Chapter 1
Practice

This monograph is about transitions:

from being a sensitive teacher awake to possibilities, perhaps dissatisfied with the status quo;

through reflective practices

to engaging in productive and effective personal professional development;

through drawing on colleagues and published research

to contributing to the professional development of others;

through being systematic and disciplined in recording

to undertaking research activity and participating in a research community.

Its aims are, therefore, pragmatic. The whole thrust of this monograph is that the natural and intuitive actions of any teacher can be developed, made more systematic and more disciplined, to good effect.

This chapter is about practice, about the various actions which are involved for any teacher who wishes to look beyond their day-to-day practice. Certain elements will then be extracted in Chapter 2.

Forces for development

Every practitioner, in whatever domain they work, wants to be awake to possibilities, to be sensitive to the situation, and to respond appropriately. Every act of teaching depends on noticing: noticing what children are doing and how they respond; evaluating what is being said or done against expectations and criteria; considering what might be said or done next. It is almost too obvious to say that what is not noticed cannot be acted upon. Of course, it is not always possible to devote enough time to listening and observing, to planning and preparing, but we do our best.

Each act of teaching is also an act of learning: learning about the pupils, learning about the situation, learning about oneself. Or at least that is the myth which is promulgated. If it were true, then there would be a lot more variation in practice from day to day than there is, a lot more experimentation, and a lot more pleasure derived from teaching. But there is too much to attend to in any lesson, too much to be aware of, too much to notice; so we get through as best we can. Far from learning from experience, moment by moment, we react, just managing or coping. Desforges and Cockburn (1987) argue this is inevitable in classrooms as

currently conceived due to cognitive overload.

> *One thing we seem not to learn from experience,*
> *is that we rarely learn from experience alone.*

A great deal can be learned from getting in and doing things, but after a while learning is supplanted by ingrained habits 'learned' from experience. Teaching is such a complex activity that it is essential to develop stratagems and gambits for dealing with common situations. The term *gambit* was taken by Pimm (1987) from chess to refer to something a teacher does which changes the focus of activity temporarily, but which is intended to contribute to the current endeavour. Often it involves a temporary or apparent loss of control, such as in getting children talking to each other.

> In the context of chess, the term *gambit* refers to a move or a series of moves which involves a possible sacrifice on the part of the instigator, but which is intended to produce an overall advantage. This idea can be fruitfully applied to the teaching situation to describe, for example, the strategy of teachers inviting their pupils to converse in pairs (for varying lengths of time). One sacrifice involved is that, by encouraging talking in pairs, even if the teacher circulates to monitor and participate in some of the conversations, she rescinds control or even an awareness of many of the verbal exchanges going on in the class.
>
> One potential gain as a result of this sacrifice is that subsequent whole-class discussions may well fare much better, as many more pupils may have something to contribute, having rehearsed its expression in the less threatening context of conversation with a neighbour.
>
> *(Pimm, 1987, p. 50)*

Habituated gambits can suddenly come to attention.

> *I suddenly caught myself repeating back to the class what one student had just said. I recognise that I do this a lot.*

There is nothing wrong with this gambit of repeating back. No judgement is being made whatsoever. But if I recognise that I do it all the time, that it has become a habit, I might decide I want to gain the freedom *not* to repeat back sometimes. I can make a list of positive and negative features of repeating back.

Positive	**Negative** (especially if it becomes a habit)
• I make sure everyone hears. • I gain time to think about a response or to find another child to respond. • I give the speaker a chance to rethink what they said and perhaps modify it before others comment. • I keep control. • I can rephrase more succinctly and memorably.	• Children may become used to listening only to me and not each other, because they assume I will repeat anything of importance. • I maintain control as the focus of discussions. • I may be seen as the (only) source of certainty and validity. ⋮

The point is not that repeating back is good or bad in itself, but rather whether I am choosing to do it, or whether it 'chooses' me when repeating back happens automatically.

We cannot afford to think out a response to each emerging incident. Habits must be developed in order to free attention to keep in mind overall goals. The trouble with habits is that:

habit forming can be habit forming.

Instead of responding sensitively to situations, it becomes usual to react according to established patterns. Classifying people and situations and then reacting to those stereotypes happens so quickly it may not even be noticed. We may continue to think we act freshly all the time, when in fact much of the time we react rather than respond.

By contrast, in those few brief moments when we feel we have acted freshly, made a choice, there is a sense of freedom, of meaning, of worthwhileness and self-esteem, which keeps us going.

The details of teaching necessarily involve noticing. We notice that the class is losing concentration, so we switch the mode of interaction from whole class to groups or individuals, or introduce a fresh task. We notice that some pupils are working quickly while others are not, so we try to give more attention where it is needed, challenging each in ways we feel most appropriate for the individual. I might notice that a few pupils always finish first, so I try to challenge them further. I might notice that some technique which I hoped they had mastered is suddenly problematic again, so I switch tasks and rehearse the technique again before proceeding.

Noticing requires sensitivity. I cannot notice that some students are bored if my attention is focused on my own nervousness or insecurity. I need to become aware of the ebb and flow of energy and attention in the classroom (and each class is slightly different in this respect).

To notice an opportunity requires two things. You have to be awake to the situation in the moment, and you have to have alternative actions prepared which will also come to mind in the moment. For example, I cannot invoke a technique like 'circle-time' if I have never heard of it or never considered using it. And even though I may decide in advance of a lesson that I want to generate some discussion, I may get so caught up in the flow of events that I forget all about it in the classroom.

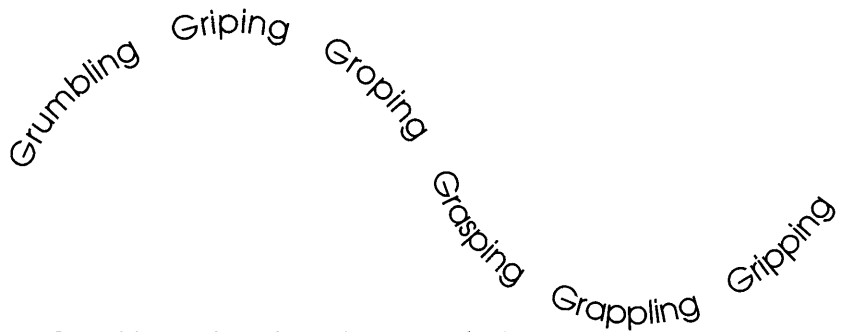
Personal forces

I did fractions with them for half a term, and today they still couldn't do them!

Some version of this cry from the heart will probably be familiar to every teacher. I explain patiently, build up from examples, use apparatus and diagrams, carefully explain techniques, and yet still they don't seem to remember. I reduce it all to a few simple rules and try to get them to memorise them; still no significant

success. I look around for some other approach, some other materials. If I find a possibility, I work at that for a bit, and for a while I feel better, then even that begins to pale or lose its promise and I look around again.

Development is a cyclical process; sometimes exhilarating, often frustrating. No description is likely to be complete, but there are usually cycles of:



Grumbling about how things are, *leading to;*

Griping about specific frustrations, *leading to;*

Groping for some alternative, *leading to;*

Grasping at some passing possibility, *which with luck leads to;*

Grappling with some issue and proposed actions, *developing into;*

Gripping hard to 'something that works', *then finding further;*

Grumbling and Griping as the substance seems to leak out.

A new cycle begins. This monograph is in part about breaking out of a cycle of frustration with the Grs.

What triggers a new phase of personal development? Most frequently, there is some form of disturbance which starts things off. It may be a surprise remark in a lesson, a particularly poor showing on a test, something said by a colleague or something asserted in a journal or book. Whatever it is, I become aware of dissatisfaction, of inadequacy. I may be tempted to blame others (the previous school or teacher, the home environment), or I may have a tendency to blame myself. Blame and justification, explanation and judgement, are ways to dissipate the uncomfortable energy which comes from noticing a disturbance. The disturbance itself is eliminated or ignored. I have too many other things to attend to.

It may also arise from something working, something going unexpectedly well, and wanting to understand why.

But sometimes the disturbance remains. Often it happens that something positive attracts my attention, something different to try which I hope or believe will make a difference. So I pursue it in detail, try 'it' out for myself.

For example:

I read that in a survey many children answered 0.3 × 0.3 with 0.9. Would my pupils do that? I try it out to see. Does it make a difference if I offer them a choice between 0.9 and 0.09 or just ask them for the answer, or ask whether 0.9 is correct? If I tell them that some other children incorrectly answered 0.9, will mine be stimulated to say what they think the others might have been thinking?

The survey provided an impetus for me to look at my pupil's thinking. Probing someone else's thinking is difficult at the best of times, even (especially?) when there is one researcher and one 'subject'. The way that the question is posed, the tone of voice, the body posture, the context in which the probe arises, all may influence the response.

What might lie behind the answer of 0.9, if it does turn out to be prevalent? One day I hear a child saying, 'oh point five times oh point five is oh point twenty-five', and suddenly I hear in my head:

Oh point four times oh point four is oh point sixteen; oh point three times oh point three is oh point nine.

What wonderful mathematical thinking! A pattern is seized upon and extended. What a pity it is applied to inappropriate data! By inappropriately pronouncing decimal names, children may be led into confusion. Now I have been sensitised by my following up of the $0.3 \times 0.3 = 0.9$ answer and become aware of a plausible way to account for their answers. Now I can praise the thinking while criticising the specific answer. Next time, I can offer a pupil a disturbance and some praise at the same time.

Returning to the 'They still can't do fractions' syndrome: in order to recognise the force behind such a quotation, you have to have experience of classrooms. You may be able to recall recent specific instances where you felt or said something similar. Alternatively, you may have a general sense of recognition without any specific instances coming to mind. In either case, you are demonstrating the way research professionals operate. They draw upon specific and generalised experience to recognise or reject assertions made to them. The idea of the proposals in Chapter 2 is to refine the details of this process, to become more systematic and disciplined, and in the process, to turn practice into professional development into research to whatever extent you wish.

In summarising his experiences while writing a master's thesis on critical moments in the mathematics classroom, John Chatley wrote:

> Central to my work for this thesis has been my own observation of myself as teacher, head of department, and researcher. As a result of this work I have become much more skilled in the process of observation and so have developed higher expectations of myself as a teacher and manager as well as being able to analyse the significance of situations more readily.
>
> Looking at oneself is not easy, reflecting accurately on the way one has worked and thought, objectively, is particularly difficult, and [...] would have been much more difficult without the documentation of the journal. This has taken my own experience and initial reflections a step removed from me personally. [...] it is only by doing the kind of examination I have of my own work that I have gained access to greater understanding of what I did and how I did it. [...]
>
> For the purpose of this research it has been necessary to recall (and where possible re-enter) situations as accurately as possible with complete honesty. [...]

> I have, by my own reflection, particularly in connection with the preparation of this thesis, become more skilled at helping others to reflect on their own experience. At times similarities to my own experience, or sharp contrasts become apparent and it is then useful to help others to identify the roots of the situation they find themselves in and the possible roots leading from it. This is along the lines of the critical moment.
> *(Chatley, 1992, pp. 143–145)*

Some things to try now

1 Imagine yourself with a group of children, and suddenly becoming aware that you are (about to be) repeating back what one has just said. Imagine yourself doing something different (e.g. asking another child for their version of what was just said). What are some possibilities for you?

2 Imagine yourself in a classroom. Focus your mind on just one thing that you want to say to the pupils. Now try to 'see' or experience what posture and gestures you are likely to adopt. Are they consistent with what you want to say? Imagine changing some aspect of posture or gesture so as to support better what you want to say.

The real test is whether events such as these ever occur to you in the midst of a lesson, and whether they help you to see something that you had not seen before.

Social forces

As a teacher, I am caught in the midst of a large institution, one extending well beyond the walls. I want my focus to be on the children and their mathematical, social, and intellectual development, but there are pressures and strictures from parents, colleagues, heads, inspectors, local and national bodies, and politicians. I may want to do something different, but find that there is no money, no time, no support, even no interest. I feel constrained and confined. My frustration may partly be due to a strong desire to change 'everything' at once, rather than selecting something tiny but manageable to alter slightly.

I may find that the statutory requirements of a National Curriculum statement serve as a useful skeleton, a scaffold around which to structure my teaching. But I may also experience it as a straitjacket which precludes any variation, because there are already excessive demands on my time and attention. Part of me may want to be innovative, but at the end of each day I am too tired to take on anything new.

One response is to work on delineating the forces acting on me. The grumbling–griping cycle can be focused on the personal level as suggested in the previous subsection, or it can be turned outward, switching attention perhaps from blaming others, to describing forces and how they work. This may draw me into the political domain, into sociological commentary, or, by appreciating how the forces work, enable me to locate a domain in which I feel I can contribute or act. It may also focus over-much on the negative: for instance, one positive opportu-

nity that the introduction of the National Curriculum offered was a chance to take stock and re-appraise.

Whichever direction is taken, outwards or inwards, sociological or psychological, any attempt to understand the situation better and to make changes requires energy. It is all too easy to dissipate energy in making judgements. A theme to be developed later is that as long as energy is caught up in judgement, whether blaming or explaining away, it is not available for transformation, for initiating further action. If I can be descriptive rather than judgemental, I can divert the energy of judgement into clearer sight and alternative action.

Some things to try now

1 Some social forces in teaching are shown in the box following. Write them on individual slips of paper and arrange them so that their position (and size?) reflects your impressions of their importance for you. Draw in some links and label them. Add others of your own. If possible, compare displays with colleagues and discuss differences.

Politicians
Inspectors
Professional associations
Parents
Head
Colleagues
Children

2 Extend the following list of adjectives and nouns to best describe how you feel about the social forces acting upon you in teaching.

Tool	Agent	Ultimately autonomous	Accountable
Deliverer	Independent	Dependent	Curriculum
Departmental programme			

Reflection

Donald Schön (1983) popularised the term *reflective practitioner* to describe experts who are awake to and aware of their personal practice, not just immersed in it. He described a number of different professions and gave examples of a range of activities which might characterise professional reflection, and coined the terms *reflection-in-action* and *reflection-on-action*. The suffix *in-action* refers to moment-by-moment awareness in the midst of the flow of events, in which experienced practitioners are able to have a part of their attention separated from the immediate actions, acting rather like an observer. The suffix *on-action* refers to later retrospective contemplation of an event, using it to prepare for the future and also to direct attempts to stand back from the action and to describe and analyse one's current situation and practices.

As with any slogan, there is great danger that what starts as a description (of things professionals do) will turn into a sequence of specific acts which are required and checked, but which become mechanical. For example, establishing an ethos in which children greet a teacher (e.g. 'Good morning, Miss ...') can ever so easily be converted into an empty form, in which some children vie with each other to exhibit scorn in their tone of voice. The virtue of planning out a term's work can turn into a requirement for lists predicting what children will be asked to do weeks ahead. In order to meet the requirement that a list be produced, it is sensible to 'make the list', even though it is just done to meet the requirement. So too with reflection. The observation that thinking back over a lesson and picking out one or two salient moments is a useful thing to do can all too easily turn into an injunction which then becomes an empty and fairly useless mechanical process.

There are close analogies with children's learning. What starts off as 'good ideas' to enable children to make contact with important mathematical notions and processes, to awaken the kind of awareness that an expert has, get converted into instruction as a series of tasks to be undertaken. Children see the tasks as 'something to be done', as the end in themselves, and this is part of the implicit contract between teacher and pupil: the pupils do what they are asked to do by the teacher, and somehow they will learn. Yet we all know that it takes more than the mechanical and superficial carrying out of tasks for most learning to take place. The child has to participate and engage, not merely go through the motions. So too with reflection, professional development, and research.

This perspective can be summarised in two terms derived from French research in mathematics education: the *didactic transposition*, and the *didactic tension*.

> *Didactic transposition*: the act of constructing teaching materials and of giving instruction transforms expert mathematical awareness into training in behaviour.
>
> *Didactic tension*: the *more* explicit I am about the behaviour I wish my pupils to display, the more likely it is that they will display that behaviour without recourse to the understanding which the behaviour is meant to indicate; that is, the more they will take the *form* for the substance.
>
> The *less* explicit I am about my aims and expectations about the behaviour I wish my pupils to display, the less likely they are to notice what is (or might be) going on, the less likely they are to see the point, to encounter what was intended, or to realise what it was all about.

Providing pupils with rules and mnemonics, and making them practise these to gain facility, can usefully augment their understanding of what the mathematical techniques do, why they work, and to what sorts of problems they can be applied. It can also dominate attention to the exclusion of the very understanding which they are supposed to represent or indicate.

The same is true of reflection. Writing autobiographical and other notes, keeping a journal, and mentally re-entering salient moments, can assist professional development and be integral to engaging in research; these activities can also be carried out mechanically and ineffectively.

Not all reflection need be deeply personal. McIntyre (1993) draws attention to three levels of reflection in the professional development research programme which he runs. The levels he identifies reflect his particular concerns with, and emphasis on, socio-political critical theorising.

> The first level is technical. People are drawn to professional development through concern with specific but distant goals, such as assessment or equity, classroom or departmental management, or the teaching of a particular topic. The effective attainment of specific practical goals is the dominant concern.
>
> Developing out of this first level is a second level which questions the assumptions, predispositions, values, and consequences, with which actions are linked. 'What makes me so confident that that is an appropriate thing to do in this circumstance?' The dominant concern is with placing the practical issues in a wider context of hidden assumptions and dispositions.
>
> The third level is characterised as being critical or emancipatory. It is concerned with wider ethical, social and political issues, including crucially the institutional and societal forces which may constrain the individual's freedom of action or limit the efficacy of those actions. How do institutions come to exert their influence? Where do institutionalised practices originate, and who benefits from them? What blocks people from changing what they do?
> *(McIntyre, 1993, p. 44)*

McIntyre's orientation is thus an outward movement from practice to forces, and might therefore appropriately be referred to as social reflection. By contrast, noticing, or what might be called 'psychological reflection', starts with the same first level but then moves inwards towards sensitising oneself (with the aid of colleagues) to notice situations in which alternative actions are possible, and then to changing practices by choosing to act differently.

This monograph concentrates on the inward rather than the outward movement.

Getting started

A process as complex and self-referential as research into one's own practice does not proceed as smoothly and directedly as written descriptions seem to imply. There are periods of frustration, of low energy and absent motivation, of high energy and desire to act or to communicate with others, and so on. There are periods when it is easy to talk about what you are doing, and times when it all seems to slip away, to evaporate. That is part of the nature of any research, and particularly of investigation from the inside, for yourself.

Sometimes you feel as if you are noticing all sorts of fresh things; the world seems alive and communicative. Other times nothing seems to stand out, and attention drifts or is caught up by events. Recognition that these are natural phases is an important awareness that can assist you through such periods in your own work. Indeed, it is an example of self-reference, for by being sensitised to ebbs and flows of energy, you may be able to be more accepting of changes in energies (both yours and the pupils), in what seems possible for you at any given moment.

To do more than cope with moment-by-moment events, it is necessary to draw out of the situation in some way, to *mark* rather than 'barely notice'. For example, the child who is caught up in anger cannot do anything but be angry. She cannot reflect-in-action on that anger, and may not even be able to reflect-on-action later. Fortunately, young children seem to have short memories of their intense states. As they reach adolescence however, states seem harder to shake off.

By contrast, teachers often stress that their own anger is with behaviour and not with the child; there is part of them which is free of the anger, and which continues to respect the person while criticising the behaviour. They are often able to reflect-in-action regarding the effect their 'anger' is having and to modify their behaviour accordingly. They can switch out into neutrality or even pleasantness relatively easily. The 'state of anger' is not preserved because there is part of them which remains separate. Children are unlikely to come to awareness of the possibility of such a separated state themselves unless they experience it explicitly from adults.

Anger is a specific and usually transitory state. More generally, to separate oneself from immediate problems, it can be helpful to try to describe the current state. This can then serve as a backdrop or control setting against which to locate changes and developments in the future. Because of living through the changes, it is often difficult to see what significant alterations do take place over time. It can also be salutary at times to witness how little really does change.

To this end, it is worth engaging in some or all of the following position-locating activities.

Some things to try now

1 Critical moments: describe briefly but vividly some significant moments from your life involving teaching and learning mathematics.

2 'Personal' inventory: carry out a personal enquiry of concerns, attitudes, and goals, along the lines suggested in Appendix A.

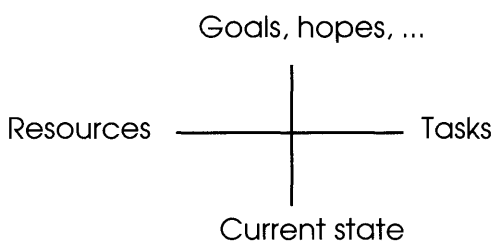
3 'Other' inventory: ask colleagues and pupils to comment on aspects of your work from their perspective, along the lines suggested in Appendix B.

4 Analysis: having described your particular teaching situation, make a list of what you see as positive and negative about the situation. What is blocking you from acting differently, and what is available as support?

These activities are all intended to provide a sort of snapshot of the current state of affairs (bearing in mind that there is a richness which can never be captured in a few words), but different people find different tasks difficult, challenging, or straightforward. It is more valuable to work at one activity that is challenging than to spend time responding easily and without challenge to several.

The 'autobiographical critical moment' is a means for bringing to the surface ideals and beliefs which may be submerged in the exigencies of moment-by-moment coping. The 'personal inventory' includes goals, aims, wishes, desires, hopes, etc., which not only provide a reminder of direction for personal development, but also provide a touchstone for seeing whether these change as time goes on. The 'other inventory' acts as a reality check by juxtaposing what others are aware of (and willing or able to record) about how you operate. The 'analysis' is an opportunity to express frustrations and to describe forces which seem to be blocking development, so that they can be externalised to some extent and their influence thereby reduced. All of these forms of position-locating are about describing the current state and contrasting it with desires and goals.

There is a background structure to position-locating. If current-state–goals is seen as an axis of development, it is useful to consider the means by which such development might take place. To this end, it is worth considering what sorts of resources you have to draw upon (personal energy and commitment, support of colleagues, friends, even pupils) and what sorts of tasks you are willing to undertake. The following diagram provides one useful framework for making entries under these headings.



'Goals' might include what I want for my pupils, my institution, my self. 'Resources' might include previous research carried out by others, support of colleagues, personal energy and commitment. 'Tasks' might include undertaking reading, writing, taping of classroom incidents and their later analysis, undertaking suggested reflective practices, working with colleagues, involving pupils, involving colleagues, etc. 'Current state' might include what I think pupils and colleagues think I do and how that differs from what I think I do, a description of the forces acting upon me which block me doing 'what I want to do', and any

dissatisfactions or uncertainties that I am aware of currently. It could be extended to a list of my most frequent habits, gambits, and quirks in the classroom.

The virtue of using a spatial layout is that the positioning can be used to get a sense of appropriateness and balance. If the goals are well beyond the reach of the resources or the tasks, then adjustment is needed. If the goals are too close to the current state, or if they are unrelated to the resources available, then nothing much will happen. If the tasks I am willing to undertake are incommensurate with the resources available, or if the current state does not immediately lend itself to exploiting available resources, then again little is possible. One purpose of this monograph is to provide suggestions and structure for an overview, contributing to the resources and suggesting tasks, but these have to be modified and mediated by personal circumstances.

Exposing primitives

We all have words which we use without questioning what they mean. They are *primitive* in the sense of being the foundations, the building blocks of our own meaning and thought. In mathematics education, words like 'learning', 'understanding', 'task', and 'activity' are typically in this category. In order to clarify details of my own practice and to locate problematic areas for more detailed investigation, it helps to identify and expose some of these primitive terms and to enquire as to what I really mean by them. Of course, if we tried to question everything all the time we would never be able to say anything! But sometimes such words hide confusions, changes over time (see Love and Tahta, 1991), and lack of clarity. Often when colleagues appear to agree but then later disagree, it may well be because they have different meanings for primitive terms. Sometimes there are several meanings and we slide from one meaning to another even in the course of the same discussion.

Some things to try now

1 Make a table of names of nine children whom you teach or observe, like the following:

A	B	C
D	E	F
G	H	I

Use some process to make the choices of pupils reasonably random.

Now use the rows, columns and three diagonals to select triples:

ABC, DEF, GHI, ADG, BEH, CFI, AEI, DHC, GBF

For each triple, find some quality of the children's behaviour in class which distinguishes one of them from the other two. Thus, child A might be more assiduous in doing homework than either of B or C. The point is not to label children, but to use the task to locate the kinds of words or ideas which you find yourself using in order to make distinctions between children. When you have found five or six different words, write them down and describe what

you mean by each of them in a sentence or two. If possible, compare notes with a colleague. Do they use similar words? In the same way? Do they make similar distinctions but use different words?

(This activity is based on work by Bannister and Fransella (1971), who themselves drew on Kelly's psychological theory of personal constructs. The intention is to elicit polarising pairs of terms and the underlying constructs that are used to make sense of a person's worth.)

2 Make a list of nine different tasks that you (or a teacher you have observed) have assigned children recently. Go through the same exercise of forming triples, and finding some term or terms to distinguish one of each triple from the other two in that triple. Again, the purpose is to bring to awareness the kinds of words that you use to think about the sorts of mathematical tasks children get set. Having found at least five or six words, try to specify what those words mean to you, and if possible, compare notes with colleagues. Do they recognise those terms? Do they use them the same way?

Appendices

Appendix A: 'Personal' inventory

Teaching mathematics is like …

Learning mathematics is like …

What I like most about teaching mathematics is …

What I like least about teaching mathematics is …

Mathematical ideas come from …

My mathematics teaching has changed recently in that I now …

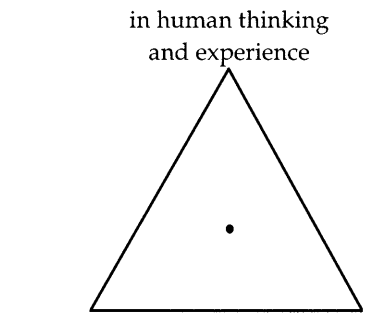
Mathematics is important in school because …

Mathematics is a cultural activity, in that …

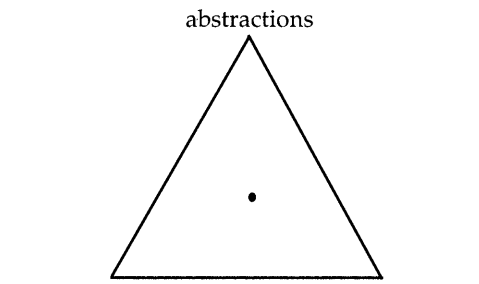
Mathematics is a solo activity, in that …

In each of the following diagrams, place a point in the triangle which represents your view as a combination of the three views expressed at the corners. The central dot represents a perfect balance of all three forces.

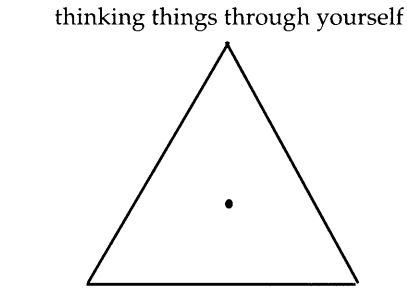
Mathematics is taught because it is important



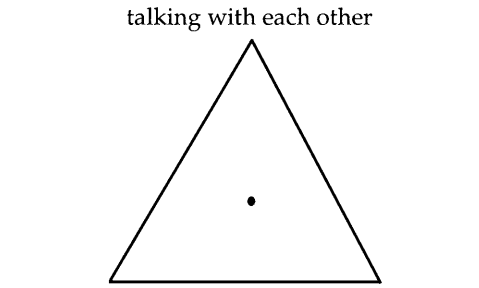
Mathematical ideas come from:



Mathematics is best learned by:



Pupils learn by:



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