels of the model articulate is still required, especially with regard to movement from the GDP to introjective and projective synecdoche.

More positively, I think that the attempt at elaborating a model which contextualises the research study and which marks out how data is to be produced and analysed, provides both the author and the reader with space for productive criticism and deconstruction of the study. It is from such productive redescriptions of his performance that the author can realise appropriate self-redescriptions and thereby facilitate his apprenticeship.

Appendix 1

Extracts from the course

1. Getting to know each other

Get into a circle. Welcome to the official beginning of the course.

As we were not all here at the meeting last term, we can go around the circle again, say your name, say where you teach.
Getting to know names game with tennis ball: Say your name, throw the ball and name the recipient; that person says his/her name, and throws, etc., etc. (10 minutes)

Break into groups of four - with people you do not know. What does your name mean to you. Talk about it, tell stories, explain meanings ... etc. (15 minutes)

Figure A1.1

2. Tasks

Tasks in general

A word about tasks - there is no way I can inflict these on you as 'compulsory' as this course is not run by marks and assignments ... [H]owever, I will, every now and then, suggest a focus for your journal writing which I believe will link the work we do on the course with your work in the classroom. I will be suggesting that it is a good idea to *do* a particular activity and *write* about it. Try to engage with this part of the course!

Task one

Imagine you are a student in your mathematics classroom. What is your emotional experience of learning mathematics? Write down words which describe your feelings as a student in these classes.

You are yourself again: a mathematics teacher. You read the above exercise. How do you, as a teacher, feel about this?

Figure A1.2

3. An expression of needs: "Hopes and fears" listed by teachers at the start of the course

Extract 1

Hopes & Fears

I hope that this course will be able to address some of the unique problems which a teacher of deaf children encounters with the teaching of mathematics. I would like to broaden my knowledge of teaching skills in the field of mathematics with a view to developing insight in the students that I teach. It would be very helpful if practical ideas could be given in the form of actual lessons or activities which can be applied in a classroom situation. I fear that the apparatus required to carry out many of the activities may be costly or otherwise not applicable in a 'deaf' classroom.

Extract 2

Hopes

1. Achieve a sense of continuous learning.
2. Experience
3. More knowledge to practical application of the subject w.r.t. all of the syllabus content.
4. How to make Mathematics a flagship subject.
5. How through [the project] I could make Mathematics more interesting.

Fears

1. None

Extract 3

Hopes

To gain effective teaching methods on difficult concepts in maths.
To enhance interest in the pupils by introducing exciting variations to maths learning.
To gain ideas to eventually change the current syllabus into a more relevant and meaningful one.

Fears

We would be required to complete projects during busy periods at school.

Extract 4

Hopes

1. To improve my teaching in a broader sense.
2. To develop the best out of each and every one of my students.
3. To teach as effectively as possible.
4. To share different ideas with each and every teacher.

5. To experiment with different techniques.
6. To go back to the classroom, more motivated, and to try some fresh ideas and techniques.

Fears

1. For the course not to be boring.
2. Course must not be too junior or uninteresting.
3. I hope I can us the techniques and strategies also in my higher standards.

Extract 5

Hopes

1. To interchange some ideas on maths - problems in the classroom.
2. To be assisted in problematic areas.
3. Acquire new methods that would make maths easy and interesting.
4. To mix with other people of common subject.

Fears

1. Since it's after school I won't be tired and this affect my participation.
2. Looking at the different education systems won't I bring something novel to my pupils i.e. will my pupils be able to meet my standard.
3. Will it help me in my B.Ed. degree.
4. Will I achieve some of my hopes.

Extract 6

Hopes

- See this course as a Refresher course.
- Learn new methods of teaching maths - making maths more interesting for pupils.

Fears

- I did maths many years ago and I may not be at the level for this course, i.o.w., my mathematical background may be inadequate.
- Commitment to complete course.

Extract 7

- I hope that this course will supplement to the knowledge that I already have, by bringing into light some aspects of mathematics that I'm supposed to know that are included or not included in the syllabus.
- Some approaches to mathematics in general.
- And maybe certain approaches to specific contents of the syllabus.
- Will enable the teachers to share different experiences of different teachers in the field of teaching.
- I hope what we are going to do in this course will not be too general such that we have to keep this knowledge in our reserve bags and not be able to use it, for a long time in the teaching field.

Extract 8

Verwagtinge

- Om meer inligting te kry hoe om probleemareas in die klas op 'n effektiewe manier te onderrig.
- Om jou eie wiskunde agtergrondskennis te verbeter / upgrade your own knowledge about the subject.
- Die kursus moet my instaat stel om vir myself 'n wiskundige bronstelsel op te bou.

Vrese

- Sal ek daartoe instaat wees om miskien my eie onderrigmetodes te ontwerp en sodoende dan in staat te wees om af te wyk van die konvensionele metodes.
- Sal dit moontlik wees om die metodes soos hier gevorm in my klas toe te pas.
- Sal die leerlinge ontvanklik wees vir eksperimentering met nuwe idees.

Extract 9

Hopes

- better equipped as a maths teacher.
- to be able to stimulate the interest of the pupils so that all fear regarding Maths as a subject is removed.
- to get ideas (new or old) as to how to deal with stone-age problems in the classroom.
- Feeling of overall satisfaction - after maths lesson
  - after marking a class test
  - after marking an examination paper

Fears

- As I am not a qualified maths teacher there is, perhaps, that psychological disadvantage in the discussion period, i.e., that I am not speaking with authority.

Extract 10

Hopes

I hope that at the end of this course I will be a better teacher.
Through interacting with more experienced teachers from other fields of work and through sharing ideas I hope to gain more experience so that I can share it with my mathematics class. I hope the course will go on as planned until its last day.

Fears

None

Extract 11

To find ways of letting the students understand the concept of Trigonometry, especially in the initial stages (i.e. Std 8).

To show them how studying Math is not important only for academic achievements but for logical rational thinking processes as well.
"Why do we have to study Algebra?" "All this factorization, multiplying out etc." (Pupil' statements)
I suppose to inform them and make them understand that it is one of the processes developing a rational train of thought at this stage, is almost impossible.

I think that Math has already proven to them how everything in Math is based on axioms, definitions, rules, etc.
Life can also be said to be dependent on rules, otherwise chaos would result.
We can show them this relationship.

Sorry I'm rambling!

4. Squares

"Boxes" activity: Problematise the role of the teacher and the teaching methodology in learning.

First give the activity as a test (start of course - see where you all are, etc.)
(10 minutes)

SQUARES

Use squares of the same size. Number each square after you have drawn it.

1. Draw a square on your paper.
2. Draw a second square alongside the first, but beginning half way along its edge.
3. The third square makes a rectangle with the second.
4. Place the fourth square directly under the third and then shift the fourth square by 30°, keeping one corner touching the third square.
5. The fifth square makes a rectangle with the fourth.
6. The sixth square lies alongside the fourth and fifth and touches the two equally.

Make as many different patterns as you can by following the instructions above.

Now write on your own. Emotion words only. How does this feel? (5 minutes)

Give the activity as an investigation, with apparatus and written instructions.
Collapse groups at some point? (10 minutes)
Write down emotion words about this activity. (5 minutes)

In the same groups, share a very positive or a very negative story/memory which you have of yourself learning mathematics. (15 minutes)

Discuss tasks in groups. (5 minutes)

Figure A1.3

Appendix 2

Extracts from the transcript of lesson 1 planning session and the post-lesson discussion

2.1. Lesson 1 planning session

Extract 2.1.1

Mark: I was just thinking that for the purposes of the write up ...
June: Mmm
Mark: ... based on one very important issue could be ...
June: Is equivalent.
June: Uh uh
Mark: Now there is some write up there on that one file.
June: On equivalent
Mark: And then here we're looking at the move from arithmetic to algebra ...
June: ja
Mark: that's another interesting sort of area ...
June: mmm
Mark: and then also starting with a complete statement in arithmetic ...
June: ja
Mark: as opposed to trying to complete the statement ...
June: ja
Mark: that's an important movement there ... mmm ... and then ...
June: Are you wanting to use this ...
Mark: I'm just thinking that these are the ideas ... Before we even get into the cartesian plane that these are the ideas that we can perhaps like focus on for the write up, man ...
June: Mmmm
Mark: ... as like key issues that we attempt to address. You know?
June: Mmmm
Mark: And what have you. So it's that and then the issue of arithmetic and ...
June: Oh this is for ... Oh you're still summarizing ...
Mark: Ja
June: ... Okay, fine
Mark: Just for what we did so far, man.
June: Okay, so equivalence, arithmetic ...
Mark: Arithmetic, dash or arrow, algebra
June: Ja, okay ... fine ... mmmm ...
Mark: And then, hold it ... ja, under that uhhh sort of, what do you have there? Mmmm, in fact it's important for us to know this statement so that we don't start having to go over all these things again later on.
June: Mmmm
Mark: Uhmmm, uhmmm ... then we can say the starting off ... uhmm ...after the important issue was addressed were we track starting off with the complete statements in arithmetic.
June: Are you saying that ...
Mark: Starting off with the complete statements in arithmetic
June: When did you summarize it?
Mark: []
June: [] starting off with complete statements in arithmetic. We're starting off with that?

Mark: And then moving to the unknown.
June: Uhhh, okay ... Okay fine.
Mark: That's just a formality. And then also then strategies adopted at a certain point ...
June: Ja, ja that is what I ...
Mark: ... I ... I nogal like the [] that ...
June: And then they applied it ...
Mark: Ja, where they had cumber ...
June: Different strategies
Mark: ... cumbersome strategies, some for them ...
June: It's a pity ...
Mark: ... but it was what they were using

Extract 2.1.2

June: ... it's a pity I haven't got that on the board here. The same thing happened today where we had ...
Mark: A classic example []
June: Let me just show you about what we did again today where I had one of these examples [...] Uhmm ... like they had that 3x -5 = x + 9. Some of them removed the 3x ...
Mark: Okay
June: some of them removed the ...
Mark: The x!
June: five!
Mark: Okay, now what happens when they remove the 3x. Let me just see how they did it.
June: Okay, they remove the 3x like that, ne. So they had -5 = -2x + 9.
Mark: Okay
June: Some of them removed the 5. But the point that I'm trying to get across is that they didn't remove the 5 first ... and then from there they worked. Do you understand what I'm saying? Now what they are doing here is they remove the 2x after a while and then add on that side. Okay. So now they are going to get 2x - 5 = 9.
Mark: 2x - 5 = 9
June: And then afterwards they went on and then then ...
Mark: Got rid of the 5
June: Ja, then got rid of the 5 and then added 5 there. So they had 2x = 14. And then they worked from there.
Mark: Okay now and what would have been they way that we would have told them to do it I mean as far as the efficient way. Come let's just work out the efficient way ...
June: Now okay.
Mark: ... or our effcient way
June: We would have first gotten rid of everything because we tend to force them to think that okay, like ... and then from there they would subtract the x and that would be 2x = 14.
Mark: 2x - 14. So that's what we were looking at and then, of course, just continue.
June: And then they just divided by two. So they compared their answers. So there's no fixed way of doing ... of ... they must first get rid of -5, you see so they
Mark: Now I think that this forms part of argument you write about ...
June: Ja
Mark: ... that could possibly be very very useful ...
June: Mmm
Mark: ...you know. Letting them grapple with their own strategies which could actually take them up the garden path till they eventually they come to the answer ...
June: Mmm
Mark: ...it's something that's theirs ...

June: Mmm
Mark: ... as opposed to adopting or implementing something that we give them ...
June: Mmm
Mark: ... which we feel is more efficient and probably is, but this is their's ...
June: Ja
Mark: ... you know ...
June: Another ...
Mark: ... so that can become part of an issue.

2.2. Post-lesson discussion

Extract 2.2.1

June: That is showing the need why I think the cartesian plane was introduced. So that they ... So that is why I needed to do map work because ... to bridge the gap. It's real maths now. Understand? It's bridging the gap so that they can see it's real. Because if you teach geography they don't see a relationship ... the relationship between geography and ... They never see the relationship. The geography teacher tells me "Look the children don't know anything about graphs. Why not?" But they don't see it like that. So what I'm trying to do, I'm bridging the gap. I'm trying to sort of link the maths to the other subjects and where it is relevant ...
Mark: Inter ... inter-subject uhh ... uhh ... uhh ...
June: Ja. That's what I'm trying to do ... At the same time! So I just thought of this the last thing last night and I tried to just throw it all together and this is what I came up with.

Extract 2.2.2

June: What I was attempting to do was ... perhaps they could [] I mean later on man [] But for gradient they are going to use it. Definitely.
Mark: What, the ... the ... the boards? Okay, sure.
June: Ja they are going to use it for gradient. I think they are ... I want them to do it. That was just the reference point.
Mark: Mmm ...
June: Now I can take it away. Now they can move around this ...
Mark: Say ... say ... say again.
June: I wanted to get them to see the reference point. I wanted them to see the need for this strategy. That is why I restructured ...

Extract 2.2.3

June: Right. I think ... Ja maybe tomorrow ... uhh ... uhh ... you mean you want to do that ... that activity or maybe tomorrow when I do speak to them about the cartesian ... I didn't tell them that. Did you see? I didn't mention. Did I mention it to them? Cartesian.
Mark: Cartesian ...
June: I didn't mention that word. I didn't want to do it because fancy words usually just scare them. I mean they just don't ... Tomorrow I going ... now that they've worked their way around plotting then I want to mention to them that it's called the cartesian plane. Then I want to have a look at that ... and also to explain to them that ...
Mark: And also that this is just a name that comes from the guy who thought about it. I mean, we had this content of mathematics [] we speak about René Descartes.
June: Okay

Mark: And that's all. In other words it's not just ... it's not a funny name you know. Just to ... to give the name a bit of ... uhmm ... uhh ... uhh ... uhh ... a bit of feeling ... a bit of meaning. I don't know.
June: Ja, okay.

Extract 2.2.4

June: No, no, no. If you start off with letting them see the relationships first. Because how are they going to see, say for example, if you have three and nine, and four and sixteen and you build it up. So they ...
Mark: Okay, okay.
June: ... must get the rule first before they can get to that, because I feel then ...
Mark: Okay, okay.
June: ... they know exactly where it's coming from.
Mark: Okay, okay.
June: Because if you just give them something like that then ...
Mark: Mmm. But ...
June: Do you understand []
Mark: Ja. Although the advantage ... Ja, I see what you trying to get at, like trying to get the rule ...
June: Ja.
Mark: ... when you might be able to use the physical apparatus here, ...
June: Ja, and I ...
Mark: ... but then not being able to formulate the rule.
June: So I think maybe we should start there with the rule, because that's where I start with eights. I'm saying ... uhmm ... to get them into the ... into the idea of .. of what functions is, ne. [] But not, now, mentioning it, you know, that's a function or things like that, but so that they can see that there's a rule related to these two being connected.

Extract 2.2.5

June: Because I must adapt it to suite my needs man and what I really want ...
Mark: Mmm
June: ... because it must go somewhere, I wanted them to know. To get used to this. That is the problem that they had. They usually have the problem that they don't know how the coordinates are given and don't know how to read them and that is ... that is why. I saw you changing it around there ...
Mark: I ... I ... I was ... I was on a different wave length. I thought ... I'm thinking here, okay ...
June: Because what, you see, what I was going to ... I felt it would be too ... the level would be too high for me to start off with. They wouldn't know what was going on. What I was leading in ... I wanted to put the boards together but I couldn't because it wouldn't work.
Mark: No, because then obviously ...
June: Ja ...
Mark: ... you would have to show the boards and what have you.
June: And that is what I did now [] is exactly what I wanted them to know for this lesson. So I used the same article but I just changed it slightly. Do you know how I changed it?
Mark: Ja, especially when it came together when you started putting the ... the ... the ... the ... the boards together on the board type of thing, and ...
June: Ja.
Mark: ... and then you had ...
June: And they were changing it around physically ...
Mark: Ja, ja.

June: I asked them where must that minus one be. Did you see?
Mark: Yes.
June: And then they said ... they actually told me where it must be.
Mark: So the roatation...
June: It must be that side.
Mark: There was basically rotating the board.
June: Ja.

Appendix 3

Extracts from the transcript of lesson 1

Extract 3.1

Here's a pegboard. Do you all see the pegboard?
Yes
Right. You'll all get a chance to work with the pegboard in a minute.
Just name this peg.
Koos
Koos ... fine.
What do you say? Name this peg.
Piet
Piet ... Ja okay.
Be original, what do you say?
Oh, John
Oh John.
Right, at the back there?
Peter
Peter.
Right at the back?
David
David
Clive
Clive
Okay fine.
Name the peg now?
Mary
Name the peg now?
Zaida
Fine.

Extract 3.2

Name ... now ... the position of the peg. Right, hold that thought.
You are going to name the position of this peg ... In you groups ...
Right ... umm ... you're supposed to be five. So just make groups. Three of you just go there to the back ... And Clive, come and sit here ... Saban go and sit there at the back with the girls ... And you come and sit over here.
Sit anywhere ... sit somewhere.
Right. Put the atlases away. I don't want the atlases ... it's got nothing to do with whatever you are going to do now.
Just tell me the position ... The position of the peg. But you must agree in your group that it's that. You must agree. You must agree to disagree.

Extract 3.3

Okay, now how would you describe the position?
South-west
How many south-west?
Three. Three north. Three holes up north and ...
Three holes up ...
And three holes east. Three holes to east.
And three holes east.
Right, you?
Six dots down Miss
Six down.
And then four east. East across.
Four across.
Right, Appolis? Appolis, your group there? Have you decided? ... Right, I'll get back to you now ... Simone?
Six up and four sideways.
Six up.
And four sideways
Four sideways.
Simone ... that is here ... sorry.
Appolis, your group? ... Okay.
Justin's group?
Four down and sideways.
Four down.
Four across.
Come now.
Four across and four up.
Right. Thank you

Extract 3.4

Let's have a look at that. You'll obviously realise later on that you could have turned this board any way to label ... or to give the position of that point. But would your position have been the same as theirs?
No. Yes.
Is it the same?
Yes
Okay, let's take Nino and Simone. Is that the same?
Yes
Exactly the same? She's using down and he's using up ... across and sideways ... Okay, these two are the same.
Let's look at the four across and the four up and compare that with Nino. Is it the same?
No
No.
And this one here? Is this the same as that? Is it the same as that over there?
No
No.
Why do you think that you people differ? Why do you think ... Kevin ... Kevin's group? ... Thank you here ... Justin ... Why do you think you differed like that?
Mmm
Yes ...
Everyone's mind works differently

Everyone's mind work differently ... But how could I have made this easier for you?
They're all more or less the same Miss
All more or less the same.

Extract 3.5

Did I give you a common point of reference? Did I tell you 'label or give me the position with reference to something?'
No
When I asked you to look at the map — I'm not going to draw it — and the position was there ... what did you use to give me the exact position of that place?
Longitude and lattitude.
You gave me the position with reference to your longitude and your ...
latitude.
Did I tell you which ... what to use here?
No
Right, okay fine. Just hold on to that pause ... Let me just try something else.
Right
Let's have a look here. Let's all work from one point. If I put this red peg in over here — if it can go in — How many positions to the right did that peg move?
Did it move to the right?
How many positions to the right?
Four
Okay I'm putting it in over here now. Did it move any way? How many positions to the right?
None. No positions.
None
How many positions upward?
None
None
So let's look at that now. Okay. So that peg hasn't moved. It's no positions to the right and no positions upward. Okay.
Yes
If I put in a peg over here. A blue peg over there. Right. Now I'm going to give you a red peg.
Can you tell me now ... looking at this peg ... can you all give me the position of that peg now with reference to your red peg. Just do it quickly ... and someone record what you have done.
Use your original position. Which was here ne? Leave your blue pegs in, just put in your red pegs. Just put in your red pegs.
With reference to your red peg ... with reference to your red peg, give me the position of your blue peg.
The nought-nought position ... I could have placed the peg in there ... Now how many positions from there do you move?
Just record your findings.
Right. Do you all come to some agreement over there?
Right ... so ... let's just hear from you at the back Kevin. Kevin's group?
Three to the right and three up
So it's three to the right and three up.
Nino's group?
Three holes up and three holes to the right.
Three holes up and three holes to the right. Okay.
Simone?
Three across and three up.

Three across up and three.
[Laughter]
Three across and three up.
And Appolis?
Three across and three up.
And Justin?
Three across ... Three right and three up.
Three right and three up.
Now, tell me now ... with reference to that point that I've given you, the original one over here, this ... this red one here, was it better now for you to be able to describe this? With reference to that point.
Yes
Right. So you see that over here now that you have come to a common agreement that you are going to move.

Extract 3.6

You don't have to write across and up, we've accepted - thank you! - we've all accepted now that moving right ... first, moving up will be written ... second, ne? So you do that. So you write your number which you want them to move right, first; the number which you want them to move up, second.

Extract 3.7

Okay ... uhmm, uhmm ... they said on this side that stage - thank you mister Edwards - Right. That you all reached that stage where you have found four and eight and all the others. Then what are you going to do with negative one and nought?
[Students shout out directions - indistinct.]
You going to make that to the ...? [The teacher raises an arm and points to her left.]
Left
Why to the left? Why not to the right?
You must give me an explanation.
Why? I want to know why! I don't want to hear any dilly-dally. Tell me why. Why must you go to the left?
Because the right is positive.
To the right you are going to? ...
Positive
To the left? ...
Negative
Okay. Fine so now how can you do it with that board?
Can you do that?
Would you now be able to [find the] negative numbers on the board?
Yes Miss
Okay so you found that. Your board was that way ne? And that was your stationary peg. Mmm?
Now ... I want to move negative one, which way am I going to go.
Left
Can I go this way?
No
Are you going to turn the board? Now show me that you turn the board, how do you turn the board.
Yes

Okay now fine, now okay now fine do this one for me.
All of you.
Okay ... uhmm ... Right fine, have you all got that one? Show me where that one is.

Extract 3.7

So you moving negative one to the? ... Left or right? Is negative left or right?
Left
Left. Why?
Now where do you come ... where do you get this from?
Where did you get that from? ... Moving negative you must go left?
Yes?
The number line
Thank you!
Yes?
The number line. Why?
Show me where. Show me where. Where's the number line?
The number line up there.
Oh here?
Yes
This number line over here.
Fine, so when you move to the left you're going to go? ...
To negative.
Move to the right? ...
Positive
Right, if I move up?
Positive
Or down?
Negative
Why?
Because it's just so
Because it's just so? Okay, fine.
So now you telling me you can find ... you are actually telling me now you can find negative points and positive points with that board.
Yes

Extract 3.8

Okay, so now we have had that, and now we can come to that there. Right? In that position. Then you said to me you turn it around. Let me just keep that like that. So you turning it around ... mmm ... huh? Was that there? Then you can turn it around quickly like that.
What in actual fact are you having over there?
A square
Ja, on the outside. Is that a square. Doesn't look very much like a square. Okay, right.
What do you ... what are you ... what are you [] over there?
You saying over here if you go up, everything up is going to be? ...
Positive
Positive, ne?
And every way to your right is going to be? ...
Positive
To the left? ...

Negative
To down?
Negative
Is that your theory?
Let's see if it really is so.
Now where do you come on that? Who told you that?
[] now yourselves?
So are you telling me you can name any of the points with reference to that now?
Yes
To that red pin? Now what was the value of that red pin?
Nought
Nought.
Okay. So if I'm drawing two lines here are you ... sowhat will be that point here?
Nought. Zero
Zero.
Zero to the left ... I'm sorry, zero to the right ... and? ... zero up ... or down. So that point there ... that position there ... will be zero-zero.

Extract 3.9

Fine. Do you know what we call this?
Coordinates
Coordinates?! Who told you that?
From geography Miss
Geography, oh! So what did you tell me just now when we started this lesson?
Huh?
When I asked you about the atlas, what did you tell me?
What were you doing there in the - looking for?
For a place Miss
Looking for a place. Fine []
So what did, what did, what did you tell you friend - your friend didn't know what did you give the friend?
Longitude
The longitude.
For directions Miss

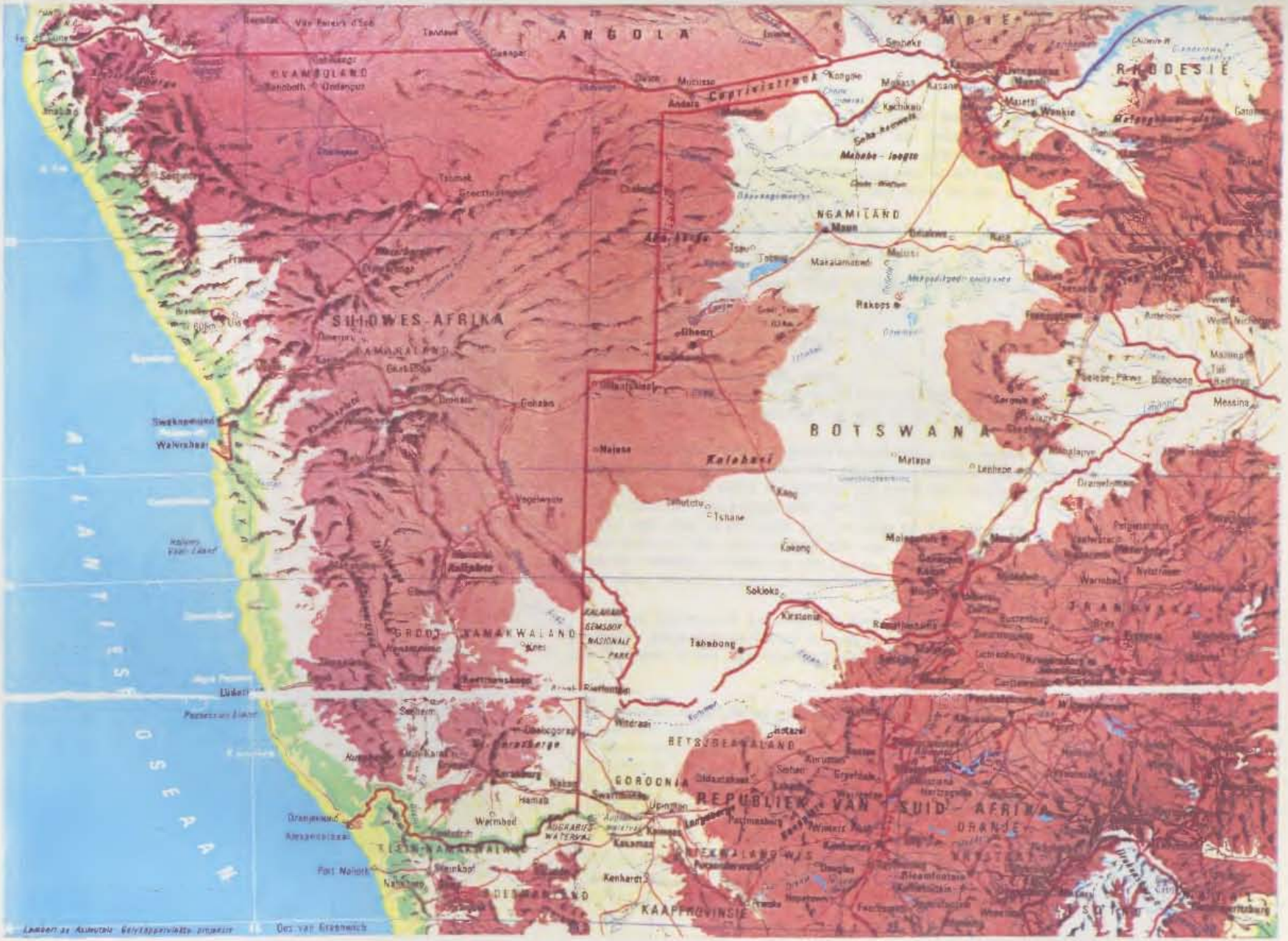

ANGOLA
ZAMBIE
RHODESIE
OVAMBOLAND
Caprivistrook
NGAMILAND
SUIDWES-AFRIKA
BOTSWANA
Kalahari
GROOT NAMAKWALAND
KLEIN-NAMAKWALAND
BETSJOEANALAND
GORDONIA
REPUBLIEK VAN SUID-AFRIKA
KAAPPROVINSIE
ATLANTIESE OSEAAN

Plate A3.1

co-ordinates

Materials required: a nail board (6 × 6 or larger), and something that will fit over the top of the nails (golf tee heads are useful—you need at least one of one colour and one of another). Alternatively a peg board and pegs would suffice but it would be more convenient if the holes in the peg board are 3 to 5 cm apart.

A coloured peg is placed in one of the holes.

Can you give a name to this peg?

Replies seem to vary from 'Tom' to 'Mary' to 'Green' to 'One' . . .

The peg is moved to another hole.

Can you give a name to this peg?

Describe where it is.

Move the peg again, again, again. . .

The 'name' is now likely to be 'in from the left, up from the bottom' or 'down from the top and in from the right' or . . .

These descriptions are gradually refined and a class agreement can be reached which only requires a number pair. The convention of using the bottom left hand hole as (0, 0) can be elicited from a pupil and given his name.

Fred says that he will refer to a position for the peg as so many holes in from the left hand side and so many holes up from the bottom. So when we say (3, 4), by Fred's rule, we mean along from left 3 and up from bottom 4.

It is, of course, not necessary to have the origin in one particular place but useful to extend Fred's rule to mean just 'so many to the right and so many up'.

The coloured peg is placed near the middle of the board.

I will call this peg (1, 2).

A black peg is placed on the board.

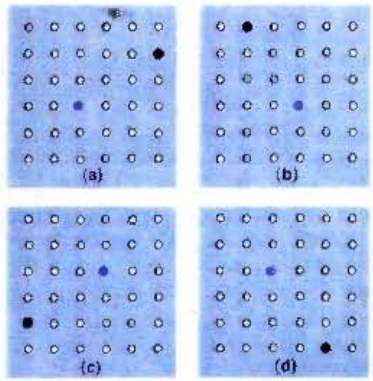
What is the name of the black peg?

It is moved to different positions.

What is the name of the black peg now? . . . and now?

At this stage it seems wise to avoid negative numbers but to include the (0, 3) and (3, 0) type of situation.

Plate A3.2



With the coloured peg near the middle of the board.

I will call this peg (4, 5).

A black peg is placed as shown in fig. a.

What is the name of the black peg?

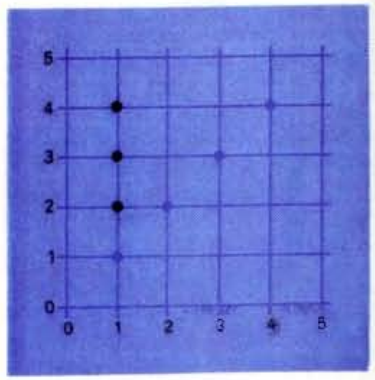
What will its name be if the board is rotated through 90° anti-clockwise? (fig. *b*). *The coloured peg retains the name (4, 5).*

What happens if it is rotated a further 90° anti-clockwise? (fig. c). And again? (fig. d). And again?

The coloured peg can be given new names and the black peg can be moved into new positions.

Can you say the names of the black peg before the board is turned?

In the early stages the position of the black peg, relative to that of the coloured peg, should be chosen in such a way as to avoid negative numbers after rotation. At a later stage it is interesting to place the black peg in positions which do require negative numbers after rotation. 9-year-olds have been known to invent negative numbers to cope with this situation.



Four-in-a-line

If the activity just described is followed by this game then consolidation of the convention is possible alongside the excitement of game strategy.

The game of four-in-a-line is played as follows:

There are two teams (or two people).

Each says a pair of numbers in turn and a 'marker' puts the point on the grid (the teams must not touch the grid). The aim of the game is for one of the teams to obtain four points in a line (the lines can be horizontal, vertical or diagonal).

Plate A3.3

Appendix 4

The wall displays

Plate A4.1

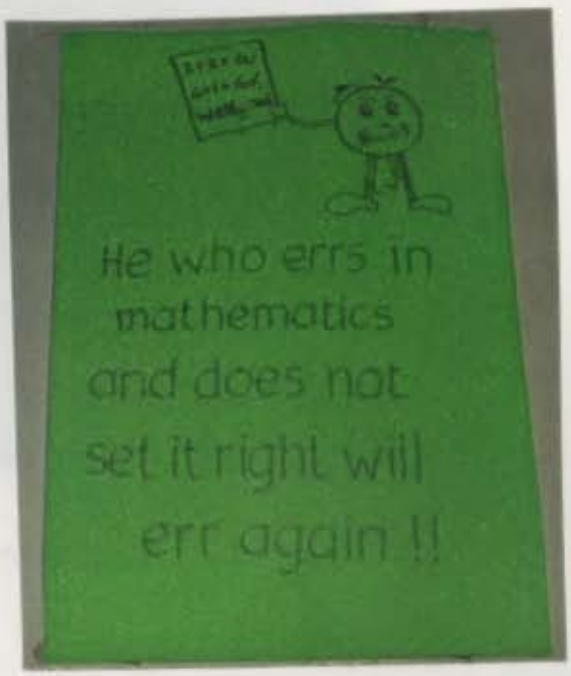


Plate A4.2

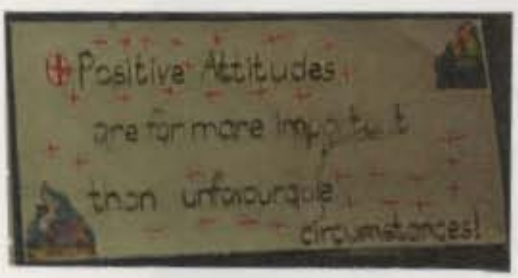
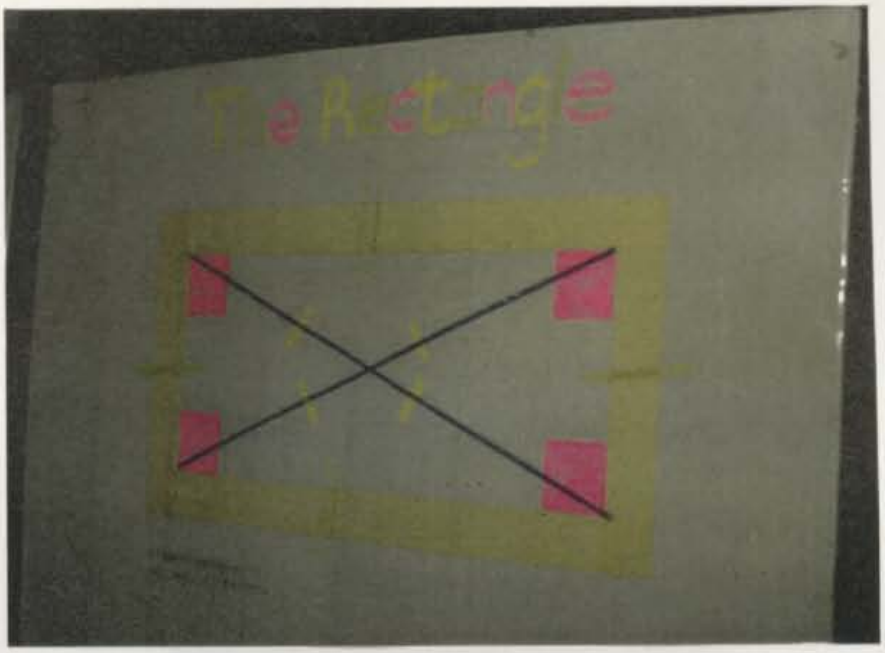


Plate A4.3

Plate A4.4



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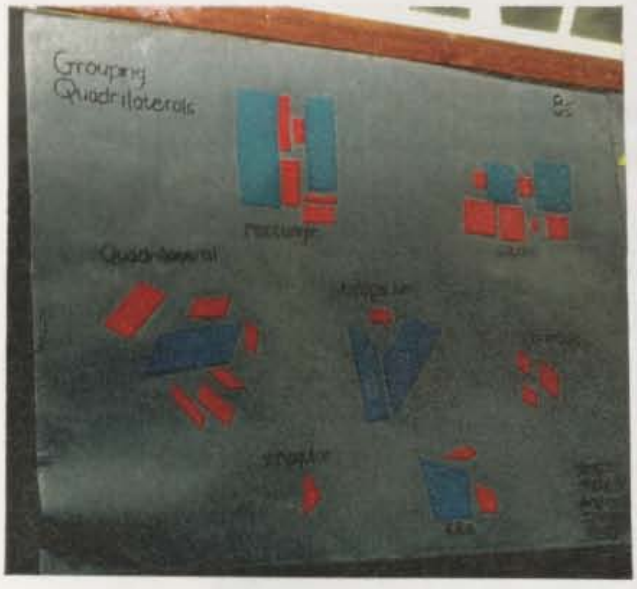

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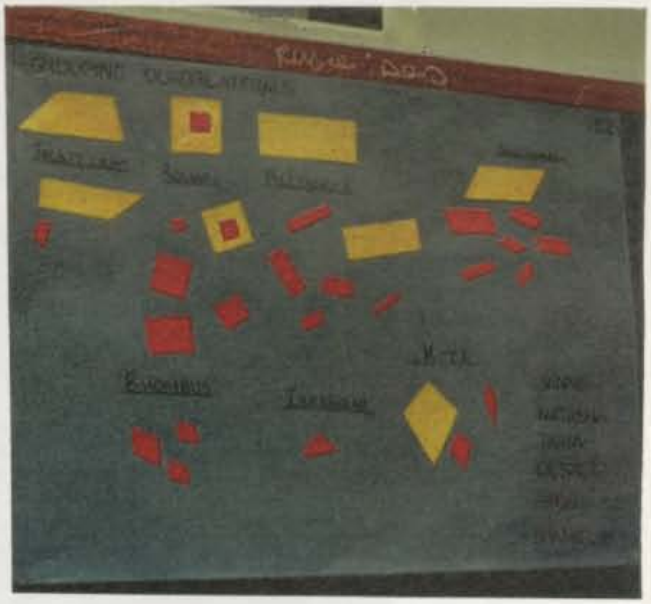

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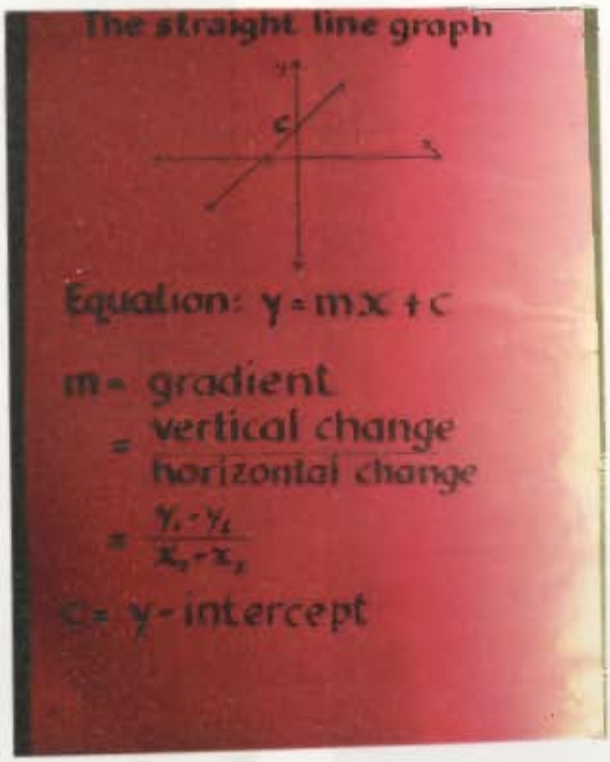

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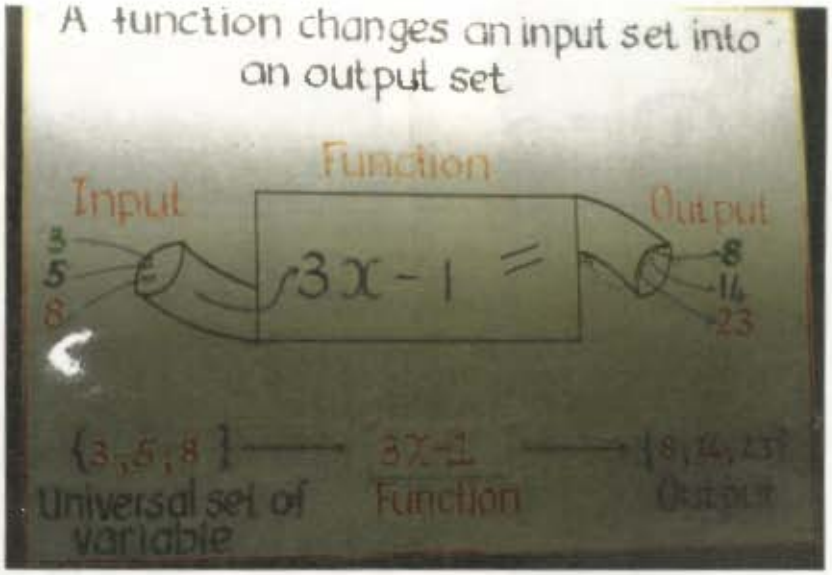

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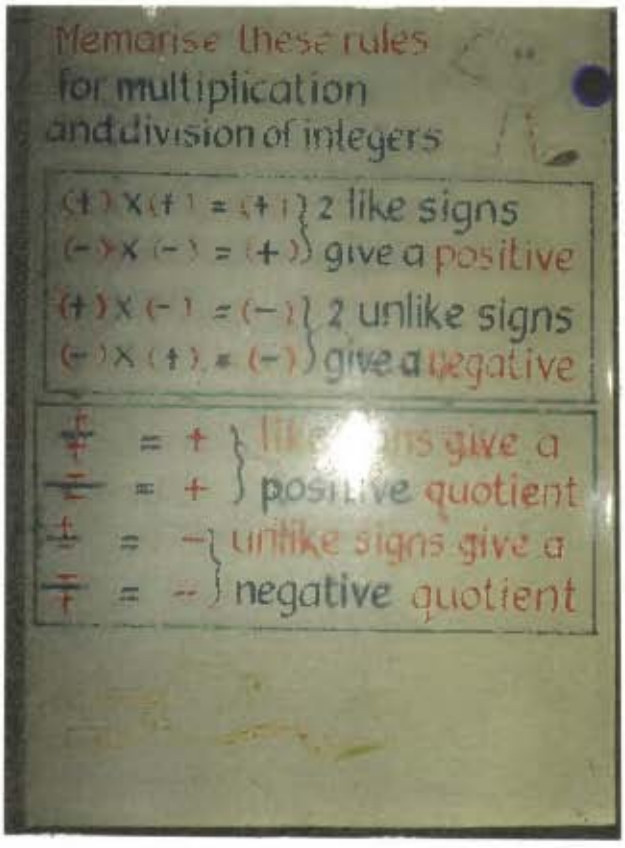

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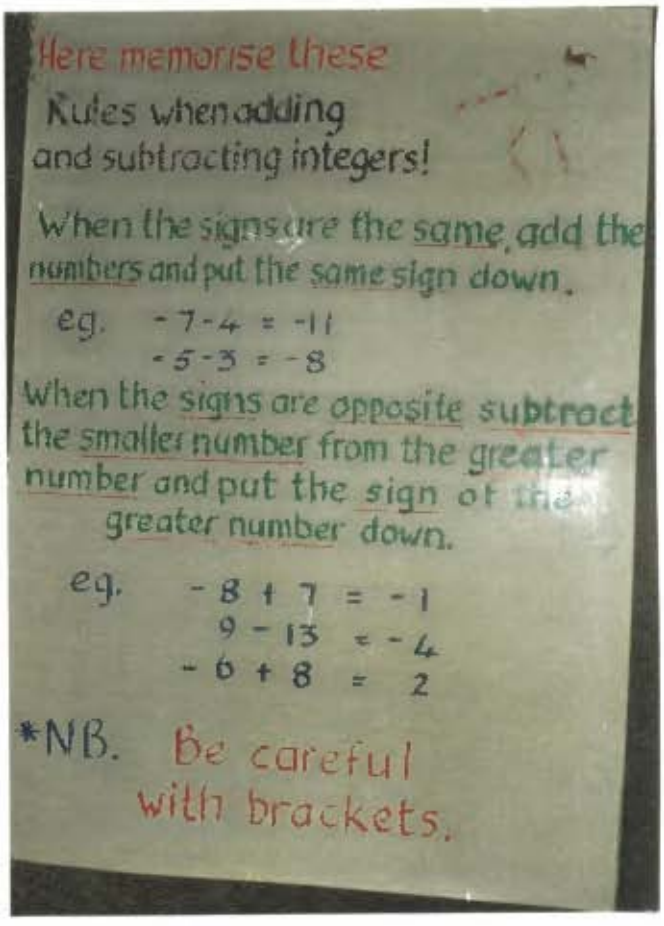

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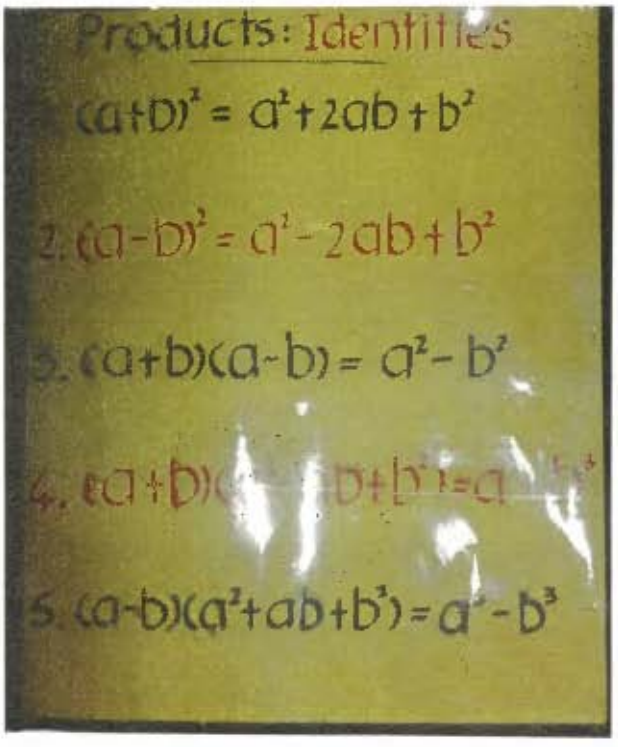

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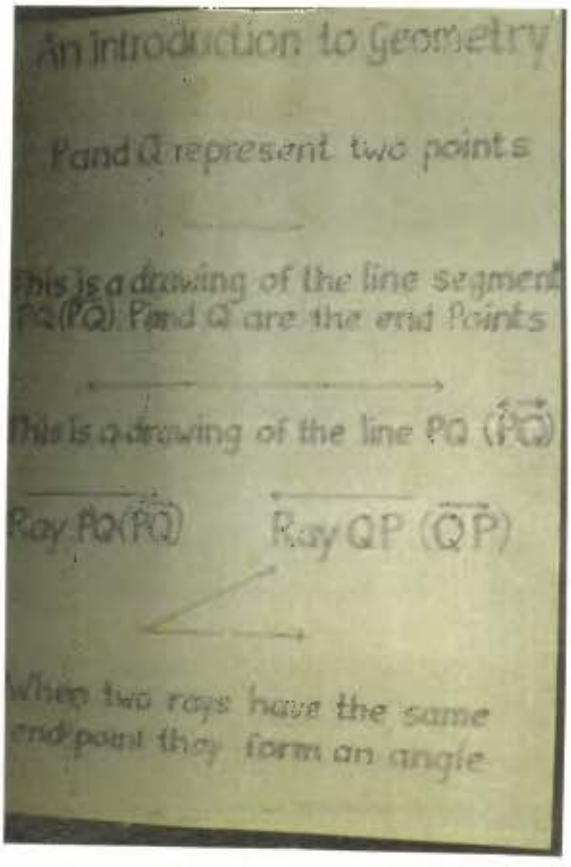

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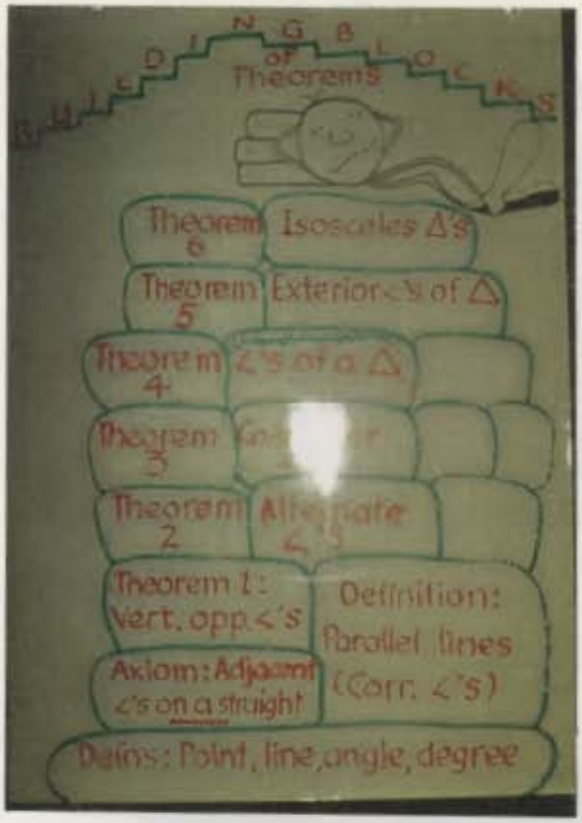

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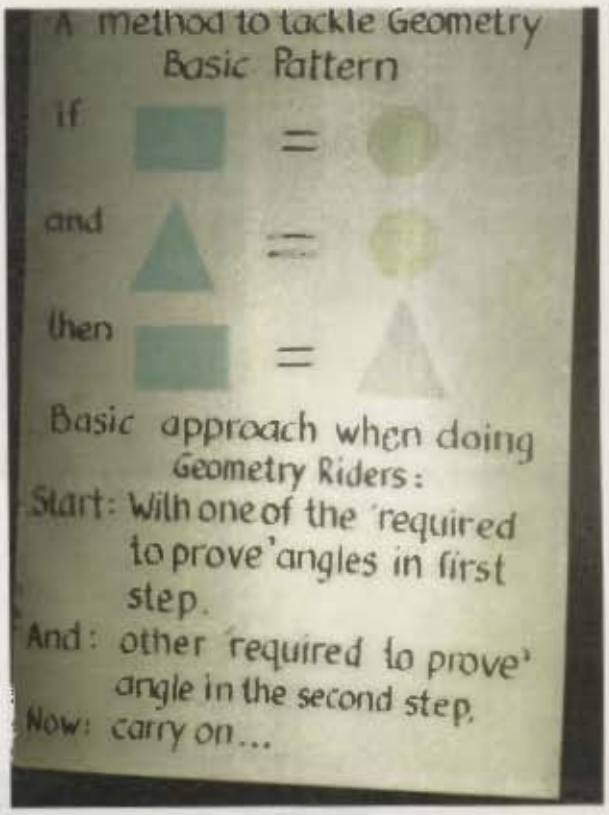

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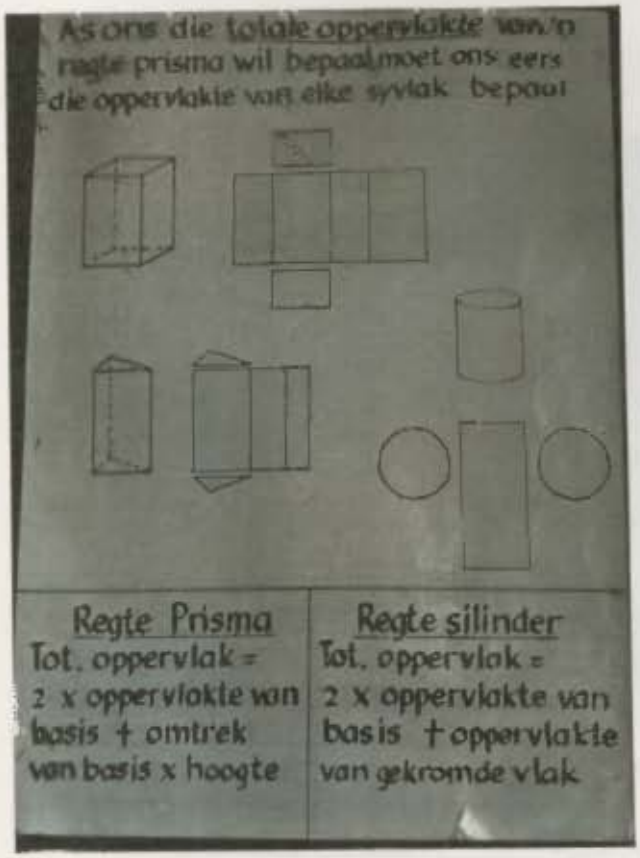

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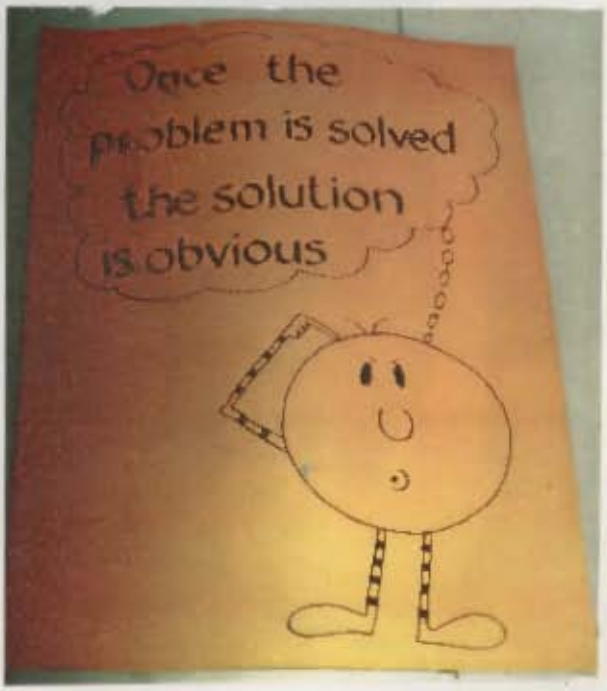

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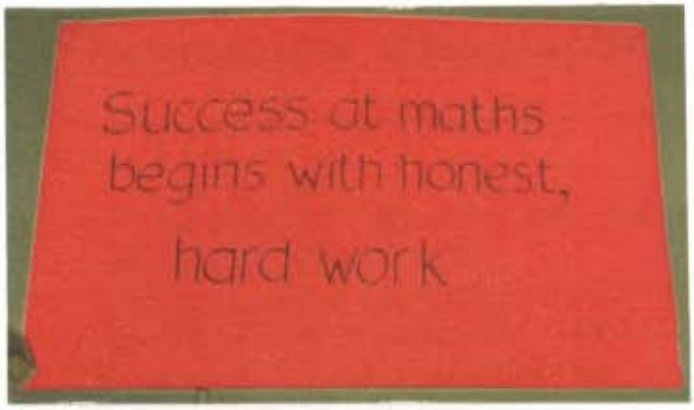

Plate A4.20

Plate A4.21

Plate A4.22

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