

The Making of  
Meaning: A Study of Teachers' Work in Maths and Language Classes  
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ABSTRACT

The experiences to which students are exposed depend on teachers' beliefs about teaching and learning. Teachers plan the content and method of lessons, but in the classroom further decisions must be made as a result of events that cannot necessarily be anticipated. Effective description of the ways experts make decisions - the framing of what Shulman(1987) called the "wisdom of practice" - could allow such knowledge to be effectively conveyed to less competent teachers.

The full study aims to examine teachers' work, using a combination of small scale close analysis (the focus of this paper) and large scale survey, to explore how beliefs affect practice and how the complexity of classroom events can best be described.

1. INTRODUCTION

Teachers differed considerably from one another ... in their knowledge of the subject matter and in their beliefs about what is involved in teaching and learning it. Also, those who mounted intervention studies that called for training teachers in models of good subject matter teaching found that the teachers' willingness and ability to implement the new models were determined in part by their subject-matter knowledge and beliefs. Some elements of the models apparently could not be implemented effectively unless teachers had sufficiently well-organized and accessible subject-matter knowledge, and some elements were ignored because the teachers did not understand why they were important or resisted because they conflicted with the teachers' beliefs about what is involved in teaching and learning the subject (Brophy, 1989, p3).

A conversation I had with a friend whose job was lecturing in the Arts faculty of a university was one of the starting points of this investigation . He had been selected for this position in the normal way; he has an outstanding academic record, has published a number of books both alone and with others, and has worked for a number of years "out in the field" in the area of his speciality. His skills both as researcher and writer made him an obvious candidate for a university position.

After some months, however, he became dissatisfied. Although lecturing in his own area and being given complete freedom to design and teach the course in any way he chose, he felt that he did not know how to go about such a task. "It's all very well to decide, for instance, to work in groups," he said, "but what kind of groups? And how should a group operate? How does one make it work? Which tasks are appropriate for groups and which are not?" And so on. All of these are of course reasonable and important questions, and he asked me to recommend books that could guide him in learning how to organise the tasks he would set his classes; in other words, books which would demonstrate how to teach.

I took from my shelves tomes that have had impact on me - works by Moffett(1968), by Bruner(1985) and others. Leafing through them I realised that in addition he would need some practical ideas to illustrate the

theory, so I added to the pile some of the volumes that had served me well - the series by Keyte and Baines(1981), some of Chessell's(1980) books, and various volumes of source material. And it became clear to me that these excellent books, whether taken singly or together, would not tell him what he wanted to know. They would not show him how to decide between methods. The value of models of teaching and learning is that they provide a structure to facilitate articulation of the content and procedure of lessons. However, until the last few years discussions of method have largely ignored the importance and effect of the people involved in implementation of these models; the teachers. Without an understanding of their beliefs and attitudes as well as the reality of their everyday lives in schools, it is not possible fully to understand how knowledge is made meaningful in classrooms.

How then is such an understanding to be gained? In the recent literature there is much discussion of the differences between qualitative and quantitative approaches, and of the validity of both as instruments of

research. Those who advocate the latter base their argument on two main threads - that statistics do not in fact create a truer picture than that created by qualitative data, and that descriptive, detailed study of specific situations can be at least as accurate in analysing the effectiveness and methods of teaching and learning (for example, Mehan, 1979, Eisner, 1985).

This study sets out to describe classroom life, and then to draw conclusions and offer suggestions from that description. It is the teacher who occupies pride of place, because it is she who makes decisions as to how the classroom should operate, and because too little time has been spent examining her beliefs and hopes, and the effect of these upon her classroom practice. Before outlining the research procedure it is valuable to review the key elements of her role.

Because learning is a process involving constant review, adaptation, modification, and restructuring of existing beliefs and information, the way in which it occurs is different for each individual. Part of the teacher's task is to be able to recognize the ways in which children may construct knowledge and the most effective methods to cause the conflict necessary for mistaken beliefs to be rejected and appropriate ones to be adopted.

It is also important that the teacher be a role model for the development of higher level thinking processes and the sophisticated language structures necessary for the forging of abstract thinking.

Mastery of content is seen as essential; empathy with children and understanding of learning processes is of little use without knowledge to share and awareness of the links between fragments of information that make these meaningful. Further, the content must be presented in a context that allows for connections to be made between previously acquired knowledge and new information, and between new information and that which is yet to be gained. Such connections are vital for matter to be meaningful.

There is general consensus about the above. Differences arise, however,

about whether or not teachers are able to carry out these functions and the most effective ways of so doing.

Stodolsky (1988) suggested that future research should involve interviews with teachers to obtain their views on why they teach each subject as they do. Indeed. Quality teaching is not just familiarity with content, but the very specialised and expert knowledge of how to make that content accessible and important to individual learners. Shulman (1987) calls this "pedagogical content knowledge" and argues that it is fundamental to recognition of teaching as a profession. Some such work has been described by Clark and Peterson (1986), including studies working with only one teacher, in which teachers' thought processes are examined.

Given that the teacher makes the management and organisational decisions in the classroom whatever the style of teaching chosen - in other words, to a significant extent constructs the classroom reality - it is appropriate to examine how teachers' thoughts influence the day-to-day operation of the classroom. It seems that until recently insufficient attention has been paid to the importance of and effect of teachers' attitudes and beliefs on their teaching.

If we could better understand the special qualities of the thinking revealed in the way teachers talk about their own work, researchers might be able to participate in a different sort of conversation with teachers about improving practice. Taking teachers' stories as evidence for their thinking about why they do what they do means developing new ideas about what "thinking" is and a different attitude towards teachers (Lampert, 1984, p.16).

## 2.0 WINDOWS TO THE CLASSROOM

How then can teachers themselves be effectively studied? Mehan (1979) argued that large-scale studies cannot capture the processes of education, and that correlational studies have even produced "contradictory interpretations of the same data" (Mehan, 1979, p.7). He pointed out that the static and remote nature of statistics is in complete contrast to the actuality of daily school life.

[...] answers to questions about the role of schooling in society will not come from large-scale comparisons between schools, but will come from

careful descriptions of what takes place inside schools. In order to understand the influence of schooling, we need research strategies that examine the living processes of education that occur within classrooms, on playgrounds, at home, and on the streets (Mehan, 1979, p.8).

This process - called by Mehan "constitutive ethnography" (Mehan, 1979, p.8) - has the further advantage of giving recognition to the work teachers already do and using it as the base on which to build further development. Teachers become frustrated at being constantly given yet another model "essential" for effective learning.

Many teachers express frustration with staff development programs aimed at exposure to still another teaching model, all too frequently focused on a small segment of research. In such efforts, the apparent underlying assumption is that staff will immediately absorb the research base and conceptual framework of whatever model is being presented and will be able

to integrate the new knowledge into their teaching repertoires (Arrendondo & Block, 1990, p.5).

Even with the greatest determination, it is practically impossible for teachers to remain up-to-date with the latest theoretical thinking, to implement and evaluate each of the new approaches, while at the same time coping with the daily demands of classroom life.

What else is to be learned from Chris Zajac? Above all, she is a pragmatist, with no apparent interest in esoteric learning theory, research design, or a well-constructed philosophy of education. The educational literature gets short shrift from Chris. While she occasionally casts about for new ideas, she seems only interested in those with immediate applicability for her classroom. Neither is she interested in pilot projects, in consciously fitting new methods into extant theoretical frameworks - or in considering philosophical ramifications of her decision.

[...] One can look long and hard to find any connection between Chris's school and the intellectual community or the education hierarchy. Rather, Chris's concerns are with misbehaving children [...] with parents [...] or with practical matters like aching feet [...] (Horton, 1990, p83)

Yet this is certainly not to suggest that teaching is a haphazard process or a profession that anyone can practise with equal adeptness. Nor is it to imply that teachers have no interest in improving their skills. Rather, it emphasizes the enormous pressures that act on teachers in the course of every day, and to insist that there must be much there already that is of value. Examination of the practice of competent teachers will not only assist learning theory but will also increase the status accorded the profession.

an argument for her position would seem to be more professional than one that cannot.... A teacher's thoughts about her beliefs, and in particular her arguments to defend these beliefs, become an important component in her professional activity (Orton, 1989, pp. 24-25).

How can such analysis be most effectively carried out? There are two key components to be examined.

1. The attitudes, beliefs, goals and explanations expressed by the teacher before and after the lessons.
2. The actual classroom events.

Putting these together may give some sense of how classrooms operate and why.

The challenges presented by the various but valid views of participants and observers, by the many levels at which interactions occur and the ways in which these may affect decision-making have been discussed in the literature review presented elsewhere. While it is felt that qualitative analysis and the close study of individuals that it invites, will create a more vivid picture than the more aloof data of the quantitative approach, it is felt also that the different aspects of school life to be explored require different structures for observations and discussion. To this end it is proposed to look more closely at the work of Mehan (1979), Shulman (1986, 1987) and Clark and Peterson (1986).

### 2.1. Mehan

Mehan looked at what happens in a single primary classroom from an anthropological/ethnological perspective. He was searching for a way to

describe the interactions between students and teachers that would explain their separate understandings. He wanted also to find a method that would "serve as a vocabulary for participants themselves to articulate their own tacit knowledge, thereby making the implicit explicit, the invisible visible" (Mehan, 1979, p176).

The result is a set of structures to which, it is argued, all classroom interactions can be reduced. His belief is that these units are the core of what he described as "recursive rules (which) "are analogous to a grammar" (Mehan, 1979, p.75) and so can be used to describe classroom events. According to Mehan, a lesson can be divided into three phases; the opening, the instructional and the closing phases. Within each phase there are certain kinds of interactions.

The opening and closing phases are images of one another, and contain "directive" and "informative" sequences (Mehan, 1979, p 72). It is in the instructional phase that the exchange of academic information occurs, and these elicitations can be divided into four categories, each of which seeks specific information. These are:

- \* choice elicitations;
- \* product elicitations;
- \* process elicitations; and
- \* metaprocess elicitations (see Mehan, 1979, pp 43-44).

Mehan argued that an interaction will be extended until an appropriate response is received, and that these sequences themselves are organised into larger units, called by him "topically related sets" (Mehan, 1979, p.65).

Mehan argued that if the teacher, on reading his work, reacted by saying "So what?", this is a compliment because it proves that the representation is an accurate one. However, while it may be true that part of illumination is to articulate what "oft was thought but ne'er so well expressed", nonetheless a more detailed consideration of the thinking that lies behind the teacher's decision making is needed, if its complexity is to be acknowledged. Further, he looked only at what happened during lessons, not at the events before and after and the participants' perceptions of and explanation of what occurred. In his view, if such factors are important, their effects will be located in the visible interaction.

Mehan's work, like other observation rating scales, may indeed serve to provide a model for the way in which lessons are broken into phases, and to describe the sequence of interactions that can occur between the participants in classroom discourse, the teacher and the students. Yet this is not the whole story. There is something unsatisfying about a description without an explanation. To understand the meaning as well as the organisation of teaching and learning, further data are needed. The less neatly categorisable and considerably more murky world of teachers' thinking and decision-making must be entered.

## 2.2. Clark and Peterson

Clark and Peterson (1986) suggested a model to describe teachers' thoughts and actions and the way in which these interact. This model is important in two major ways. Firstly, it emphasizes that all classroom events -

visible and invisible, and involving both teacher and students - affect one another in a circular rather than linear manner. Secondly, it divides teachers' thinking into three categories - planning, decisions and beliefs - and acknowledges that these must be examined before and after the lessons as well as during them. Clark and Peterson argued that their model is of use primarily as an heuristic device - of particular assistance in understanding the associated literature (Clark & Peterson, 1986, p.256). To understand what it is that expert teachers do, it is necessary to find a way to describe classroom events, not just in the sense of their structure, as Mehan's work has done, but in a way that can draw from apparently one-off events - the detailed script of a lesson or small group of lessons - the general skills that teachers apply almost unconsciously. If this knowledge can be better articulated, it will help both in the debate about methods of teacher appraisal and in the training of novice teachers. The work of Shulman (1986, 1987), in exploring the nature of teacher knowledge, adds a structure to record with accuracy and depth the levels and complexity of teachers' thinking and actions both within the classroom and in preparation for it.

### 2.3. Shulman

Shulman differentiated between kinds of teacher knowledge, in an attempt to define what it is that makes the knowledge of a teacher different from that of a subject specialist - in other words, to find what kind of knowledge it is that makes teaching a profession. For too long this specialised

knowledge - "the wisdom of practice" (Shulman, 1987, p.11) - has remained implicit rather than explicit, with the result not only that the expertise of teachers has been insufficiently recognised, but also that teachers themselves have been deprived of any systematic access to the knowledge of their peers.

He argued (Shulman, 1987) that there are at least seven categories under which teachers' knowledge could be categorised. (For later purposes the categories have been numbered and their order altered).

1. Content knowledge.

2. General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter.

3. Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers.

4. Knowledge of learners and their characteristics.

5. Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and

6. Knowledge of educational ends, purposes and values, and their philosophical and historical grounds.

7. Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special

understanding (adapted from Shulman, 1987, p. 8).

While these categories can be seen to apply both to teachers' behaviour in the classroom and to their planning, it is not a simple matter to distinguish cleanly between them at all times. Indeed, it appears that pedagogical content knowledge encompasses the other categories, and that the value of the different labels is to distinguish between the various kinds of knowledge the teacher must make use of in the course of a lesson and often in the course of a single statement or question. The categories allow meaningful articulation of the many aspects of teachers' work, and so may help both researchers and, importantly, practitioners, to define what is they do.

The model for pedagogical reasoning and action which Shulman outlines in his article (Shulman, 1987, p.15), enlarges on the kinds of activities that teaching involves.

#### COMPREHENSION

Of purposes, subject matter structures, ideas within and outside the discipline

#### TRANSFORMATION

Preparation: critical interpretation and analysis of texts, structuring and segmenting, development of a curricular repertoire, and clarification of purposes

Representation: use of representational repertoire which includes analogies, metaphors, examples, demonstrations, explanations and so forth

Selection: choice from among an instructional repertoire which includes modes of teaching, organizing, managing and arranging

Adaptation and Tailoring to Student Characteristics: consideration of conceptions, preconceptions, misconceptions and difficulties, language, culture, and motivations, social class, gender, age, ability, aptitude, interests, self concepts, and attention

#### INSTRUCTION

Management, presentations, interactions, group work, discipline, humor, questioning, and other aspects of active teaching, discovery or inquiry instruction, and the observable forms of classroom teaching

#### EVALUATION

Checking for student understanding during interactive teaching

Testing student understanding at the end of lessons or units

Evaluating one's own performance, and adjusting for experiences

#### REFLECTION

Reviewing, reconstructing, reenacting and critically analyzing one's own and the class's performance, and grounding explanations in evidence

#### NEW COMPREHENSIONS

Of purposes, subject matter, students, teaching and self

Consolidation of new understandings, and learnings from experience

(Shulman, 1987, p.15)

These categories may provide a means to do what the work of Mehan (1979) and others could not. Together with the model, which is implicit in the discussion which follows, attention can be focussed not only on the nature of classroom interactions but also on the reasons for them, not only on the visible actions and interactions but also on the way in which decisions are

made. Thus a base is provided from which to attempt an accurate description and discussion of how subject matter becomes meaningful in the reality of

the day-to-day classroom.

### 3.0. THE STUDY

The purpose of this study is to take on Shulman's challenge of defining the "wisdom of practice" in an attempt to capture the knowledge that is the essence of the teaching profession. The aim is to see if Shulman's categories and the language of his model can be applied to observable behaviour in the classroom; to explore whether the terms can help to examine how teachers make decisions and how their knowledge and beliefs affect their teaching of subject matter. The study will focus on teachers at the upper levels of primary school, teaching lessons of Mathematics and Language .

The overriding question of this study is expressed then in Shulman's own terms - how is pedagogical content knowledge to be articulated?

The attempt here is to use a number of kinds of information to "thicken" the picture. As has been argued earlier, observers arriving in the classroom simply to code what happens, lack knowledge vital to make valid judgements - they lack context. It is proposed here to use a combination of interview, field notes and videotapes of certain lessons in the attempt to gain this understanding.

The question then arises of how to present these data. This has been a matter for considerable deliberation. Constructivism and its relations in various disciplines and under various names have caused questions to be asked about appropriate writing styles, and have certainly eroded the validity - indeed the possibility - of the so-called objective stand. Even in the ordering of data there is a problem. Should the transcripts be presented first, before a discussion of the teacher's beliefs and plans, so that they can be viewed without the shading caused by knowledge of the teacher's intentions? Or do the intentions provide a context without which the transcripts are stripped of one vital level of their meaning? What is the place of an apparently impersonal description of the classroom itself, which of course is not impersonal at all but the view of the observer? And how should the transcripts be presented? Should segments be selected to illustrate the teacher's expressed beliefs? Or the observer's (perhaps less explicit) hypotheses? If the transcripts are merely displayed, what can be gained from them?

It has been decided therefore to try to capture the elusive "truth" of classroom life by approaching it in different ways - by setting different ways of seeing side by side. Some order must be chosen, so let it be from what was once called fiction to what was once clearly fact. Increasingly the language of story is entering research. (See for example Bruner(1986) and Eisner(1985)).

The beginning of the day as I saw it therefore opens the next section, followed by the teacher's own description of her routine. They demonstrate thus two perspectives of the same reality.

A description of the teacher herself is next. An excerpt from the ten hours of audiotapes is presented first without comment - Linda introduces

herself, talking about her own beliefs and about the lessons that will be taped. And with this the challenge begins.

For descriptions and transcripts, vital material though they be, will be seen by readers in the context of their own individual experiences - and therefore will be understood in a myriad of ways. If we are to glean wisdom from the practice of experts, it becomes necessary to be able to generalise from specific experience. To do that, - to ensure that we are talking about the same things - it is necessary to find a language that can categorise while still maintaining a broad picture, a common vocabulary that will minimise misunderstandings.

My intention is to see whether the categories Shulman has developed provide a means with which to articulate Linda's teaching style - to link what she says about herself and her teaching to her practice.

As with the problems in presentation of data discussed above, I have wrestled also with how fairly to select segments from the transcripts. The temptation is to present the whole, as anything less is of course a significant weakening of the context that gives understanding. But constraints of space do not permit such indulgence, and the purpose of this paper is to focus on the usefulness of Shulman's categories as an aid to description. If they prove a useful tool, the full study will utilise them

in an attempt to convey the complexity of classroom life.

Therefore selections from the taped lessons have been chosen on the basis that they represent a range of the kinds of activities that took place in this classroom. Columns have been used so that selections from the interviews, Shulman's categories and my own explanatory comments can be presented side by side. It is hoped that from these multiple perspectives some sense of the layers of reality has been captured. For the purposes of this paper and the restrictions of time and space, it has been decided to make use only of a single lesson of Mathematics.

### 3.1. The classroom.

Mrs King opens the classroom door at 8.35 am. Lessons don't begin until 8.50 or 9.00, but many of the children are already waiting outside. She puts her bag and books on her desk and writes the new day on the board - Monday, August 5th, 1991. Kids enter, unpacking their books and pens from their bags.

- How was the party, Elizabeth? Bet no-one got any sleep! You're all going to be useless today, I can see that! And Sovereign Hill? ... And how are you, Harriet? Better than last week? Or still a bit pale? ... Anna! You look tired too! And Christina! I can imagine you talked all night!

Kids giggle and shuffle, exchanging glances. There's little time for response, but none is really required; an atmosphere of family is being recreated after a weekend away from it all. Mrs K. disappears to the staffroom to check the "daybook" for alterations to the day's schedule. It is interesting that Linda's own description of the beginning of the day, given in the interview conducted prior to my visit to the school (p.70), does not refer at all to dealing with pastoral matters or establishing a positive personal relationship with the students. She mentions only the

need to deal with organizational, routine matters before the real teaching of the day can commence (See Stodolsky (1988)). Further discussion with her might have revealed whether this behaviour, which I saw as a major part of her teaching style, is so ingrained she is not aware of it, or whether she did not consider it something I would be interested in hearing about. Now, how will I describe a typical day? Well, I'm not good at getting up, so I'm usually rushing, not late but usually between 8.30 -8.40 a.m. I manage to get in there. In the summer it's easier. You open the door and they all pour in and immediately rush to the desk, before you've even got your handbag down, about this homework or "I didn't do this". I don't go to the staffroom first. I go and open the classroom and let the girls in and put the heater on. ... So straight in. The kids get unpacked. Now Monday and Friday we have assembly so you get them ready. Make sure they've got everything, tucklunches in, anything else that has to be collected, this pile here, this pile there. You're sort of full of orders. My husband always says to me "Stop treating me like I'm one of the children". It's very hard when you're doing it all day to sort of come out of that mode. Especially as you know, sometimes husbands need to be treated like children. Anyway. it's just the way you are and you just sort of become reasonably efficient with the children, so you sort of transfer that to your life. Then we might go on with ... it depends on the timetable for the day (A/70)

### 3.2 Linda: beliefs and practice

L: Now the discussion was a bit slow at first; then they came out with - as I said - the expected sort of things about because of our sort of school and the way that we promote learning that it's necessary to have all these skills to be able to get a better job - like it's, you know, the golden egg at the end of the rainbow. I - I was trying in what I was saying to them - trying to get them to - which I don't think I did very successfully - to realise that once they have skills and learning then it doesn't matter if they don't get into law; it doesn't matter. They've got all those skills and then they will be able to do something else with it and I should have gone on with that but then I - I sort of got a bit sidetracked. Because that's my whole idea. I read a book or some notes once about this Gestalt approach to learning and I think that that to me is what education is all about. If you haven't got the rounded person then how can you have anybody in any profession working well with people who have other ideas

than you. I mean you may be a marvellous mathematician but that is not life. I mean you can't operate in your little world all by yourself and especially if you're connected with other people or you're working. If you're working with children or with adults, you have to allow for their views and their likes and dislikes. It's very hard to say "Well, I'm sorry, no - Maths is the only answer."

[So] I try to give them the - build up the kids that are feeling insecure in things, to get them to be able to speak, to be able to read, to enjoy reading, to want to do it for the love of it and to have fun with it so that it's not all hard work. But also I think they have to know that there

are limits. That you have to, if you want to do something you have to work at it and that's not easy. And it's not always easy. That's why I always bring in the examples of sport and dancing of course as I've done it. [...] That it is the same that whatever you want you have to work for. But you've got to have basic skills (D/25-26)

And I do think that sometimes we are giving our kids too much choice in the way they learn today. You know, I've got a couple who blatantly say that they hate school, don't want to know anything about it and they don't work and they just fiddle around and do this, that and the other. [...] But it's the attitude that worries me. This anti-work attitude. [...] I don't know whether I'm very good at handling those kids. Because I've always been such a worker. I don't understand that attitude (A/27-31)

Linda has been a primary teacher at the same school for fourteen years. She became a teacher after time as a dancer in the early days of television and after a couple of years at home with a small child. She returned to study after the break-up of her marriage.

Concern for the physical and mental health of the children in her charge is a driving force in her planning and is apparent in her way of dealing with children in the classroom. That is not to say that she is unaware of or rejects the current theories about teaching and learning; indeed, she attends many inservices and actively tries out what she has learned. It is just that (and this is said with no negative implication whatsoever) in spite of genuine concerns about her own inadequacies as a teacher, she believes that while research may be right about how children learn, her own knowledge is more precise in knowing what they need.

L: There's been a lot of sessions and a lot of inservices and a lot of books I've read lately on planning and how you should do this and that. But it all boils down to how you are. I mean, I noticed in your book when you talk about gifted children, it's a gut feeling. I think teaching is a bit like that. I think you have to do what you feel right with. Now, I know when I read a lot of these books I say, "Oh Linda, you don't do this and you don't do that". But no matter how many times I tell myself that over fourteen years, I still haven't changed.

This conflict between theory and the "wisdom of practice" (Shulman, 1987, p.11) is apparent in Linda's discussion of her Mathematics teaching, an area in which she has less confidence than in Language.

L: I don't enjoy Maths very much, although I think I'm getting better at it. I'm doing a lot of problem solving and I've found some great books with really stimulating stuff in. .... We do calculator games. They're quite fun. ... But I feel, sometimes, I really do give them the Rigby book, open at page 27 and do this and I'll explain that.

I: And is that bad?

L: Well, I guess I've been made to feel that it's bad by all these new ideas that are around. I really don't think that it's bad. I think that it's probably quite good nitty gritty stuff. (A/66)

The evidence of the taped lessons suggest that Linda is being overcritical of her performance. It would be more accurate to say that when she is

convinced of the need for change in methods, she does incorporate what she learns from inservices. But she does not necessarily throw out the old methods; the two may exist side by side, as with her teaching of spelling, or they may modify one another, as with the alterations she makes in her ways of using traditional textbooks. Note also in the following comments that the views of parents and of people looking into the classroom also have some influence on classroom practice.

L: And you see this is why I'm very bad at getting through Rigby because I get bored with it. I get bored with "Take out Rigby. Open to page 66. Let's discuss this. Let's do that. Yet there is some terrific stuff in Rigby. [...]

But I think also this sort of Maths has come about by me reading and I understand how boring it can be just to do sums all the time and to learn - you know, like we'll do percentages, we'll do decimals, we'll do multiplication of decimals, we'll do division of decimals, we'll do all of that until - you know, you're so sick and bored with them. So it's nice to intersperse.

So that's why this week, this program that I've got is how I would like to work with Maths all the time now. But it's taken me all this time to get around to it. So I need to do a learning one like percentage. You've still got to have your problem solving and your quick questionin and your table things. You've got to have some sort of homework and it's got to be structured so that they don't get into trouble with it at home. You cannot send thought provoking homework because then they don't know what to do with it. They try to discuss it with their parents and then the parents come up to you and say "What is all this nonsense they're doing for homework?" "She can't do it because it's not black and white" The parents at this school seem to look for homework that is black and white so that's another reason why Reading Between the Lines is nice for homework because the parents can understand it.

So. So I'm really very happy with what I've done for this week's planning for Maths. I think it's interesting. I think I'm covering areas that need to be covered. I'm also experimenting with some newer stuff which I've learned from CIMIC and reading those books over the holidays.

I: I think it's great that you're doing it while I'm here.

L: Well, isn't it silly? It's like a dinner party. When I have a dinner party, what do I do? Always try a new recipe. I never do the safe thing.

I: Well, it's very courageous.

L: And yet for me, to go into all fo this new stuff I am much, much braver this year than I've ever been before. Because I really - I guess I felt inadequate about how I was going to tackle it and I've always been worried about the result - what comes out of it. Have we got a wall hanging to put up? Have we got something for the wndows? Have we got something in a book so that if somebody asks me what I have done ther it is. I mean that sort of thinking has to go out a bit. Cause you don't always need to have something written down. As long as you know that the children have participated in it and there's something that's gone in - they've internalised it (D31-32\_)

Indeed it may be that because of her insecurity about her Maths ability, she is more open to new methods. For instance, the transcripts demonstrate clearly her readiness to focus on students' method of solving problems rather than simply on getting the correct answer, which is one of the key changes in recent Mathematics teaching.

It should also be said that both in class and in the staffroom Linda has a role as peacemaker. The transcripts show how her concern for her students extends beyond whether or not they have mastered content to awareness of their physical wellbeing, knowledge of their family situation, interest in their activities outside school hours and recognition of the way their peer groups operate and the effects of these.

### 3.3 Planning and preparation

My presence in the classroom and the discussions we had before, during and after the units meant that planning was much more explicit than it would normally have been. This does not render the results invalid, however. The demands of the school day do not mean that planning and preparation do not take place, but that the more experienced one becomes, the more automatic and implicit are these processes. As Shulman (1987) argues, this is a loss of the valuable learning which comes from reflection and self-evaluation, not only to the teacher herself, but also to other, less expert teachers. One of the advantages of the research procedure adopted here is the opportunity offered the participating teacher to spend time reflecting and articulating practices. It is to be hoped that this benefits not only the researcher but also the teacher and perhaps those with whom she works. Linda's notes for the taped Maths session, written in the Teacher's Chronicle diary which is the planning book for many teachers, reads as follows.

123MATHS

\*Mastermind

\*Colour M/mind

\*Hrunkla Village "What is Maths?" (Brainstorm -list on C/B)

-Then discuss the idea of a Maths project (indir.) What can you do? Each girl produce a page for a book!

Most experienced teachers would be able to follow such a plan - it would be adequate, for instance, for an emergency teacher to take over should Linda be absent. It is highly likely, however, that while the material might be covered, the method would be different, and a novice teacher would have little idea from these notes how to proceed. Yet in fact a considerable amount of thought has gone into the idea of the lesson, as the audiotapes demonstrate.

As I have said already, Linda does not view herself as particularly skilled at Mathematics. It is interesting to speculate whether this affects her planning and teaching, and in what ways.

CAT

NO.MY COMMENTSTRANSSCRIPT OF INTERVIEW

1

2The ones that can't sing that are left in the class, I'll do a read ... or a language thing or often do a story, something like that with them so they get that little bit of extra language work because that's my forte. I find Maths the difficult area and I don't feel as comfortable with maths. I don't know what it is. I just don't feel that I'm stimulating enough with it or it gets very boring. [...] I just don't have much confidence in myself with Maths. That's why I've read all these books over the holiday.

7Here Linda distinguishes between the knowledge of subject matter and the knowledge of how to teach. I wasn't good at Maths at school. And I think it's a real throw back. [...] I have learned much more about teaching since I've been out than I did in college [...]

2/1

(The effect this has on my teaching is that) I try to be so fair, I try to get kids to understand and sometimes when you've done it three ways and they're still looking at you blankly you think, what the hell do I do now. You think, how can you not understand it. An old teacher said to me many years ago when I started at (this school), she said if you try to get them to understand, you explain it, you go through all the processes and the various methods of trying but in the end they're still looking blankly, teach ... Eventually they'll come to understand. (A/27-29)

The following extract is taken from the interview which took place several weeks before my visit to the school.

3/6Here it can be seen that Linda is willing to try new methods and indeed spent part of her holiday I am trying - I'm going to try a new thing - some Maths projects, this term. I've just read a book on it which is quite inspiring, [...] 2/1 reading textbooks. The theory provides inspiration, but in thinking about the lesson, other matters have importance. But what I thought I'd do, Julie, and I don't know if this will work for you, is that I'll do an introductory sort of, you know, a warm-up session with some games and calculator games and stuff like that, whatever. Then I may do a teaching unit. I don't know where I'll be up to (A/21-22).

In the interview which took place during the week of the taped lesson, Linda outlined in very precise detail how the lesson would operate and why. It is clear that she has thought out both content and method at some length, and that while she has made use of textbooks for ideas, she has made modifications to them and in so doing entered into a kind of debate with the textbook writers.

1/2Content and method fairly specifically outlined here. Tomorrow morning what I've got planned for you is that we're going to do a little bit of Master - I'll do a Mastermind on the board with four digits. Then I'm going to do a colour Mastermind with four colours. We've only done it with three - [...] and once again it's what you know and you've got to keep relating back to the material you know.

The key ideas which unify the various activities are identified. Then it

goes on to what we call the Hrunkla village [...] There's a whole story here [...] and they have to work it out. [...] I've put on a little bit out of the book because it's re-state the problem. clarify the question, include the hidden question. So they've got to look at this sort of format and this is how it helps them to 1

2

In this exercise the content is the processes. answer. Also the fact that we've done lots of Mastermind [...] It's the same sort of thought process. That you need to organise the information. You get rid of the unneeded information, find the needed and assumed information and then check the solution to the problem; then evaluate and rethink the methods where necessary.

4

2/3

1 Awareness of student needs encompasses knowledge of how to transform material so that it can be understood as well as awareness of the amount of time activities are likely to take.

I need to go through that with them a bit. It's a bit high-falutin language. They won't really understand it but some might get it. [...] So that will probably take, I've allowed probably half an hour for all of that, all right. Then I wanted to go on, because we've got three periods, so then we've got an hour and I was going to start off with - this is an idea from the Maths project book which I've been trying to get to since I read it over the holidays. So I thought I'd start it with you.

4/2/1

4/2

Knowledge of the students allows her to anticipate their responses and therefore plan appropriate strategies.

Awareness here of where difficulties are likely to arise and how to deal with them.

The reactions were just as she said they would be, but the flow charts did no eventuate.

First of all it's "What is Maths?" - we brainstorm. I'm going to ask the girls and put it all up on the chalkboard, exactly what is Maths. So hopefully they'll come up with things like calculators, fractions, decimals, shapes, sizes, all those sorts of words ... Then, from there, I want to discuss [...] the idea of doing a Maths project, at which we'll probably get a huge "Ohhh!!" because they won't fancy that, and then I need to have - they need to have, some idea of what to do. So what I'll probably do is I can show them, yeah, I might need to show them how to plan a unit. So I might put up a flow chart of say money or time - because time is bound to be up there as part of "What is Maths". So then we'll take one of those out and then we'll do a flow chart to see what areas they can actually go and investigate to make a project on time ore money or area or shapes or whatever. So then each girl is going to do at least one page, preferably two pages, to put together into a Maths book. So this is going to be a Maths project from the whole class[...]7Knowledge of strategies combined with practical experience.

Now I've made them individual because there'll be too much noise if they start to do them in pairs or even in fours becuae you inevitably get one doing all the work and the others sitting by having a lovely time or being annoying or something. So I think I'll make them all do something.

[...]1/2/7

Here the textbook is acknowledged but adapted. Her goals are different. Now the book suggests that we have lots of resources and things ready. I'm not going to have too many. I really would like them to try and do it from what they know ,or they have to actually go and find the resources. I don't want to make it sort of so easy for them. [...] I really want them to put it in their own words and that's the emphasis.[...]4/2Experience teaches that plans are never infallible. Therefore the ending of the session is left flexible.

So that time will just go. I mean if it goes well it will be fine - we'll well and truly go over time. If they don't fire then it will be a bit deadly but they might have time actually to start their project - it just depends. (C/51-55)

#### 3.4. The Lessons

While one of the aims of my full study is to compare Maths and Language lessons, space does not permit that to be done here. Instead I have decided to focus on the first Maths session and to see whether or not Shulman's categories of knowledge are of assistance in framing the discussion. To attempt to present the layers of explanation simultaneously, I have made

use of four columns. In the first is the numbered category based on Shulman's proposed kinds of knowledge. In the second I comment on the transcript, informed by my own viewing of the classroom, my field notes, my awareness of the categorisation system and my knowledge of the interviews. The third column contains extracts from the interviews with Linda, some recorded before the unit, some while watching the video, and some at the conclusion of the week. The fourth column contains the transcript of the

videotape.

The session divides into six episodes, which have been summarised below. They vary considerably in length, according to the flow of the lesson. Sections have been chosen to be representative of types of interactions and decisions rather than of quantity. For instance, Episodes B and C have much in common both in style and substance, and a fragment of Episode D gives a sense of the remainder. The need to make selections becomes most frustrating in Episode F, where the detail itself is fascinating as an example of the way in which pastoral and content can intertwine. More will be presented in the full study.

A. Preparatory. Brief activity to "energise" the class and bring them together as a working unit.

B. Mathematical game 1 "Guess the number" - whole class activity, blackboard.

C. Mathematical game 2 "Coloured squares" - whole class activity, blackboard.

D. Problem Solving: "Hrunkla Village" - small groups, written problem.

E. Discussion on use of folders and exercise books - whole class.

F. What is Maths? - discussion with whole class leading to individual selection of project topics.

While there is interesting material in all episodes

Episode A - Preparatory.

Before the subject matter of a lesson can even be broached, the atmosphere must be conducive to learning. Teachers develop techniques to create appropriate moods.

CAT

NO.MY COMMENTS  
LIINDA'S COMMENT  
TRANSCRIPT OF LESSON  
A positive attitude within the classroom group is Lesson begins with kids doing exercises - shaking arms, legs etc. Lots of laughter etc. 2/4 important to this teacher. Sensing that the children T: Shake your hands, shake your fingers, shake hands with the person next to you, say good morning. are less than alert Ss: Good morning, good morning. she postpones momentarily the commencement of the lesson proper. As soon as the atmosphere is lively - but before it is out of control - she rushes straight into the first activity. T: Clap your hands, right, sit down

So in the first part of what is itself an introductory segment, we see a combination of kinds of knowledge - general pedagogical knowledge (classroom management) [2] and an awareness of the learners as a group [4] which enables her to recognize readiness to proceed.

Episode B. Mathematical game 1 "Guess the number" and Episode C. Mathematical game 2 "Coloured squares"

Episodes B and C are games involving mathematical squares. The link between each of these and the written problem which follows them is the need to be able to recognise information that is helpful to solving the problem and to discard that which is not.

It is thus not a simple matter to distinguish between content and process - at times, the content is the method. For instance, in the following extract, instead of looking only for the correct answer, she is interested in the reasoning behind particular responses.

CAT

NO.MY COMMENTS  
LINDA'S COMMENT  
TRANSCRIPT  
1 Knowledge of content is inherent - (Afterwards) That was good. They were starting, T: (smiling) Now Sophie, how did you - why did you guess nine?  
2 knowledge of I think the majority of them  
S: Because, um ... um... appropriate strategies and to actually use the material that's there - the  
T: (juggling chalk, smiling in an encouraging way) Just a guess?  
4 familiarity with the knowledge they've found  
S: Yes. students are the governing factors. It may be that Sophie is out, and use it wisely. Sophie did admit - and I knew it was a guess - that  
T: You did

just guess. Were you quite sure that it was the s.. you weren't sure ... which digit weren't you sure of?  
chosen because she she finally got that last  
S: Um.. is reasonably articulate, or because she provides one. It was just one digit. Well, when you've only got 3 and 3 there's only one  
T: (pointing to second last number guessed) From this number. We knew that there were three right ... a kind of "meter" - digit - and they just had  
S: The 8. if she has understood, then it is reasonable to decide which digit they'd try with so I suppose there was a certain amount of  
T: The 8. You weren't sure about the 8. (pointing to board) So you thought the seven was correct  
assume that most reasoning in there (D/12)  
S: Yes others have also.  
T: But you changed that one. (this exchange happens fast, almost as one continuous speech from T)  
S: Mmm  $1+2+3=7$   
Pedagogical content knowledge - wisdom of practice - composed of content, pedagogical knowledge and curriculum knowledge  
T: Mmm (an examining kind of look) Who, when they got to that number (6785) was fairly sure that we'd got the six and the eight and the five? (0322) (some hands up) (pauses, looks around) All right (a thinking tone) - we weren't too sure about that one (pointing to the 7)  
All right, not a bad game (Pilot Maths 1 p4) all blended together. She assesses how well content has been mastered by checking the process used, and makes her thinking explicit.

In the following exchange the difficulty of accurate categorisation is evident. The teacher's comments check for understanding [1], serve a pastoral purpose [4], and move the activity along [2/3] - all at the same time. The ability to use this kind of knowledge of individual learners [4] combined with appropriate strategies [2] must surely be amongst the most important characteristics of successful teachers.

1/2 This serves both to clarify the issues and to provide some direction.  
T: Let's see, well, let's just see. Everyone agrees with that. All right. Have we got enough information now to go on, or do we need to have a - ask for more information? (s murmuring) Anna?  
A: (quite a long pause then XXX)  
T: What's in the first column. (writes above it and adds to the number of questions they've asked) OK. Brigid?  
B: The first column - it's - after the first blue there's another blue ... then another blue  
T: Do you all agree? A blue there?  
Linda allows a  
S: Yes certain amount of  
T: And? (0781)  
student debate  
B: And then ... another blue  
4/2/1 here without intervention. This allows her to determine the extent of their understanding and also gives students time to solve it themselves.  
S (various) Then blue blue.. No, but .. It has

to be because etc. It still couldn't work. It could be yellow. Yeah, and then it works out. And then a yellow at the bottom. Where? Yeah, there, a yellow at the bottom. (While students discuss T remains still at board) T: What do you think Helga?

4/2 Superficially, this H: Yellow down the bottom. question to Helga is no different from T: Yellow down the bottom. Do you all agree that that's a yellow? questions to any Ss: Yes. 1 other child. But Helga is an ESL student and neither academically strong nor an active T: Hands up those who don't agree. So do you want me to put the yellow in there? (Ss: Yes) All right. OK I'll put the yellow in there. All right. All right. Now. Where can we go from there? Jude? participant; the J: In the fourth column teacher knew from T: In the fourth column (pointing) the student J: going down discussion that she T: Yes, go down - where? had the right answer J: Um (wiggles) and therefore asked her to present it. T: Oh, you want to know what's in the fourth column? J: Mmmm 1/4/3/2 Certainly this is a leading question, but it serves a similar purpose to much of the above passage; questions and comments that check for understanding while at the same time moving the activity along.

If I hadn't stopped them they would have kept asking questions. I realised I had to point it out - OK that's your third question, now come on, can you make sense of it? So I sort of bullied them in to it. But then I s'pose they're still learning (D/12) T: Does everyone want to ask that question yet?

Ss: No

T: Hang on Jude. You're up to four questions - so just see if you can work any more out without asking questions first. (PM1 p.8)

It can be seen from the above discussion that the matter of content is far

from simple - often the content is process, and, more importantly, it is not a straightforward matter to distinguish between pastoral, procedural and subject concerns. It could even be argued that part of the teacher's skill is to interweave each aspect into the other almost seamlessly, without however ignoring any.

This can be seen in the summing up of this activity, where attention is drawn to the key issues. Linda's concern for the affective needs of her students [4] is apparent in the amount of positive feedback she gives - but this certainly does not mean that content is neglected.

4/2

1

4 Praise is given, the activity is summarised and thus the specific content is emphasised. T: And red. Well that's not bad. Good effort. Four questions really and a lot of discussion. If you were doing that in your group of course you could discuss that a little more. But you can

gradually see - because of the rules, because you know you can't go this way (pointing) and you have to join with a face on and you've got four colours, there are certain ways of organising the colours. So well done - I'm quite pleased with that - all effort was very good. In the book they did it in three so you're only one behind. That's a very good effort (P.M.1 p.10).

In linking the completed activity to the next one, the teacher focusses several times on the process which is presumably a major objective of both exercises - "you've got to work on the information you've got." Again perhaps unconsciously, she ties the exercises together by referring back to the earlier one and forward to the next one [1 and 2].

Episode D. Problem Solving: "Hrunkla Village" - small groups, written problem.

2/3

4/2

I'm sort of really trying to push with the groups of four and I really have noticed an incredible difference this term. I mean I know Biddie had her worries yesterday with Pamela and there'll be a few things like that always. But they're much more enthused about working and the four really does work because they're not all shouting over each other, there's not somebody being Now, I'm going to give you a written problem. (0987) [Assorted oh nos) Now this is the same sort of thing - you've got to work on the information you've got. So don't go thinking "ohoh oh I can't work this out" - think about it. Now you can work into your groups - um sorry Julie I'll use that red table, so can we have the six groups please. So Pamela and Brigid, and Brigid and Judy go to the red table. Just move the case off for Mrs Landvogt and move the table over this way a bit so you can get the XXX in.boss. The four of them seem to share it quite well. This group is slow and that group over there are a bit slow too because Christina is clever but she's a bit intimidated by Carol I think. And Bec is also - I've still got that problem over there because I don't know where to put Bec (D22-23) .1/2

3

4/2

It is worth noting how Linda's concern for her students is used to

establish both awareness of individuals on a pastoral level and as a disciplinary strategy.

In the audiotape discussing the lesson later, Linda commented "When I said 'Mastermind' today I noticed that a few of them pulled faces particularly Nancy and Nan over there and Rebecca was half asleep.[...] They both don't like school much and I don't think they like thinking and yet once they get into it - I mean that table then was the quickest." (D/13)

It's called the Herunkla village (pause) and it's a story about some very peculiarly named people and a space trip. At the bottom of the sheet, I've got something to help you work out the problem. Now it's in quite complicated language so when you've got the sheet I'll actually read it through with you. But I don't want you to forget what we've just done (handing out sheets); we've just done Mindstretchers - uh - sorry, Mastermind - and we've also just done the colourcode and we've got to work on what information - will you put your cuffs up and wake up - are you not well this morning (to Rebecca) - are you tired? What's hurting? [R: No] Anything hurting? You're just a tired person. Well, wake up please, we need to be wide awake this morning. OK. (moving around class) You're tired too? You're hot? Some people are cold and some are hot, we can't win can we? OK have a read girls and see how you go.

3/1 Most of the clarification that follows is provided by the teacher. Later she moves around the class to check on understanding.

Recall that in planning this lesson Linda had said "I need to go through that with them a bit. It's a bit high-falutin language. They won't really

understand it but some might get it.[...] So that will probably take, I've allowed probably half an hour for OK (moving towards the front of class, voice back to teaching level) First of all just look the bottom bit before you read the story and I'll see if I can try to put it into your language - it's a little bit difficult. Oh no, I haven't got one for my - I need one for myself - oh, there's one here. Right. At the bottom I've got "restate the problem" Who can tell me in their words what they think I mean by that - restate the problem? Liz? Liz: all of that, all right. (C/53) "E: Like chop out all the words you don't need T: Good girl E: and XXX

Often the check for understanding involves repetition of the student's response, perhaps to T: That's right. So restate the problem - find out what the problem exactly is because sometimes in a problem there's a whole lot of -er- information that you may not need. Clarify the question and in brackets it's got "includes the hidden question". What could that possibly mean? Soph? clarify and perhaps S: There's a question XXXX4/3/1 to ensure that all have heard.

T: Good girl. There's a question in there that's not obvious. So you have

to think "Aha, hang on, there's something in there hidden, I've got to keep that in the back of my mind too while I'm reading." (Clarification of problem continues and students begin work).

T: I've got one group with an answer. Ss (assorted): We have too. As some students complete the problem, the teacher T: Alright, shush - keep it to yourself. Has your group got an answer? (Ss: XXX) All right, keep going. (more working noise) 2 checks on the progress of all the groups without giving any indication of what the correct solution is.

Linda commented "Isn't it funny how the-my top groups as I would put it - had more difficulty with this. Perhaps [...] they're looking for the more difficult method. Whereas the girls who are not so clever at it [...] were really very quick, that table that I don't consider to be very 1562 (to Anna) I don't know what the answer is - I can't tell you whether you're right or wrong. XXXX Just stay with your group. (To whole class) If you've got answer in your group, then just stay with that until we sort of work it out. I've got three groups with answers now - how many more? (looking around class) Yeah I know, that's all one group. Elizabeth and Ali, have you worked it out yet? lateral thinkers. Perhaps Ss: Yes

1/2 Note the reminder here of procedure - cooperative learning - which is one of the main goals of this lesson. they didn't analyse the unneeded information so much and the other kids were really analysing each one out (D/21)". T: You've got an answer. Brigid and Judy group - no answer yet? And Helga and XXXX (Chat and laughter - can't catch the words) Have you worked it out Nancy? You're XXXX what they're doing? Why don't you work it through together? (listening to the group working)

In her discussions (Amber comes up with sheet - T gives explanation with arm over her shoulders) 4/1/3/7 with Amber, with Judy, and with Pamela she checks for understanding and method of thinking Now have you restated the problem? Have you actually written out the sum? ... All right looks like we're nearly all right - is that group up there (the top one) still not right?

Brigid: Well, we've sort of got an answer.

T: You've sort of got an answer. What do you This is particularly mean by sort of? 4/1/3 important in the case of Pamela's S: Well, we're not sure about it.

T: Hang on (coming up the back) tell me what =7 misunderstanding of your sort of answer is. the word "several", where Linda Judy: We've got an answer - we think it's five explores why Pamela holds the mistaken T: You think it's five? But how did you arrive at it? Are you all agreed with the way you . BELief before giving several (!) examples of correct usage. arrived at it?

Pamela: It says XXXX

T: Well several is more than one isn't it? It is also Ss XXX Reading from sheet, explaining significant that in working this incident the teacher seems to T: (listening, nodding ..)

P: But can 'several' mean just five? have understood that T: Of course. What do you think several there was difference means? 1/2 of opinion within the group without P: Seven.

T: Seven? Why seven? being told so. P: I don't know. All of the above T:

Because it starts with S? XXXissues demonstrateP: XXX (fiddling with pen)the challenges of accurate categorisation - Linda's questions are influenced by her knowledge of the students, her knowledge of the content. and her T: Well, several means just more than one. We had several days of bad weather - that can be anything from two to seven - usually if you've got seven you'd say a week of bad weather or a fortnight of bad weather - several is usually more than one but less than seven. OK so you've got a sum. OK (louder) everybody's got an answer? (moving to board) This group hasn't?desire to check forS: We sort of have but ...kind of reasoning.T: Well all right - tell me what you think your answer is so far. 1719S: XXXXT: So you don't agree with them? Do you all agree about what they've done? .... You're not sure Nel? (PM 13-14)

Part of Linda's aim in this lesson involved the use of co-operative learning strategies, and in the above discussion and elsewhere she makes reasonably explicit to the students the importance of the group's manner of solving the problem, not just the solution itself.

The process involves much repetition of students' explanations as well as inquiry not only about the mathematical reasoning involved but also about the way the groups operated - whether they worked individually or as a whole. This monitoring is continual, and takes place simultaneously with matters of discipline.

I:So the point of the exercise was the group?T: Well, that is getting an average of two groups, but do you think that was what the question was about?L: It really is, the group N: No4/1/2/7It is worth noting that while the choice of group activity may appear at first to be a purely pedagogical one, it is not so simple. Part of Linda's concern has been to act on some peer conflicts that have been affecting classroom behaviour. discussion and being able to put it together which is getting into the whole thing of my - the co-operative learning thing that I'm sort of really trying to push and with the groups of four and I really, I have noticed an incredible difference this term as far as - I mean I know Brigid had her worries yesterday with Pamela and there'll be a few things like that always. T: No, it wasn't, was it? So you sort of were on the track but you got a bit - what happened here I think was the last part you didn't get, you didn't really analyse it properly, did you? You got your two lots of things but then why did you add them together? (pause) Was that just a wild guess? (pause) rather than a thought? OK. Did most of the groups - can you all please put those pencils down right this very moment? Can anybody tell me, in their group, did any one person come up with it or was it a cooperative effort?But they're much more enthused about working and the four really does(points) You got it in that group? (points to back) Any one... did you work it out together? Liz? All together?work well because they're S: XXXThe challenges posed by the lengthy process of checking not all shouting over each other, there's not somebody being boss T: Pretty well discussed?

What about that group up the back? Did you work it out individually, or did you discuss it?the reasoning (D22-23). S: We discussed it.process and methodology of S: We worked it out individually first and then we discussed it.groups and T: OK. What about here?individuals becomeS: XXXclear in the S: I worked it out.teacher's need to call the class to attention a number of times.T: So you all had thoughts of your own and then you discussed it. What about here? You were very quick. It was a very good discussion group over here. Did any one particular person come up with it? [NB Rest of class not really listening to explanations but not being disruptive]Ss: XXXS: I did that etcT: Alison and you together, would you say that these two - that you three - but did anyone come up with "This is how you do it" kind of thing?S: XXXIn this passage Linda checks for understanding, emphasises the key issue and calls the T: But you were very quick, so that was very good. OK so you were cooperative learning. You thought it would be a lot harder? Right! (To whole class) Alison's come up with the comment she thought it would be a lot harder.class to attention Ss: Yeah2/1/7with the same sentence - an example of the blend of classroom management strategies with T: And I think a lot of you probably thought that, didn't you, when you saw all the writing. OK. PLEASE put away the colouring this very moment, put it away in your Maths book please, and girls come back to your other groups. 2190content knowledge (moves to front, cleans board)that makes up pedagogical content knowledge.T: So sometimes things are not as difficult as they look - that's very important. (PM1 pp16-17)

So far Shulman's categories do seem to be of assistance in providing a vocabulary to examine the components. It is interesting then to examine an unplanned segment of the lesson.

The following episode "just popped out (Linda,D/24)". It came about because it happened to be that time of the year when teachers meet to decide on textbooks and stationery for the following year. While the discussion is clearly not concerned with Mathematics, it can be seen to have a role both in (obviously) giving the teacher information she seeks and, less obviously, establishing the classroom atmosphere as one in which the views of students are valued [2+4=7]. Note, for instance, in the following interchange, how Anna begins defensively in anticipation of being told off for having the wrong folders, and then she and others elaborate on their views as they realize that the questions are genuine, not disciplinary. It could however be asked whether any of Shulman's categories truly fit this kind of tangential discussion.

Episode E. Discussion on use of folders and exercise books - whole class.

T: So sometimes things are not as difficult as they look - that's very important. Now, everything out of your hands, I need total concentration for our next task. (pause) Moving desks is like moving away for six months

with you kids with all your junk. What have you got there, Anna? What are all those document folders? (2065?)Given the teacher's (This discussion) just A: These?comments it could be popped out. I don't know -T: No, on your desk.argued perhaps thatProbably it would haveA: They're my folders.all this has a stemmed a bit from thisT: What for?pastoral concern.morning - the fact that IA: Spelling and Maths and Japanese.It

certainly serves for the creation of was a bit - I don't know - worked up about T: Oh Why are you keeping them there? Aren't you having ringbinders now? atmosphere - but since this is only textbooks and things to order [...] and perhaps IA: Yeah. See, if I tip the folder the wrong way they all fall out. So if I put them - incidental how fair is such a categorisation? was also thinking about you know what is Maths. [...] It just sort of came out this bit because at the beginning of the year I always tell them things T: So you find the document folders are good, do you? I'm particularly noticing this now because we're trying to order books for next year. Open one up and show me how you've done it. You're fairly neat and tidy 2088 - open up inside though. like they must be able to A: This is spelling. Well I've got all the - ask questions and feel free T: all the sheets in there But no matter how many A: Yeah times a teacher says that T: Oh it doesn't penetrate. It just - I don't know - it A: And then ... just - I don't know - it just sort of popped out. IT: Oh. Does anyone else like that idea - of having document wallets? really didn't plan any of S: I like these - that (D/24). T: Hands up those who don't like the folders - the ring binders. S: XXXXT: OK. Hands up those who would prefer a document-type thing where you could put different things in for each subject? S: XXXXT: All right. Hands up how many of you would like to go back to using an exercise book just for Maths? [various hands up] (PM!p20)

This discussion continues for some minutes in a similar vein and is, I would argue, neither an unusual nor a useless episode in any classroom. When Linda returns to the planned lesson, the atmosphere seems recharged. So it is possible that the whole discussion served the purpose of providing a kind of "recess" in what is, for children of this age, a lengthy session on a single subject (ninety minutes).

The fact that it is not however easily categorised by the Shulman system, because it deals with neither content nor process, is not of course a weakness of the teaching.

As with the earlier episodes, the new task flows so smoothly from the one before that to place the heading at the precise beginning it would be necessary to split the speech. But that it not to say that the new event is not clearly distinguished from the one before - the teacher's tone changes, and the introductory sentence is clear - "I have a question to pose to you today -"

Episode F. What is Maths? - discussion with whole class leading to individual selection of project topics.

2/1T: [...] None of you have finished up your first homework book yet (S: No) - they were quite thick enough. Almost finished? OK, now (tone becomes more business like) I have a question to pose to you today and I want you to think for a minute before you start jumping up and down - 2319 - and I really want you to put your hands up 'cos I want to write down what you're going to say. I want to ask you "What is Maths?" OK? What is Maths? (Pause) 2/1 The first part of the episode is information-gathering brainstorming. So have a think for a minute - what is Maths? (Pause) I don't want your feelings on it this time - I want to know what it is. (writing on board) All right - who's got a hand going up straight away? Flick?

The exercise continues with students suggesting ideas.

(The discussion continues with students suggesting various aspects of Maths).

T: Vertical - good girl. Christina. All right, I think we've got enough for the minute, hands down.Ss: Ohhh...T: No.S: Grams ...

2

1/3

4/2 Linda draws the brainstorming to a clear firm close and draws attention to key aspects of the list.

Note how she assigns authorship - and hence ownership - to an idea she recognises as focal.T: Grams, litres, all of those, let's think. Shhh shh. All right. Now, I've asked you what is Maths, and you all looked at me a bit silly when I asked you that question (laughter). Now, notice the first things that came out, that it's a subject, a subject at school. It was ages - and problems, and problem solving, and numbers. So those things sort of came out first. Then we got to our four processes, they came out pretty quickly too. Now, Biddie came out with something that I think is really very important, and I was very pleased to see somebody come up with that. (circles it on board) (laughter) Do you agree with this?Ss: Yes.

2

6

4/2 Linking the discussion to an earlier debate provides context, and emphasises that the exercise is a grander one than simply choosing project topics. Referring back to T: OK. Now when we asked you some time ago some questions about reading, a lot of you put on your answer sheets that you read because you sort of you knew it was good for you, you had to do it for school, you had to be able to read to learn to spell, 2703 and therefore to be able to get a job. All right. And when we did our Maths graph, up the back there, most of you said that you need to know Maths to be able to get a job.views expressedSs: Mmmearlier by students shows them that she values their views.T: That's right, everybody did, didn't they, out of the twenty four of us - that was the whole idea of the graph. Now, really though, deep down, do some of you like Maths just because it's fun?..(asst "oh yeah").. No, really, think about it, I don't want you to be silly now. It's the expected answer, everybody says "oh I hate Maths", but you really don't, do you?Ss: (Offer various explanationsT: Sums are boring? Yes, I know, I agree with that. But if anything - how many of you find practising the forehand of tennis boring - against a brick wall - when your coach says to you "I want 500 hits of forehand against a brick wall?Ss:

XXT: Well, say 50Ss: XXT: All right, hands up those who - swimming? - I want you to do 3 kilometres of freestyle. Ss:XXX

6

2/6In this discussion we see the opportunity taken to discuss issues of wide significance. The links the teacher draws between this discussion and previous ones allows students to [So] I try to give them the - build up the kids that are feeling insecure in things, to get them to be able to speak, to be able to read, to enjoy reading, to want to do it for the love of it and to have fun with it so that it's not all hard work. But also I think they have to know that there are limits. That you have to, if you want to do T: Or when you're training for the athletics - around the oval, six times, early morning, late afternoon. [various hands up] So there are many things in our lives that we come up with that are boring, aren't there? At a certain time when you're doing so many of them. But do you really feel that Maths and reading, (pointing to board) this is the important thing about it? How could we have solved that Hrunkla village problem this morning if we didn't have Language?see broader something you have to work Ss: We couldn't have applicability, while still serving the immediate goal at it and that's not easy. And it's not always easy. That's why I always bring in T: No. Could we have solved it if we only had Language and didn't know any Maths? 2771of motivating students for the project.the examples of sport and dancing of course as I've done it. [...] That it is theSs: NoNow she draws attention to the process she is using as well as to the desired response.same that whatever you want you have to work for. But you've got to have basic skills (D/25-26):T: So. [Ss;

Because we XXX] What am I trying to get out of you? It's very important for our (pointing to b/b)Ss: Everyday life.4/1In the course of this discussion a number of important issues appear which are unlikely to have been anticipated. Linda chooses to pursue them, which reflects the concerns for the development of the child as a whole person that I quoted at the

It was good to get that out of Elizabeth because she's a kid who sits back a lot. She's quite clever but she's not one to speak out with T: That's right. So when children sit in school in desks like you, making lots of noise and tearing up bits of paper Amber, [laughter] making a mess [laughter] - you're very lucky. What about the children years ago, who at your age were down coal mines, because there wasn't such a thing as compulsory school. And do you think you are um going to have an opportunity in your life to choose what you may do - to a certain extent? [Asst agreement "sort of"] Elizabeth you're shaking your head - no, you

don't think you'll have an opportunity to choose what you'd like to do?  
(T's voice is sympathetic and interested; asst Ss giggles]outset.her ideas  
and things, so IE: Well sometimes yes, sometimes not.really sort of wanted  
to press her to get something T: Well - uh - I don't understand what you  
mean,out D/27)E: Well, you know in senior school ..T: No, I don't mean in  
school - when you've left school altogether.E: You might want to be a  
lawyer or something, and you mightn't be able to do the work, so you've got  
to do something at a lower level.T: At a lower level of academic standing.  
That's because of the way the university system works. 2810 OK so what are  
you trying to tell me Liz? QUIET please!!(to rest of class)(pause)E:XXXXT:  
Those who didn't hear. who are too busy talking and fiddling with bits and  
pieces, Elizabeth said that sometimes you might want to be a lawyer, and  
you mightn't get enough points, so therefore you have to do something with  
a lower number of points, so you mightn't end up doing what you wanted to  
do. So what - what - do you think that leads to? How does your thinking  
come back to that? What have you got to think about if that's what you want  
to do?[pause]E: Well, um, if you want to be a lawyer, you've got to, sort  
of, you've got to like do a lot of work ...

I have most reluctantly cut the discussion here for reasons of space. In  
the course of a few minutes Linda deals with some important issues to do  
with personal goals and ambitions and fear of failure.

4/2/1Appropriate comparisons with other activities make the point T: Oh  
but darling - how many times are you taught to play a forehand in tennis  
before you do it beautifully? Do we all go on the court like - what's her  
name?clear.X: Boris BeckerI always use that thing about the tennis player,  
I'm very boring about that. But I mean. they don't think about how many  
hours Becker or someone goes out there to practise (D/26).T: Boris Becker?  
(laughter) How many hours has he practised to get like that? You see,  
you've got to relate it back to real things. Now Christina and Rebecca are  
now doing ballet. Now I know where they're at, I know all the pain they're  
going through, I've done it. And it took ten, twelve years before you  
could get a job working as a dancer, because you have to train for it. So  
why do you think, because a teacher tells you once about something, that  
you've got to remember it? Your poor little brains have got so much going  
in all day, it's not fair sometimes It could perhaps be argued that the  
complexity of this discussion does not seem adequately catered for by use  
of categories lke "knowledge of learners"[4] I think this is because  
Shulman's categories may not cater adequately for events that are not  
clearly task -oriented or subject-oriented.. to expect for one little thing  
to go in there and stay.

Teachers never mind explaining. As I've said to you, perhaps after the  
fourth time I might get a bit terseand red in the face and hop up and  
down,but most times I will explain it to you again quite sensibly, won't  
I? I was a bit distressed on Friday (laughs) when a number of people kept  
coming out here and saying "I don't know how to do long division" because  
we'd spent a lot of time on long division, but then we hadn't done it for a

while, and once we went through it again, was everybody pretty well right?  
Alison's not, because she hasn't learnt it, but those of you who were

unsure, once I did it on the board again, were you OK then? So it's your memory - your memory's not so good at the moment. Anna?A: Like when you say, "Does everyone know this, does anyone want to ask questions?"and you're not brave enough to put your hand up, then you don't know., and you have to come up and ask you again and XXX (T looks at clock. Sympathetic laughter from class)T: Do you prefer to come up and ask me privately than put your hand up?S: No4/6

Linda winds up the discussion by pointing out that everyone makes mistakes, including teachers, and then focusses attention on the major task.T: Does anyone feel awful about coming up and asking me at the desk? That's not so bad is it?She doesn't care what anybody thinks But it's in front of all of you - but we all make fools of ourselves - I make a fool of myself in front of you. What does it matter? (laughter) I tell you when I don't know things - I make mistakes in spelling, I make mistakes in Maths. I mean I'm not dying about that, I mean I don't care - that's life, isn't it? You can't be perfect all the time.

2

2/1

Most of the initial instructions are to do with procedure. Later I asked Linda to describe her planning for the project. She said "I wrote "What is Maths? Brainstorm. List on chalkboard, then discuss the idea of Maths projects. What you can do. Each girl produce a page for a book." So I had those ideas in my hand. That's my shorthand writing down. I mean to write that down I s'pose I thought and jotted and - you OK. Now, what we're going to do now, from all the information that's on the board, you are going to do me a Maths Project. (groans) I knew you'd say that, "groan, groan" . Now what it is, we're going to compile a book. And this book is going to be - we're going to pretend that it might be a book for grade 4s or 5s and what each girl is going to do - and each girl is going to do it totally individually - you are going to take something from the board, or something else that you can think of, and research it, and you are going to do at least a page of beautifully presented work - A4 - it can be either lined paper, plain know - wriggled things around for about half an hour at home til I'd decided how I'd do it. Because as I said to you when I was planning the week, I had so much information that I could do that was sort of interesting and different or you know and still with Maths content in it - I didn't know which ones to do, which ones would flow into the week (D/30)."paper,whatever you want, at least a page, probably better

not to double side it, because if you write on the other side sometimes it all comes through and it's hard to read - and I want you totally to explain in your words something that's on the board. And I want everyone to do something different. 3113 So I'll give you five minutes - hands down - to think about something on the board that you would like to do a project on. Now some of the words there are not suitable for projects. Some of them need to perhaps go together, but I want you to think about it. No, hands down, just think about it - five minutes. (moves to desk) Have a look at all the words on the board, you are going to do it, and you are going to take out a contract on yourself, all right? You are going to say that you are going to say that you are going to do this - and you are going to do it in the next - we've got about three weeks to do it. Then we'll put it all together and make a book out of it.X: Um do you do it in your words or...?Linda deals with students' questions and gives them a few moments to think. Discussion continues of who will do what.  
2/1

This just came into my head too because - who was writing a contract? Oh, Jane came to me the other day and asked me to look at the contract she'd drawn up for a little girl who's got a T; So how many money people am I left with now? Well, I think those four can just do it. And try to tackle it from different areas. All right? Everybody's happy? Wonderful. So please write down your project please. Now open your Maths book everybody quickly. (looks at clock) One minute. Maths exercise book. And. Today's date. And underneath it write these words. Everybody write this. I promise to undertake a Maths project on the subject of behaviour problem. And Ss: XXXthis little girl had to sign that if she was very naughty and nasty and unkind to people and physically abuse them then she had to go and sit in the office. And she signed this contract [...] I thought that was a terrific idea. [...] And I guess that was sort of floating around T: Did you? But you're not doing that now. XXXX That'd be terrific in graphs. That'd be very interesting. Yeah. Super. All right. I undertake - now, what did I say? I promise to undertake a Maths project on the subject of And you have to put today's date. And sign it. I promise to undertake a Maths project -in my head. I've never S: Why do we have to?actually got kids to write up contracts and things like that. I've always felt that's a bit - I don't know. I think it's a bit unnecessary. I think mosst of them work anyway and you really - you've got to get it out of them - but IT: Because I want you to know that it's there. - to undertake a Maths project - on the subject of and then put two little dots, and then put your subject - or area I suppose it could be called - yours is Roman numerals and other number systems, Anna, then we can leave Harriet do just the one. just

thought it was fun ((D33X: XXX-34).T: All right, you can put that in a little bit, but you'll find there are some other terrific number systems to look at. I promise to undertake a Maths project on the subject of -X: Do I just write ...?T: And then you sign it. Signed - and then your

signature please and today's date. (quiet discussion. It's clearly recess from the noise outside, but noone's moving)

The lesson winds up with Linda reviewing the goals of the project - presentation, audience, and research procedure. She wrote in her journal, "They did all this quickly and well and we had it sorted out by recess. I found it quite rewarding as a lesson as they had got to the point I had wanted (G/12)".

#### DISCUSSION

At this stage it is worth reviewing again the categories from Shulman which have been a significant focus of the analysis.

1. Content knowledge.
2. General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter.
3. Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers.
4. Knowledge of learners and their characteristics.
5. Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures;
6. Knowledge of educational ends, purposes and values, and their philosophical and historical grounds.
7. Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special understanding (adapted from Shulman, 1987, p. 8).

The categories Shulman has developed do assist in providing a common language for unravelling the layers of teachers' work, at least as far as the sessions in this study are concerned. However, they are not the whole story. For instance, while it is possible to apply them to tangential discussion such as the one on appropriate choice of exercise books, such categorisation is artificial. This is perhaps due to the fact that Shulman is largely concerned with the teaching of subject matter, and this kind of tangential discussion has little to do with that. However, it would not be appropriate therefore to ignore such unplanned segments of classroom discussion. They are a regular and far from meaningless part of classroom events, serving as they do to create atmosphere, provide an "interval" and increase the teacher's knowledge of her students. Indeed, at times, such as during the setting up of the Maths projects, the opportunity is unexpectedly provided for some important discussion of beliefs and values. In analysis both of classroom events and the interviews, some categories are much more in evidence than others. For instance, in the excerpts used in this paper, there is no illustration at all of the fifth and few examples of the fourth. This is not however surprising if the context of interview and classroom is considered. The other types of knowledge do appear to cover much of the planned classroom events. although it is frequently the case that within a short excerpt and even within a single sentence, several categories apply.

Yet this does not undermine the usefulness of the categories as one way of seeing - as a way to draw attention to the expertise of good teachers and to the difficulty of the task before them. Indeed one of the advantages of

the categories is that in separating out kinds of knowledge this complexity is emphasised.

It may be however, that it is misleading to suggest that pedagogical content knowledge is a category separate from the others. Rather, it is the "umbrella" term which encompasses the others and conveys what it is to be a good teacher - the ability to apply the other kinds of knowledge in a manner appropriate to the classroom and its students. That is why I placed it last rather than fourth, as it is in the original article (Shulman, 1987, p.8).

Another point worth making is that while the categories certainly can be made to function as a kind of coding system, in discussion it was necessary to expand on the classification. This is not really surprising - a coding

system is a simplification and discussion of course an amplification. Part of the original intention was to use the terms of Shulman's model in my discussion, but in practice this was found to be unnecessarily restrictive - and the categories have provided sufficient labelling to minimise misunderstandings.

It is hoped that from this analysis the multi-layered nature of classroom life has been captured. While it has not been possible to add in the students' perspective in as much detail as that of the teacher, that was a deliberate choice given the restrictions of space and resources. The intention was that through seeing the teacher's planning and thinking before, during and after a lesson, set against the actual execution of the lesson, a better understanding of the complexity of teachers' work would be achieved.

And perhaps this method of research might have the added benefit of offering something in return to the teacher generous enough to give her time and courageous enough to display her work - the opportunity to articulate her knowledge and have its value acknowledged.

Teachers usually have no way of knowing that they have made a difference in a child's life, even when they have made a dramatic one. But for children who are used to thinking of themselves as stupid or not worth talking to or deserving rape and beatings, a good teacher can provide an astonishing revelation. A good teacher can give a child at least a chance to feel, "She thinks I'm worth something. Maybe I am." Good teachers put snags in the river of children passing by, and over the years, they redirect hundreds of lives. Many people find it easy to imagine unseen webs of malevolent conspiracy in the world, and they are not always wrong. But there is also an innocence that conspires to hold humanity together, and it is made of people who can never fully know the good that they have done (Kidder, 1989, p.313).

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