SMILE with Us:
Personal recollections of the Secondary Mathematics Independent Learning Experience

by
Rachael Gibbons

Edited by Hilary Povey, Alison Clark-Wilson and John Hibbs
I am delighted to have been asked to add a foreword to this excellent book. Very many thanks to Ray for both having the vision and doing the hard work to get it launched, and to all the contributors for being prepared to take the time to tell the great story of SMILE.

While I was only for a short period centrally involved and have never taught SMILE as a classroom teacher, I like to think of myself as a long-term supporter, having been in from the very start.

When I moved in 1969 from classroom teaching to become a teacher trainer at the Chelsea College Centre for Science and Mathematics Education in Fulham I found my boss, Professor Geoffrey Matthews, was just about to extend his work in primary schools in the Nuffield Mathematics Project into the first two years of secondary school. I asked to be involved in this extension with a local school, Fulham Gilliatt (now Fulham Cross). As well as asking participating schools to trial
other Nuffield teaching resources like problem cards and module units, Geoffrey offered Nuffield funding to a charismatic Kent teacher called Bertie Banks to provide Fulham Gilliatt (and another girls’ school then known as Ladbroke Grove) with his Ridgewaye School learning scheme. This scheme, later to become the Kent Mathematics Project, incorporated self-learning materials, written and audio-taped, and creative activities, all allocated to pupils using a sequence of task-matrices. The reason for selecting these schools was that they had each suffered from frequent staff turnover and standards were low; the scheme was intended to at least provide some continuity of learning. I spent half a day a week for a year at Fulham Gilliatt working as a teaching assistant alongside two very competent teachers, Myra Plummer and a young geography teacher, Sue Stewart, and was impressed by how well the scheme worked; it engaged pupils and the test results seemed to demonstrate real progress in learning.

Later I attended Jim Mayhew’s crucial meeting, referred to later in the book, of Inner London Heads of Department at Ladbroke Grove Mathematics Teachers’ Centre (itself one of the Centres created by the Nuffield Project) where SMILE was born. The problem was to decide how to cope with mixed ability mathematics teaching. John Stewart of Chelsea School talked about their use of Bertie Banks’ Ridgewaye Scheme. (I never discovered exactly how Chelsea discovered the Scheme but the fact that he was married to Sue with whom I had worked at Fulham Gilliatt presumably had something to do with it!) The Inner London Education Authority (ILEA) might have ended up taking on what was essentially the Kent Mathematics Project if Kent had not refused to allow them to participate, thus creating the need to devise an ILEA version of the material but using the same structures of levels, matrices and tests.

I then joined for a year or so the regular meetings of teachers working on the materials - I was part of the group devising games and simulations with Jeanne Coker from Holland Park and Graham Smart and others. I can’t remember all the activities we produced for trialling but I do recall spending a long time adapting an idea from the ATM journal Mathematics Teaching to create the Racetrack card.

Alongside this early participation in the design process, I was regularly in and out of lots of SMILE schools supervising school practice for our PGCE students, many of whom stayed on to teach in ILEA schools, so one way or another I got to know many SMILE teachers, some of whom, like Ray, became distinguished inspectors and advisors in ILEA and elsewhere. I also met others at SMILE conferences at Ladbroke, Stoke d’Abernon and other centres. One conference sticks in my mind where Ray had asked me to lead a group analysing the content progression of the number cards to see what ideas were missing or not well covered - to my surprise this was quite strongly resisted by some teachers in the group who were committed to SMILE cards as providing creative activity and were not prepared to consider any systematic analysis of the content dimension of the tasks!
Finally I was asked in the 1980s by the ILEA to direct a project, co-funded by the Nuffield Foundation and the ILEA, to provide a formative assessment structure and scheme throughout secondary schools which would lead to a GCSE; this would need to match SMILE but also other schemes, including for example the School Mathematics Project (SMP). The outcome was GAIM - Graded Assessment in Mathematics, which in its turn formed the basis for the 1989 National Curriculum and its pilot assessment schemes (though I don’t accept responsibility for all that has happened since!) I was lucky to be able to recruit to GAIM many outstanding SMILE teachers, both on a part-time basis and through temporary full-time secondments; there are too many to mention but the full-time GAIM team members I recruited from London schools and am still in touch with include for example Dylan Wiliam, Alice Onion, Gill Close, Mundher Adhami, Steph Prestage and Sue Johnston-Wilder.

It is very easy for me to become nostalgic and emotional about the great times, experiences and friendships related to SMILE which have enriched my life. But it is also important for the sake of those who were not there to reflect on what factors contributed to these experiences and how they can even now be re-created to enrich the professional and personal lives of others.

The core was being able to meet together frequently and over a sustained time period outside the school environment with teachers and others with broadly the same values about mathematics teaching, to discuss and hammer out between us specific curricula, teaching schemes, activities, resources and assessment materials. The common purpose both launched and consolidated friendships as well as, most importantly, leading to a permanent improvement for students learning mathematics. The processes of developing and trialling connected with SMILE ensured that the activities were of high quality, engaged students, stimulated learning, and worked in real schools with real teachers – of how many of the resources used by teachers today can one claim that?

Research in primary schools that I was later involved with at King’s College London (Chelsea merged into King’s in 1985) has shown that effective professional development of teachers requires four ingredients – sustained time, sustained talk, availability of external expertise, and motivation to achieve something which will improve students’ learning. SMILE had these ingredients in spades, and moreover led to a first class teaching scheme which was a positive influence for thousands of students. We need to not only recall it with fondness but to create the will and the resources to enable teachers today to profit from the same sort of developmental activity. Now there’s a challenge!

Margaret Brown
October 2011
SMILE WITH US
Ask many teachers and they will say that theirs is not a job but a way of life. Ask many teachers of mathematics during the 70s, 80s, 90s and beyond and they would say that they were not maths teachers but teachers of SMILE. Such was the power of SMILE, a unique curriculum development project set in and around the SMILE centre in NW London.

When I was asked about SMILE I would say that it was two things; a way of working, of organising the teaching of mathematics in a classroom and a treasure chest of wonderful teaching and learning materials often brilliantly presented by SMILE’s graphic designer Charles Snape.

It was however much more. It was a club that drew maths teachers from across London and around the UK into a powerful movement for change. It empowered teachers to break away from the constraints of their school and mathematics departments in order to improve the lot of their pupils in their classroom.

Those interested in making real change in our classrooms should read Ray’s book. This remarkable story should not be forgotten nor should Ray’s personal commitment to making mathematics come alive for so many teachers and their pupils.

Although Ray’s book was finished in draft form, her death in July 2018, aged 90, means that it is published posthumously.

John Hibbs
April 2019
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Professor of Mathematics Education, Kings College, London

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one-time Smile teacher and former HMI

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## Timeline of SMILE within the ILEA

This timeline only covers the period when SMILE was an ILEA project. Even for this period, it is, of course, incomplete and covers the major structural, organisational and personnel developments.

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<tr>
<td>Autumn 1972</td>
<td>Birth of SMILE at Ladbroke Maths Centre: week-long conference for heads of maths organised by Jim Mayhew</td>
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<tr>
<td>Autumn 1973</td>
<td>20 schools participating. Ronnie Goldstein seconded to Ladbroke as fulltime co-ordinator</td>
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<tr>
<td>September 1974</td>
<td>First longer course with teachers released from school one day a week</td>
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<tr>
<td>Spring 1975</td>
<td>Splash 0001 Behold the birth of SMILE and Splash 0010 How did it all happen? by Laurie Buxton, ILEA Chief Inspector for mathematics</td>
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<td>Nov 1977</td>
<td>New SMILE Centre opens along the corridor from Ladbroke with secretary Beryl Shinn, two teachers (Ronnie Goldstein and Nigel Langdon) and graphic artist Charles Snape</td>
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<td>Spring 1980</td>
<td>Factor launched</td>
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<td>Nov 1983</td>
<td>Ronnie Goldstein, now Director of SMILE, gets a new job at Warwick University after 10 years at SMILE</td>
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<td>Jan 1984</td>
<td>Hilary Povey takes over as Director Investigator 1 published</td>
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<td>June 1985</td>
<td>Nigel Langdon, now Deputy Director, leaves to take up post of maths advisor in Ghana after 8 years work at the SMILE centre</td>
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<td>Jan 1986</td>
<td>Charles Snape leaves SMILE and is replaced by Billie Old Alan McLean appointed as Deputy Director of SMILE Julie-Ann Edwards and Roger Kingsnorth, two seconded teachers, finish four-term project on Logo based at the SMILE Centre</td>
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<td>1986</td>
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<th>Date</th>
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<td>Nov 1987</td>
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<td>April 1991</td>
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With thanks to Gill Adams who provided the information for this timeline.
Introduction

My main message for today’s, and tomorrow’s, teachers? If we have SMILED effectively (and there is no reason why you can’t, whatever subject you teach), it is the most certain way to initiate an enthusiasm for life-long learning in our pupils. In this book, I provide my personal recollections of SMILE, interspersing these throughout with comments by other voices – other Smilers, maths education researchers and maths advisers and inspectors. It is intended to be both a history and an inspiration.

It is a very personal account and so it seems appropriate to include here at the beginning of the book in the introduction a set of my core beliefs about teaching and learning:

• Learning patterns are diverse and everyone needs their own individual learning path and should be given as much choice as possible.
• The lecture mode/lockstep\(^2\)/whole-class-teaching may be a cheap way of transmitting information but it does not necessarily impart a life-long lust for learning. Teachers should not interrupt learning but be waiting in the wings to give prompts when necessary.
• Accurate individual assessment is at the heart of effective teaching of whatever kind, but this means something more sophisticated than standard tests.
• Inclusion means inclusive/comprehensive schools and inclusive/mixed-attainment groups. Setting is exclusive: a top set must always imply a bottom set.
• Schools must try to compensate for the disadvantages of background.
• A national framework is useful but teachers are the best people to create a curriculum to fit their own pupils. They must have the time and the place to do this.
• Teachers, like their pupils, learn by doing, by sharing ideas. Their continuing professional development should be organised locally and related as closely as possible to their classroom activities. They should be encouraged to form active learning groups where they design their own syllabus and, in the main, learn from the task in hand and from each other.

(I use Chapter 1 to expand on these, my personal, educational values.)

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1 This book is all about SMILE. The website https://smilemaths.wordpress.com/ provides an illuminating overview of SMILE remembered in 2018.
2 A phrase coined by WW Sawyer, which I will revisit later in Chapter 1.
SMILE achieved all these ends and its story illustrates for the present generation of teachers that this philosophy has been tried, that it has worked and that, therefore, they too can dare to work in this way. This story can affirm for teachers the possibility of achieving inclusion and of nurturing the desire for life-long learning.

Because I was an original Smiler, and then became the Inner London Education Authority (ILEA) inspector most closely involved with SMILE for over ten years, with the privilege of joining many other people’s classrooms, it seems appropriate that I should compile the story. But you will hear many voices beside mine, for the majority of us who have been a part of SMILE over the years want to tell our own versions. We had discovered that the conventional whole-class lesson did not work for a group containing a very wide range of achievement and together, we sought out another way. We came together initially because we did not have the wherewithal to deal with groups containing the widest possible spread of achievement and, together, we created the means to work successfully with such groups. We knew from our own experience that our SMILE classrooms were effective, more so than all our previous attempts at creating enticing learning environments. What we created we could see would also prove more effective for all types of grouping and in all subject areas because every class contains a set of individuals with differing interests and preferred ways of learning.

In the following pages we shall be expressing some of our excitement in the work we did together and with our pupils. Our experiences and successes, we believe, have a relevance for teachers today who may be so demoralised by SATs, league tables and all the rest that makes up the stream of directives which have poured forth for the last twenty years or more from the politicians via the departments responsible for education. We recognised that the system of textbook and teacher exposition would not work. Our need in the early 70s was for classroom material from which the students we had in our classes might learn to think mathematically. The philosophy behind it was something we just did not have time to discuss at first. We drew on our experience and, if the results we produced were encouraging in the classroom, we added the material to the growing body of activities on our network. Nothing was tidy and we shall present the story as it appeared to us to develop, practice and theory intertwined. We thought on our feet and our background philosophy grew clearer as we worked. So, this book is not only about practice in classrooms but also about the intellectual journeys of the teachers involved.
INTRODUCTION

Chapter 1 tells you more about my beliefs and the passions that have driven my life-long engagement with education.

Chapter 2 deals with the sense we had of being in control as teachers.

Chapters 3 and 4 recount the early history of SMILE. An Interlude interrupts the narrative to address the argument so often raised when those not involved in SMILE look at it from the outside: did it isolate learners into separated individuals or did it help create independent learners who worked together in a learning community?

Chapter 5 concerns how the materials began to be developed and Chapters 6, 7, 8 and 9 discuss how the creation of materials generated powerful continuing professional development for the teachers involved, changing both them and the nature of what they were producing. Another Interlude gives a vignette of the collaborative teacher experience.

Chapter 10 deals with how SMILE began to explain itself to others.

Chapter 11 begins with a discussion about formative assessment in SMILE and then gives a detailed account of how the SMILE public examinations evolved. A third Interlude describes a pupil conference held at the SMILE Centre.

Chapter 12 gives a full description of an inspectorial visit to North Westminster School, one of the highly committed core of SMILE schools and a final Interlude reflects on other inspectorial engagement with SMILE.

Chapter 13 tries to capture some of the emotive experience of SMILE for students and teachers alike and Chapter 14 concludes the book with the demise of the ILEA, the lingering death of SMILE and the lessons that might be learnt for today from this brief history of the project.
Chapter 1: My educational values

Although, of course, my deeply held educational values cannot help but pervade this entire volume, as part of setting the scene for the account that follows, I set out here some of the intellectual and moral understandings that have shaped my lifetime in education.

Inclusion and diversity

Inclusion is much talked of today, but what does it really mean? Does it only apply to those who have been deemed to have ‘special educational needs’ or is it something broader? What is it that makes a child feel included? Currently, it seems to be assumed that as long as everyone, regardless of their disabilities or needs, is ‘included’ in the same school all will be well. But in almost all English secondary schools, the placing of students into ‘ability’ groups creates a set of expectations for teachers that overrides their awareness of individual capabilities … setted lessons are often conducted as though students are not only similar but identical - in terms of ability, preferred learning style and pace of work … The restrictions on pace and level of work that are imposed in setted lessons have also been a considerable source of dissatisfaction, both for students who find the pace of lessons too fast and for those who find it too slow.3

And it’s the set you’re in that counts rather than the school. With traditional resources and pedagogy, you could not possibly ‘include’ every pupil in all the activities set in a whole class approach. ‘Lockstep’ – that marching together of a whole class through a textbook or using other ‘weapons-of-mass-instruction’ only enhances the exclusion felt by some students, especially those who had achieved the most or the least. Feelings of exclusion are felt most strongly in any environment in which ‘sameness’ is valued rather than diversity. The teenager in particular is seeking to be one-of-the-crowd and is fearful of displaying any eccentricities within the peer group. But a system of lockstep, which aims to treat them all the same, must inevitably show up the differences because they cannot all work in the same way and keep up the same pace.

Diversity is at the forefront of education theory today. Howard Gardner⁴, in his study of four apparently exceptional individuals (Mozart, Gandhi, Freud and Virginia Woolf), exceptional in four very different ways, maintains that “each epitomises one of four possible relationships of which we are all capable.”


What is it that causes some people to develop to heights which the rest of us seem quite incapable of reaching and why are they such different mountain ranges that they scale? Gardner suggests that it is not solely the result of something innate within the person herself, but a dynamic interaction between inside and outside. Gardner also states that that, because “it has been established quite convincingly that individuals have quite different minds from one another”, education ought to be responsive to these differences. Or, as Ostwald (1853-1932) espoused, an educational system is effective in proportion as it proves itself adaptable to the infinite variety of human nature. If this is so, we should be questioning as educators the characteristics of the methodology and the environment that foster the fullest development of all children.

Over the latter part of the last century theories of intelligence increasingly stressed the diversity of individual learning patterns: each child learns at a different pace and in a different mode. Howard Gardner’s ‘individual centred education’ and his definition of up to nine different intelligences\(^5\) questions a school structure based on lockstep in sets and streams, where every child in a group is chosen on the principle that they conform as far as possible to some imagined learning norm. Why? The only reason that springs to mind is that it apparently makes life easier for the teacher who may then (legitimately it is generally believed) treat them as a homogeneous group with all their steps locked together with military precision. This must inevitably slow the progress of the majority. It must also, of necessity, breed exclusion. A recent study of the age of children relative to the start of the school year found that the younger children in the year group, because of the pressure to keep up and their relative immaturity, were more likely to suffer emotional and behaviour problems indicative of psychiatric disorder.\(^6\) The pressure to conform no longer holds if each person in the group has a different set of targets.

We only provide an off-the-peg education and if we want every child’s learning to fit with no rubs and wrinkles, and to prove a long wearing garment which will last all through life, then it must be made to measure. Of course, in our current life, where all things are not equal and there are only the few who can afford clothes that are made to measure, we most of us must buy off the peg, and those of us who are not ‘stock size’ know to our cost the considerable ingenuity required to make clothes fit when they have left the peg. As we shall see as the book unfolds, Smilers were allowed the opportunity to create individual mathematical tasks to fit their own students and to weave them together to create the kind of variety of programmes that would include everyone.


\(^6\) Study by Robert Goodman & Tamsin Ford, Institute of Psychiatry, King’s College London, reported in *The Guardian*, 29.08.03
What does learning outside school have to teach us?

A telling illustration of the fact that teaching methods have not kept up with needs was shown early in 2004 when anxieties surfaced, especially at government level, about the ‘truancy’ problem. It seems that more and more parents were taking their children out of school for holidays, very often to places where they had their roots. Sometimes these holidays extended for more than a month. Instead of grasping such invaluable opportunities for experiencing richer educational opportunities than can ever be presented inside a classroom, the questions being asked were: who shall fine the parents? and how can the ‘truants’ catch up?

At the same time the results of a survey of museum visits found that teachers recognised how “pupils’ experience of seeing and doing unusual things in a resource-rich environment enhanced prior learning and triggered new questions.” It was further reported that for those with learning difficulties “museums were sometimes the only way to access the curriculum and to develop life-skills.”

Of course, the anxieties about ‘catching up’ were entirely relevant to whole-class approaches. If the methodology in the average classroom had really changed, if it were not so important to move up the league tables, if success in tests at certain ages were not de rigueur and the aim were not, as far as possible, to make everybody fit in the same tick box at the same age, then we might well consider paying the parents rather than fining them for taking their children abroad. The kind of positive questions that could be asked include:

• What free resources can this child’s holiday bring to the classroom?
• What experiences of cultural difference can the class gain?
• What presentation can be made by the holiday-learner for the rest of the class to share?
• What photographs, pieces of writing, video footage, information leaflets, etc. can she provide?
• What can the whole class learn about the language, religions, architecture, food, clothing, customs … (the list is endless) of the place one child has visited?

Then the learning experience of the individual could well be extended to all members of the class, difference might be celebrated and a richer education experienced by all, with a much needed, respectful study of another culture taking place in the classroom. Then, with a 21st century pedagogy attuned to flexibility, the potential of every child could be brought out – which after all is the definition of education – and the inculcation of habits of life-long learning might have some hope of emerging.

Smilers looked again at the issue of individualisation and lockstep. I need look no further than my own school days to find a telling example of that opposition. Having gone on to university I would, I suppose, have been considered one of the school’s successes. Indeed, the school did give me many rich learning experiences.
Yet, it was not there but at home, with a more individual-centred approach, where I gained some of what were for me the most valued skills, knowledge and understanding, almost in spite of what was happening to me at school.

An example may make clear what I mean. My mother, an expert dressmaker - although formally untrained - made many of the clothes worn by my two younger sisters and myself. From an early age we watched what she did and she welcomed our queries, explaining the processes to us whenever we showed curiosity. We had access, even in war time, to left-over pieces of fabric and were encouraged to make our own attempts at creating clothing, first, on a small scale for our dolls and then, as we became more skilled, for ourselves. We were from a very early age allowed to use needles, pins, tape measure, even the highly valued, sharp dress-making shears and the sewing machine. We were guided in the cutting of paper patterns from dolls’ clothing already in existence and then from garments we wanted to copy for ourselves, as well as using commercially-produced patterns bought for or lent to us. Throughout we were encouraged to experiment and to choose what we wanted to produce, help always being available when we asked for it. Each followed her own inclinations, resulting in a rich variety of home-made clothing taking shape.

Parallel to this activity, in my school needlework lessons the task set for all members of the class was to make a very simple summer dress from a basic, commercially-produced paper pattern (the same pattern for everyone as far as I can remember). In its making, rather than taking the short cuts I had devised for myself, we were required to follow rigidly all the standard procedures of tacking and basting, pressing and finishing off, etc. That summer dress hung around on a coat hanger for years, a half-made garment which never did get finished.

A similar contrast between two such approaches, expressing satisfaction with the more open one, was made by a participant in the 2002 summer-school programme at England’s first Gifted and Talented Academy at Warwick University: “At school you have to do a set task, exactly how the teacher tells you … Here, we take our inspiration from an idea … I keep scribbling down thoughts on my paper.” But why should such an approach be restricted to the ‘gifted and talented’? Is this yet another example of exclusion?

Guterson⁷, when writing in support of home schooling, suggests that, in schools as they are organised today, it is impossible to meet the diverse needs of students. He maintains that schools can never be as effective as education at home. For one thing, he considers that teachers cannot know individual students well enough to provide for them adequately. Considering the difference in the two pedagogical approaches illustrated by my experience, how influential were those home-education experiences in my developing appreciation and understanding of mathematics? Did the placing of paper patterns on folded pieces of fabric to produce plane shapes with bi-lateral symmetry, the fitting of the pieces of a pattern for a garment on to the

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Chapter 1: My educational values

available fabric as economically as possible and the final manipulations of initially plane pieces of fabric so as to make them fit 3-dimensional bodies, give me my first interest in hands-on geometry, so that it was once again the home ‘teaching’ which started me on the path to mathematical thinking? Were the embroidery and the knitting, started at home at a similarly early age, with their basis of repetitive process and designs involving reflection, rotation, translation, etc., the practical experiences on which the understanding of geometrical theories could be built?

Guterson, who teaches English in an American high school, chose home schooling for his three sons, because he believes that our educational institutions are thoroughly at odds with what science tells us about how people learn. A fundamental change in the system is needed, he believes, to allow children to follow their singular paths as learners, guided by those who know them well enough to help them choose the most suitable paths to follow. Only in that way could a truly effective education be offered.

Instead, we have schools required to ‘deliver’ the curriculum,

_The ready-made package which must be successfully (i.e. measurably) pushed through the mental letter-boxes in the brains of all schoolchildren, at given times to children of given ages …_ Child-centred education has a bad press, yet all parents recognise the balance to be struck between giving the child what the adult believes to be vital, and allowing the child him/herself to direct the nature of the development … pupils need involvement and control; individualised programmes of learning; learning which is appropriate (‘just in time’ …) and which is lifelong.8

As it is, with today’s pedagogy – namely lockstep – we are left with the question of whether full development, mental, physical and spiritual, for _all_ children is any more achievable in today’s schools, through the conventions and orthodoxies of today’s education, than it ever was. Trying to tidy it all up, by introducing more narrow testing (with neat rows of tick boxes), detailed instruction on lesson organisation and regulations on amount of time spent on mathematics, has taken us backwards to the rigidity from which, thirty years ago, the _SMILE_ group managed to break free. If lockstep could be abandoned there might be some hope of a _SMILE_-type approach right across the curriculum.

**To push or not to push? that is the question**

So, what is ‘progress’ and how does the teacher ensure that it is being made by every student? “I haven’t started teaching Angela to read. I don’t want to push her. I think play is still important for children” – a mother’s comments about her 3-year-old. “They don’t come to school to be sheltered, they need to be pushed” – the words of the headteacher of a special school for children with autistic

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8 Liselotte Lyngso. *What’s it all about?* Editors: we have been unable to source this reference.
spectrum disorder/autism and social and communication difficulties. Perhaps *knowing the right moment* to ‘push’ is the key to effective teaching and learning at all stages and in all cases.

John McEnroe in his autobiography considers ‘pushy’ parents. Richard Williams, the father of Venus and Serena, told him, “Kids have no idea what they want to do most of the time … Look, I picked something great for them … So of course, I pushed them.” McEnroe, deploring the horror stories of pushing tennis parents, says that his parents were the driving force behind him and that he seriously doubts whether he would have been the player he became if he hadn’t been forced into it in some way.9

Pressure of the 'horror story; tennis parent might be likened to the pressure in the British education system coming at present far too hard and too often from outside – from nationalised testing. There is terror attached to formal assessments of this kind, while many have grave doubts about both their efficacy and their accuracy. I have read that the latest argument against league tables is that they may well be measuring learning that is taking outside the school, rather than resulting from lessons in the classroom. One has to remember the old horse drawn to water proverb - the student who is corralled into the classroom cannot be forced to learn.

The key is to be able to distinguish between the time when, with a push, she10 will take off and when the push will be counter-productive and turn her against that particular avenue of discovery perhaps forever. Such fine tuning of learning is not something that can be contemplated under a regime of whole-class teaching: for each individual the right time to push is different. You cannot satisfactorily push a whole class. To find the right time to push, sensitive assessment is vital. But it is not necessarily the assessment made by SATs or other carefully measured findings.

**The tyranny of numbers**

Before concluding this chapter, I want to dwell briefly on the “tyranny of numbers”11. At its most succinct this is the recognition that what gets measured is what gets valued. The problem is that what really needs measuring is not countable. We only have to think of the 18th century mathematical prodigy Jedediah Buxton who, asked if he had enjoyed a performance of Richard III, could only say that the actors had spoken 12,445 words!

We are currently experiencing an obsessive preoccupation with numbers with the uncontrolled use of mathematics as an end in itself12. The whole cult

10 When the text is newly written for this book, I have favoured the female pronoun as generic rather than the male as a counter-balance to previous practice; but where the text is historical, I have stayed with whatever was used in the original. You will see that SMILE gradually came to a similar awareness.
12 Richard Scase, professor of organisational behaviour at University of Kent, Canterbury.
of measurement, statistics, targets and indicators that has become such a feature of modern life cuts across the guiding purposes of education. These numerical indicators are about management at a distance, and they will always miss the point: school league tables make teachers concentrate on borderline pupils at the expense of their weaker classmates. Charles Saumarez Smith, Director of National Portrait Gallery, argues that measuring fever actually causes inefficiency - it creates “a belief that the system is more important than the individual, that accountability is more important than intelligence or creativity, with the result that the public sector is likely to continue to limp along impotently and inefficiently as long as it holds a low sense of its own political valuation and public esteem.”

People are expected to do what the targets tell them rather than what is actually necessary.

Caleb Gattegno explains how in his use of Dienes’ coloured rods with deaf children: the rods “introduced… children to number without using counting”. That this could be of greater importance than may at first be realised will dawn on teachers of secondary mathematics who have experienced long years of struggling Year 10 students who have learnt to do no more than count. If asked, for example, to multiply 17 by 3 they are as likely as not to make three rows of 17 tally marks in their exercise books and then count them one by one – perhaps reaching 51 as a result. Indeed, Gattegno reminds us that:

> Counting is a lengthy and costly procedure, used in exceptionally simple situations in life, and it was precisely in order to increase their power and to avoid the slowness and the limitations of counting that men developed the processes of arithmetic.

As the old Scottish proverb says: “You don’t make sheep fatter by weighing them.”

**Looking forward**

Seymour Papert, who did so much to infiltrate the classroom with computer use, had criticisms of current classroom methods:

> Learning in schools today is not significantly participatory – and doing sums is not an imitation of an exciting, recognisable activity of adult life. … powerful new social forms must have their roots in the culture, not be the creatures of bureaucrats.”

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13 “The storming of the accountants”. The New Statesman, 21.01.02
15 Year 10 pupils are aged 14+ with other Years following this pattern. In the 70s, Year 10 pupils were called fourth formers and here too the other years followed the same pattern. When the text is newly written for this book, I have used Year 10 etc. but where the text is historical, I have stayed with whatever was used in the original.
16 ibid p. 5.
But so far in the 21st century, all too often, education has been the product of bureaucrats, planned as a one-way system where we continue to fail many of the children much of the time. It is true that over the turn of the century the majority of pupils’ performance in a narrowly defined set of standardised tests seems to have improved remarkably, but are those experiencing the tests more enthusiastic about learning?

Warwick Sawyer, of anti-lockstep fame, who taught mathematics to a variety of young people in a variety of countries, points out the importance of such enthusiasm:

*If a child left school at ten, knowing nothing of detailed information, but knowing the pleasure that comes from agreeable music, from reading, from making things, from finding things out, it would be better off than a man who left university at twenty-two, full of facts but without any desire to inquire further into such dry domains.*

Do pupils today have a greater store than previously of transferable knowledge and skills they can later employ outside the classroom? Will the proportion of today’s over-tested children becoming ‘life-long learners’ be greater than before? Or is the school still a workshop trying to turn out perfect specimens in some narrow aspects of learning and having many more failures than successes? (That is, if we measure success as a thirst for life-long learning.) These standardised, mechanistic measures do not appear to have much relevance to an ability to deal with “the global knowledge base”, which Chris Watkins and Peter Mortimore remind us is “growing exponentially”, while the “social fabric of our societies [is] being altered by the mass expansion of communications. Pedagogy”, they therefore maintain, “must change to keep up … must seek to engage those who would otherwise be excluded … [and must] support all learners to generate knowledge and to learn what to do when faced with uncertainty.”

Successive governments have, so they say, been bent on ‘improving’ education - meaning what? At least, one hopes, ‘education for all’, and at best – borrowing again, this time from the Campaign for State Education (CASE) - ‘the best education for all children’. Maybe the aim of universal education is impossible to achieve anyway; whether it can be achieved in one institution in the present day’s political ethos is by no means certain. A former colleague of mine (not teaching mathematics) used to tell me when I despaired of reaching all my students that it is essential for a teacher to believe it is possible to teach all the 30 students in a class, while, at the same time, knowing that it is not. In 1974 I wrote in the TES:

*It is argued that when every member of a class is proceeding at his own pace the teacher will waste much of his time through repetition; it seems more economic to*

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Chapter 1: My educational values

give one explanation to the whole class than to give it many times to individuals. This argument seems to me to presuppose that when an idea is expounded to 30 pupils each of those 30 has reached the right stage of mathematical development and is in the right frame of mind to receive it. I wonder how often this happens even if ‘fine setting’ is achieved.

I was not, of course, the first to question the possibility of teaching 30 students identically all at the same time:

My second shock was the discovery – obvious but not always appreciated in the classroom – that one’s pupils are all different … twelve soldiers ranging from a very knowledgeable officer who wanted to study Further Heat Engines to a young REME craftsman who had some inclination to embark on what would be a very slow journey towards O level. I gave them all the calculus course just the same and I really think they enjoyed it, but most of the time I just tried to help them on their own problems at their own level, and I have never since been able to face a class of 30 and pretend to myself that all the children were congruent … working at their own rate trying to relate the mathematics with their own interests.20

However a group of 30 pupils is formed, the idea that such a group is suitable for discussion is remarkable. For a discussion outside a school classroom the optimum number of persons involved is usually at the most half that number. A seminar where all participants are to be involved rarely has more than 15 members. If a conference is broken down for discussion the groups formed are likely to have from 8 to 12 members.

SMILE certainly always aimed for this target of educating all the children in a class, and many of us believe its most able practitioners got as near the bull’s eye as possible in an imperfect and uncertain world. Which is, indeed, why this book is being written. It depends, of course, what you mean by education. If you mean providing a safe, supportive and welcoming environment; treating all children fairly, with dignity and respect; helping each child to follow her own unique path of development (which is like no other child’s); extending each child’s individual powers of understanding, imagination and skill as far as it is possible for them to go, together with the imparting of a desire for ever more learning in those areas individuals have chosen for themselves (life-long learning) – that is a tall order – but it is, of course, the vision of the dedicated teacher. It was certainly the vision of those teachers who were collected together by Jim Mayhew at the conference at Ladbroke Mathematics Centre in the autumn of 1972 that saw the birth of SMILE and it was the never-ending task they set themselves over the years that followed.

20 Hailstones and Folkweave. Looking on the Bright Side. Editors: we have not been able to source this reference.
Chapter 2: Taking control

One day in the autumn of 2000 a man was waiting at a counter to deliver some material to be printed. He told John Barzey, who stood on the other side of the counter, that it was SMILE material.

“SMILE?” repeated John Barzey.

“Yeah.”

“SMILE mathematics?”

“Yeah.”

“It changed my life.”

John described how in his first year in secondary school he and his mates more or less gave up on maths. They were bored by the exercises set and half the time did not understand what the teacher was ‘on about’.

“Then,” said John, “Mr Garwood arrived and took over our class. He introduced SMILE and I began to take control of my own learning.”

This chapter provides an introduction to the SMILE project. It seeks to explain how the project, driven by the need for curriculum development, was nevertheless an extraordinarily powerful vehicle for the continuing professional development of those involved. It begins by drawing out the real sense of teacher control that was embedded in the project from the very beginning, explains some of the reasons for the need the teachers felt for new curriculum materials, indicates that teacher collaboration was from the very beginning an essential component of the project and conceptualises that collaboration through the idea of action learning.

Teachers in the driving seat

During May 2001, when I was first thinking about writing this book, a TES cartoon was captioned, “It says you’ll have to take responsibility for your own development”. The article flagged the government’s proposal\(^1\) to “give teachers more control over their training”.\(^2\) It seemed a welcome step forward. Yet, on second thoughts, it seemed all old hat, for teachers who had been involved with SMILE, some of them for 30 years or more, had control over their own continuing education. What is more, the smaller print of the TES revealed that the proposal for this new century was merely to give teachers money to make a choice between courses “decided by someone else.”\(^3\)

How different from the approach of Jim Mayhew, one time inspector\(^4\) for mathematics for the Inner London Education Authority (ILEA) and later Her Majesty’s Senior Inspector for Mathematics (HMI), when he set up a week’s

\(^{1}\) Learning and Teaching: a strategy for professional development, DfEE, 2001

\(^{2}\) Warwick Mansell, “Getting personal about training,” TES 9 March 2001

\(^{3}\) ibid (my italics)

\(^{4}\) The ILEA called its subject advisors ‘inspectors’. 
conference in the autumn of 1972 for heads of mathematics departments in secondary schools. His vision for those heads of department was that they would produce a scheme of work. The scheme was to be flexible enough for mixed ability groups in order to improve the mathematics education on offer in secondary schools.

He had recognised the skills and talents of members of the group, he valued their experience and initiative and he wanted to use them. In particular he had noted the work of John Stewart, who was already beginning to put together such a scheme at Chelsea School. The result of that week’s conference was SMILE (Secondary Mathematics Independent Learning Experience) an opportunity, backed by the ILEA, for a group of secondary mathematics departments to improve their own practice by producing resource materials for their own classrooms. Thirty years on, the classroom materials are still being discovered by teachers, now that they form part of the STEM eLibrary.

Figure 1: A selection of SMILE materials

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25 The phrase which originally gave rise to the acronym was “secondary mathematics individualised learning experiment”. Later, as pedagogic approaches changed and SMILE was no longer an experiment (whilst remaining experimental), it seemed more appropriate to interpret the acronym in the form given above.

26 https://www.stem.org.uk/resources/collection/2765/smile-cards
This book tells the story of the evolution of these materials. However, it also demonstrates how the production process of SMILE proved to be a remarkably effective vehicle for the continuing professional development of increasingly successful teachers. These teachers were put in the driving seat, being given the facilities to develop new practice. It was a long-term, continuing study/task. From the beginning, it was the participants who decided the form ‘the course’ should take, they decided the nature of the tasks to be created for their pupils and the approach to be taken to the mathematics in hand and they chose the experts to support this process (whom they believed could give them more insight into the task they had set themselves), while much of the time they learnt from each other and from the work in hand.

We teachers, like our students, had taken control of our own learning. The story of how we did this (for I was one of those original Smilers) and how it changed our lives as well as those of our pupils seems to us worth the telling not least because it may give the teachers of today the courage to experiment, to share ideas and to create more inviting learning environments for their students.

Mixed ability learning groups for mathematics

Although the purpose of this book is not to argue the pros and cons of mixed ability learning groups for mathematics, the underlying philosophy of such groups must be explored because their introduction was the first reason for the creation of SMILE. (The second was that sufficient numbers of people well qualified in mathematics could not be found to staff the schools.) John Stewart and the other teachers involved, recognising that no suitable texts existed for such groups, were seeking – and John was already adapting – materials that would be more pupil- and teacher-friendly. Through the collaborative approach to finding and writing material those not so well versed in mathematics could learn from their colleagues. In addition, all recognised the variable levels of achievement in any group of pupils brought together.

As my own classroom experience had grown over the years, I recognised more and more clearly that a class could never, and should never, be considered as ‘a class’, a uniform body. It is and always will be – however carefully streamed or setted – a group of disparate individuals with varying temperaments, interests, needs, capacities and potentials and, above all, with different modes and speeds of learning. But, until I became part of SMILE, I dared not, for the sake of my sanity, let this deeply buried recognition rise too near the surface because I knew I could not cope with it effectively. Faced with a group of thirty individuals, how can a teacher hope to develop a style to which all will respond, and encourage a rate of working by which all are challenged but not dismayed?

Before they came together the SMILE group had become ever more firmly convinced that effective grouping for learning could not be based on levels of previous achievement, you can’t ‘tidy-away’ the difficulties. Setting and streaming
Chapter 2: Taking control

are attempts to bury this insoluble dilemma so that teachers, and the administrators behind them, can pretend that a class is a class, a more or less homogeneous entity, where all members have the same learning patterns, the same speeds of assimilation, and may therefore be appropriately set the same targets at the same ages and stages. Politicians, however, when introducing all the new nationally-imposed initiatives and legal requirements, up to and over the turn of the 21st century, have endeavoured to make the system tidy, with students neatly labelled and packaged; but, in all, they have only tinkered with the system. The changes have done much to restrict the freedom of teachers to innovate but, nationally, there has been no attempt to find a new pedagogy for the 21st century where new technology abounds and new insights in psychology are emerging. Nor has there been proper consideration of how to encourage that flexibility in skills and knowledge so often recognised as necessary for the work force in this new century. Nothing has radically changed and this attitude has remained prevalent to the present day.27

In spite of the recognition in the Cockcroft Report of a “seven year difference”28 in the spread of mathematics achieved by children of the same age, from the late 1990s onwards and with the introduction of the National Numeracy Strategy, the politicians of the day have stressed the importance they attach to a whole class approach to mathematics, whilst also pushing for some setting in the primary school. And the same philosophy is clearly, rising steadily up the educational ladder, and decreasing the number of non-selective, inclusive groups for mathematics in secondary schools.

Yet in 1975 Kelly wrote of “the unfairness to which all forms of selection in education have led because of their inherent inaccuracies and inefficiency.”29 The very least enthusiastic of the pro-mixed-ability-groups lobby are those who believe in such grouping because of the dangers of mistaken judgement. It is better not to hang a prisoner who might have been wrongly sentenced. How many pupils are wrongly sentenced to the bottom set?

Rhys Griffith, when questioning Emily about the difference between the level of difficulty in German and English lessons which flanked the bottom set mathematics lesson where she obviously found the work too easy, quotes her as

saying. “Oh, I shouldn’t be there, I’ve always been in Set 2 for maths. It must have been a mistake when the computer printed out my timetable. But no one ever said anything so I just stayed there. It’s my time off.”

**Teacher collaboration**

The story of SMILE, therefore, is basically about the collaboration of secondary mathematics teachers and about their taking control, not only of the conduct of their own day-to-day lessons, but of the production of the materials to be used in those lessons. The story is about teachers sharing their expertise and understanding in the carefully considered preparation of activities in mathematics for their own pupils to use independently. It is a story of the cut-and-thrust of argument about mathematics and about the devising of the best methods for presenting it to pupils at the secondary school stage. For the participants in this task, SMILE became, first and foremost, a process through which they all made remarkable and continuous growth in their professional competence. The venture demanded co-operation within the mathematics departments involved where, because the outcome was for the benefit of the pupils of all its members, teachers willingly spent extra hours writing material when they might have been relaxing, or covered an extra class or two for colleagues who were writing when they might have been doing their own individual preparation and marking. The evolution of a spirit of collaboration and a method of fitting the mathematics course as closely as possible to the needs of individual pupils is obvious when reading through the pages of Splash, the vehicle for the exchange of ideas among Smilers from 1975 onward.

![Small Smiles](image)

“Sir. Will you mark my work please?”

“Why? Can’t you use the answer book as you usually do?!”

“No, sir.”

“Why ever not?”

“It says here Please do not mark this sheet in any way.”

*Figure 2: From Small Smiles, Splash 0001*

Learning from each other was at the heart of the project. How often during meetings or at conferences or in the pages of Splash another teacher would say

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31 The A5 booklet, produced about six times a year to keep all individual members of the project up to date with current, joint SMILE thinking, materials and activity.
something that stopped you in your tracks because you didn’t agree with it or it put a different slant on your thinking about classroom practice or gave you a different approach to solving a problem. Listening and having the opportunity to experiment with an idea, helped to clarify what we were doing in the classroom. We think our approach might work for you, whatever subject you teach.

**SMILE: process or product?**

Someone said of SMILE, ‘If the materials are valuable, writing them is invaluable.’ In essence, then, SMILE is not a product but a process. For the teachers who have shared in it, it has turned out to be, first and foremost, a process through which they have all continued to grow in their understanding and in their professional competence.

Once SMILE was established, the opportunity to meet regularly throughout the year (all day Monday) was supported by the ILEA. Details of this ‘course’ are found in later chapters but here I want to draw attention to this amazing ‘marriage’ of developing materials and growing the stature of participating teachers which is perhaps not always fully understood. The creation of learning materials was the medium for the teachers’ learning but this was missed by, for example, HMI.

*The long course … has dual objectives which might be separated: in-service training and the creation of new material. The in-service training might be carried out in short courses and through visits to schools. The revision and creation of new material might be completed more successfully if there were a stronger representation from schools; i.e., experienced teachers high in the mathematics department.*

This suggestion of a division of activity into two strands – creating new materials for the classroom and what would now be called continuing professional development fails to recognise that integration of the two was essential to a form of “action-learning”.

The career of Reg Revans, who had introduced a new form of learning in the business world, followed experience in a local authority education department with work in education in the National Coal Board and the National Health Service, and ended at Salford University. It was in October 1945 that Revans suggested to the Mining Association of Great Britain the formation of a staff college where those with problems could come together and learn with and from each other. He “defined this approach as ‘Action Learning’ and described it as a process where comrades in adversity” proceeded from diagnosis to treatment of real problems rather than courses where the members listened to “the reminiscences of no-longer-involved experts”.  

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His was a new vision of continuing professional development where “participants take responsibility for their own learning and they develop skills in supporting their peers”\textsuperscript{33} because he maintained that “our understanding of what we need to do to train managers falls far short of our technical mastery of the training of circus animals.”\textsuperscript{34} It is not difficult, substituting ‘teacher’ for ‘manager’, to apply Revans’ theories to the continuing professional development of teachers – and, in doing this, we have a model remarkably close to the SMILE process as it applied to teachers and, in part, to their students. The task the Smilers set themselves – to develop a curriculum for their own students and a way to present it that was most appropriate to their individual needs – is what teachers can do better than anyone.

They do need, however, opportunities to discuss their day-to-day work. As SMILE grew, smaller groups, organised by task or by locality, were formed which proved excellent forums for teacher discussion – very like Revans’ action learning groups. As Alan Reilly wrote,\textsuperscript{35} “In a teacher-based project such as SMILE the need for involvement of each individual is paramount. A smaller group…can provide this.”

It is hoped, therefore, in the following pages to give a history of this process alongside a description of the dynamic set of materials – which constitute SMILE for those not closely involved – and the changes in pedagogy and classroom organisation which grew up with them.

The SMILE story will be told in the following pages by many voices speaking at a variety of times and in a variety of tones – teachers and pupils, and others who gave the space in which the teachers involved could let the project take root. In some sense it might also be considered to be oral history with much personal recall but its reliability will be made certain by the documentation and records being quoted. Some will be recording events of the past as they happened, speaking to us today from the pages of Splash of the 70s and 80s. Others will be recollecting and analysing past progress from a later perspective.

Many of the participants will not be named because, from the beginning, anonymity was the name of the game and the group’s belief was that the material should be held in common and should not be seen to belong to any one individual or group. The importance of the project for those participating was the sharing of ideas, the creation of materials for use in their own classrooms tomorrow and, in the process, what turned out to most important of all, the growth of their own understanding of mathematics and the learning process.

\footnotesize{\textsuperscript{33} Ian McGill & Liz Beaty, Action Learning: a guide for professional management & educational development, London: Kogan Page, 1992.}
\footnotesize{\textsuperscript{34} Reg Revans, The theory and practice in management, 1966.}
\footnotesize{\textsuperscript{35} Alan Reilly, “Pimms No. 9” Splash 1001, October 1977. (my italics.)}
Chapter 2: Taking control

The strength of SMILE had been the degree of teacher involvement it enjoyed and, when given enough autonomy, its ability to grow more effective teachers. The fear was expressed as early as January 1976 that, as it grew, increasing size would inhibit the close involvement of the classroom teacher – that the product would take precedence over the process. As history has moved on, the involvement of the teacher has indeed decreased, but not because of the rapid growth in the size of SMILE, which spread like a forest fire to begin with. Rather, it is the ever-increasing centripetal force exerted by the politicians on the education system that has extinguished some of the fiercest of the fervour. The enthusiasm has been doused by a changing political climate where trust in teachers has decreased, tests of mechanical obedience have been set for both teachers and pupils and fragmenting legislation has gradually eroded teachers’ freedom to organise – amongst other things – their own methods of continuing education. In days when competition between schools is promoted rather than collaboration and when teachers’ records matter more than the pleasure, profit and purity pupils find in their mathematics learning, it seems important to tell the story of this exciting innovation built on principles of inclusion and collaborative learning in the classroom, the materials and methods of which have so much relevance for the 21st century.

36 Splash 0101, January 1976
37 Geoffrey Matthews’s preferred order of objectives in his mathematics series for St Dunstan’s School.
Chapter 3: The beginnings of SMILE

This chapter outlines the comprehensive context in which SMILE originated and the dilemmas produced by the commitment of some schools to mixed attainment teaching. It introduces the Kent Mathematics Project (KMP) which was the forebear of SMILE, explains the vital role of both the ILEA and the provision of teachers’ centres as midwives to the project, describes the initial week-long course that brought the original Smilers together and records the birth of SMILE.

The comprehensive context

SMILE began during the heyday of the comprehensive system and admissions were in the limelight as they sometimes are today. How was a school population to be chosen so that it represented the whole range of achievement? For some years after the creation of comprehensive schools, Year 6 pupils in the ILEA sat the Comparability test in mathematics, English and comprehension and ‘teaching to the test’ was a problem then as it is now. The results of the test were used to group all primary school children into three bands. Each secondary school then had to admit into its first year 25% from band 1, 50% from band 2 and 25% from band 3 giving, it was believed, a balanced intake according to ‘ability’. The comprehensive school was to include everyone, thus ridding the system of the selective grammar schools from which the majority of the population was excluded.

There were no league tables. However, the comparability test, although it had nothing to do with measuring one school, or one pupil, against another, resulted in some teachers spending time with their Year 6 classes in ‘teaching to the test’. Furthermore, although the pupils were not given their results, they caught the feeling of panic from their teachers. Not surprisingly, therefore, the tests were eventually abandoned in favour of some less obtrusive instrument of assessment.

After an intake of students whose levels of achievement spread right across the spectrum had been achieved, the schools still had decisions to make. How would they organise those students in classes in order to ‘include’ as many of them as possible? Three options were open to them. They could:

1. form learning groups which contained a balance of children from all 3 ‘bands’;
2. set according to achievement for some subjects (mathematics usually being the first of these);
3. stream so that pupils with differing levels of achievement were organised almost as different schools within one building.

Some grammar schools remained in neighbouring boroughs and in some areas of inner London the bands were skewed and schools struggled to recruit according to the plan.
The schools in which Smilers operated chose the first option because they believed that exclusion was not so much about which school you attended but in which class within that school you were placed. They believed setting and streaming were exclusive. This was based on changes in perception of intelligence. No longer the Burtian39 fixed entity but something much more complex, making it well-nigh impossible to prophesy how far any child might progress given favourable circumstances. This belief in possibilities without limits for all children is made clear by one of the original Smilers: Hilary Povey looks back from a 2005 perspective:

*I began teaching mathematics in 1970 in an inner city comprehensive in Hackney. The students were put into two bands on entry: 120 in the top band and 120 in the bottom band. Within each band, four sets were created for mathematics. I had recently emerged from training college and, as part of my studies there, had been required to read and analyse some texts that were to become classics: examples included John Holt's How Children Fail, Paul Goodman's Compulsory Miseducation and Robin Pedley's The Comprehensive School. One that had a profound influence on me was Brian Jackson's Streaming: an Education System in Miniature. Research clearly showed (and continues to show) that the division of school students into bands and sets and streams has little effect on the attainment of a school's academically successful students – but it produces a long tail of poor achievement and impacts very negatively on the social and personal welfare of those deemed unsuitable for the higher classes. At my school, an even balance of boys and girls in the divisions was deliberately kept – but students who had recently arrived from the Caribbean (of whom there were many in the school) were to be found disproportionately in the lower band and lower sets and students with middle class backgrounds (of whom there were few) were clustered in the upper ones. So what on earth were we doing? And where was social justice?

I was young and idealistic (now I'm old and idealistic!) and was very concerned with these questions. Much educational rhetoric at the time was advocating mixed attainment teaching for English, history, art and so on but arguing that mathematics and modern foreign languages were deeply hierarchical subjects and so couldn’t be taught to groups comprising students of varied levels of competence and understanding of the subject. I wasn’t prepared to accept that so when my Head of Department, Chris Stolz, asked me to attend a week-long course the other side of London that was focusing on this issue, I grabbed the chance with both hands and with gratitude.

39 Until his death in 1971, the British educational psychologist Sir Cyril Burt, psychologist and geneticist, was viewed as one of the most significant and influential educational psychologists of his time. After his death, the legitimacy of his research was called into question and he was accused of fabricating his evidence in order to prove that intelligence was inherited. Recent work has reopened the issue.
Smilers believed inclusion for the learning of mathematics meant embracing all sorts and conditions of learners in the same class - and they attended the course wanting to find out how to make this possible.

**Coming to terms with mixed achievement in mathematics - KMP**

The story starts in the schooldays of John Barzey who we met in the previous chapter. Mathematics teachers were coming to terms with learning groups of a kind many had not met before - a kind most thought was not feasible for learning their subject. Indeed, I too thought they might work for other parts of the curriculum but not for the study of my own discipline. The belief had long been that mathematics could not be successfully taught unless the students had been divided into groups of similar levels of achievement. However, in 1970, we find Geoffrey Matthews (the first professor of mathematics education in the country) maintaining that “a sort of revolution” had taken place in this country during the past decade in the teaching of school mathematics. He explained that, unlike the recent and ongoing changes in education, it had been “a very British revolution”, in that no minister or government inspector had issued a new syllabus but that there had been an outbreak of projects of various sorts.40 One of the questions raised by these schemes, he suggested, was “Must we always teach from a text book?” With this question in mind, he described a non-text book, but nevertheless structured, system being developed since 1967 by a team of twelve teachers led by Bertie Banks41 of Ridgewaye School, Southborough, Kent. It was designed to cater for the widest variety of needs and interests. Finally, he gives a judgement of the project:

This system has certainly been appreciated by the children who have used it so far; each feels he has his own personal programme. The teacher has time to concentrate on their individual problems. It may be that the “disaster kit” will find some favour with teachers who don’t feel their position is disastrous at all.

The idea underlying cards, modules and kits is to give the children an opportunity to think for themselves.

Banks responded to Matthews with a description of the origins, the organisation and the advantages of the Kent Mathematics Project (KMP). To give the flavour of a KMP classroom he notes earlier titles of the scheme – *An Auto-Instructional Course in Mathematics* and *The Ridgewaye Individualised Course* – both discarded because they did not convey the deep involvement of the teacher in the learning of all the children or the fact that “children like to work together and help each other in a remarkable way”. He also remarks the way children respond to working without a teacher “on their backs, especially if they feel they are really mastering a task and know exactly

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41 Bertie Banks is introduced in the Foreword.
what it is they are mastering.” He expresses the belief that such a way of working:

- makes the grouping of children unimportant;
- means that mathematics can be learned at the maximum learning rate of each child;
- meets all the requirements of a fully comprehensive system;
- could cater for any child in any subject;
- could dispense with the fragmentation of present school time tables;
- could make possible an integrated day.

While KMP was growing in Kent - being used by 1975 in 65 Kent schools of all types (except infants) - in 1970 Geoffrey Matthews was instrumental in getting the material into two west London schools: Ladbroke and Fulham Gilliatt, both girls’ schools with problems in recruiting specialist staff. Meanwhile International Computers Limited (ICL) had become interested in the material because they thought it lent itself to ‘computerisation’ and had begun to attempt to develop an electronic version. Some of this material was being used, quite independently, in the same western area of the ILEA in Chelsea School. More details of this activity will emerge later.

At that time KMP offered personal mathematics courses for all students between 9 and 16 years of age, using a material–bank of programmed booklets, tapes and worksheets organised into mathematical levels and areas. At the start the teachers of the early experimental schools were the main source of materials but the rate of production was always desperately behind the demands of the schools, especially as the number of schools in the project steadily increased, as did the year groups in those schools using the material.

A two-dimensional display of available materials - rows indicating levels of difficulty and columns relating to mathematics topics - gave the possibility of quickly accessing for each student a programme of tasks from chosen aspects of mathematics at appropriate levels of difficulty. The mathematics levels, initially intended to relate to the conceptual development of a child of average attainment, eventually, after several years’ use and moderation, related to one year’s conceptual development for an above–average student. SMILE adopted a similar structure illustrated below. It was regularly updated as new material was added or old material was moved or replaced in the light of classroom experience.

Figure 3: The SMILE network
A place to think - Ladbroke Mathematics Centre

These changes in classroom practice were not the only significant things taking place in the mathematics education scene in the 1960s and 70s. In 1965 the Joint Mathematical Council of the United Kingdom (JMC)\(^{42}\) commented:

*The past century has witnessed significant developments in the fields of mathematics, education and psychology. However, the main body of teachers of mathematics has been substantially untouched by these developments.*

One of their recommendations was that

*facilities be provided within the school structure for serving teachers to develop their knowledge and efficiency, preferably by setting up Mathematics Centres under Local Education Authorities.*

This was a liberating suggestion, for teachers could not change their ways without the opportunity to stop and think together. It was made in the light of the first mathematics centres pioneered by the *Nuffield Project* in 1964 and more teachers’ centres followed as a result of the JMC’s suggestion. These centres gave teachers a place where they could do this essential thinking. Denis Frost, the warden of Ladbroke Mathematics Centre (who we shall see as the story unfolds was vital to the birth of *SMILE*) tells the story of one of the first of these thinking-spaces provided for teachers.

“In 1964 the Nuffield Foundation Mathematics Project was established with the object of producing a contemporary mathematics course for children aged five to thirteen. The Director of the Project, Dr Geoffrey Matthews, chose fourteen pilot areas to take part, one of which was the ILEA, and the Authority in turn chose some of its schools in North Kensington to use the pilot materials: 5 infant schools, 4 junior and 3 secondary.

To take part in the project LEAs had to provide not only schools to pilot the materials but a place for the participating teachers in those schools to meet (i.e. a teachers’ centre). So the Ladbroke Mathematics Centre was set up in Middle Row Junior School.

In the early days it was run on a somewhat part-time basis by the head and deputy of Middle Row Junior School. In 1967, having just completed a year-long course at the London Institute of Education, I was appointed Warden. This was still a part-time appointment as I was allocated a half-time teaching load at Middle Row Junior School. Every Wednesday the teachers in charge of mathematics in the pilot schools came to the centre to discuss the Nuffield Guides as they were available. It was these guides, produced by the *Nuffield Project Team*, that brought about

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42 Editors: we have been unable to source this reference.
CHAPTER 3: THE BEGINNINGS OF SMILE

Changes in the attitudes of participating teachers. Many other teachers in schools in the area wanted to find out more about the new Nuffield mathematics, so many INSET mathematics courses were organised to cope with the demand, from ‘one-night-stands’ to 3-day courses, to – eventually – 6-week courses. “

Most of these courses were for primary teachers, but Jim Mayhew, ILEA inspector for mathematics in the area, also organised meetings for heads of mathematics departments in secondary schools. During one of these meetings, on 6 May 1970, ‘the remarkable Bertie Banks’ was introduced. A large audience of secondary teachers at Ladbroke Mathematics Centre were so captivated by what Bertie Banks had to tell them that a visit to his school was planned for 1 July 1970. The party consisted of about seven or eight secondary mathematics teachers, including John Stewart, Head of Mathematics at Chelsea School, who was already adapting some of the ICL/KMP material to build up his own maths card system. All members of the ILEA party were very impressed with the way pupils worked through their tasks. Altogether, the day was a great success.

Heads of secondary mathematics departments, facing the challenge (new for many of them) of organising effective learning in mixed ability groups and a shortage of qualified mathematics teachers, met to discuss their problems at the Centre. Geoffrey Matthews was influential in Banks being financed to introduce some of his ideas into two ILEA schools. John Stewart at Chelsea School was sure that he could turn his own cards into a scheme like that of Banks. A supportive infra-structure was in place in the form of an advisory service which recognised the value of the creative ideas of teachers and which was willing to back teacher-generated initiatives; a teachers’ centre, where all the discussion and work could take place; and an Authority with enough flexibility and vision to back the venture with central finances. Jim Mayhew staged a Conference on the teaching of mathematics to mixed ability groups in secondary schools.

The enthusiasm generated by the conference was such that it was agreed that a mini mixed-ability project be started. So, the ILEA’s secondary mathematics project (“practically teacher-proof” according to Geoffrey Matthews) was born.

SMILE is born

The idea of building a universal, inclusive education system is, of course, a relatively modern one and it is to be questioned whether it has been achieved anywhere in the world or ever will be. But twenty schools decided to try to achieve this end and signed up to participate in the new scheme to be run by teachers for teachers. The pilot schools transferred money from their school allowance to Ladbroke Mathematics Centre so that cardboard and paper could be purchased and converted by the Centre into the materials the schools required. So began the work of building up what was a vital part of the architecture of both KMP and
SMILE: a network of mathematical activities capable of supplying the mathematics educational needs of all the children in the twenty participating schools.

Looking back in September 2001, Jim Mayhew, whose vision of inclusion brought everything together, gave his version of how SMILE began.

In the late sixties and early seventies, heads of comprehensive schools in ILEA were introducing mixed ability teaching for a mixture of social and behavioural reasons. The ‘bottom sets’ in subjects were often uncontrollable and so it was thought that it would be a good idea to get rid of such sets. Mixed ability was the perceived answer by heads, as it would mean that there would be no bottom sets!

But, of course, the textbooks in existence were written for teaching in ability sets. This was nothing short of disaster except for very gifted and flexible teachers. Therein lies the second factor [giving birth to SMILE]. Mathematics teachers, of any shape, size or ability, were in very short supply. And so weak mathematics teachers were often struggling with inappropriate materials to teach the full ability range within the one class. What should be done? It was then that I arranged the conference of heads of mathematics departments in 1972, and put that question to them. Several people contributed, some still using SMP materials but with little conviction. John Stewart was one of those asked to contribute.

John was using KMP materials. The suggestion was made by John that it would be good for ILEA to co-operate with KMP and produce material together. And so, I went to see Eric Briault who was then the boss of ILEA.

It was probably the result of what I said about John’s work that Briault went to Chelsea to see the work there. He wanted to see for himself what was happening. He came away convinced that the KMP material had something to offer.

Briault approached Kent for a partnership, but he got the brush off. I think Kent were flattered but also maybe afraid that ILEA would take over. We had to make the decision on various options:

• forget about the whole thing;
• buy material from KMP;
• produce our own material.

Because of some weaknesses in KMP, we decided to go it alone.

And so, we started with John still in Chelsea, Ronnie Goldstein, whom we were able to get released from his school, and many willing volunteers. SMILE was born!

Perhaps, the rest is history!

Jim Mayhew’s attitude, when he set up that week’s conference for heads of mathematics departments, was that “the ideas would come from the schools”. He
recognised the talents of the members of the group he had brought together. He valued their experience and initiative and planned to give them full expression. His vision for them was one of action learning. He was determined to empower them – encouraging them to work as a team and learn from each other – to produce a scheme of work flexible enough for the mixed-achievement groups they faced, thereby improving the mathematics education on offer in the ILEA secondary schools.

Teachers found the SMILE experience life-changing, because taking control of their own professional development resulted in a change of role. They were inspired, wrote their own materials and discovered that – because their classes covered the full range of mathematical attainment to be found in the first-year pupils in a comprehensive school – they had to change their whole approach in order to cater for the needs of all learners in their classes. The mixed-achievement groups created for social reasons provided the impetus for change of method. Responding to that challenge these teachers were put in the driving seat and given the facilities to develop new practice. It was a long term, continuing study/task.

The question of continuity of enthusiasm was one that puzzled Laurie Buxton, Staff Inspector for Mathematics in the ILEA, as he struggled to come to terms with his new responsibility, the strange phenomenon known as SMILE. He wrote in Splash:  

SMILE was certainly a happening. I am still not quite clear how it crept up on us. Odd bits of memory piece together for me how it came about. Firstly Bertie Banks at Stoke d’Abernon on Wimbledon finals day. We dragged ourselves away from Rosewall and Newcombe to hear him – and stayed to cheer. His organisation sprang to life and I longed to visit his classroom.

Later quiet words from our Jim (Mayhew) about stirrings at Ladbroke and then a surge of personalities as the original Smilers burst upon us, bubbling and arguing, the cut and thrust of John and Ronnie – Denis getting worried, and with reason, as he became gradually smothered, like Alice, with a pack of cards. But coping none the less as he always does.

Of one thing Laurie was sure. He found that SMILE was – although

at the production and management end still something of a Frankenstein monster
- … where it matters, in the school, a genuine salvation in some difficult situations.

His assessment was that,

unlike so many attempts at change, [SMILE had] a really solid basis. It sprang from needs in the classroom, was constantly tested back there and developed, as all schemes should be, by the teacher in the classroom.

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43 Splash 0010 (we counted in binary in those days). Summer 1975.
44 At that time the ILEA had a residential teachers’ centre, a magnificent country house at Stoke d’Abernon.
It will become more apparent as the story unfolds that what was also essential for the venture was the support of a local administrative and financial structure. The ILEA made it possible; the slow death of \textit{SMILE} started when the ILEA died.\footnote{Editorial comment.} The ILEA was capable of funding the production of classroom materials created by a local group of teachers from a number of different schools. And it was an imaginative and creative educational body. When Tim Brighouse became the Schools Commissioner for London in 2002 he noted:

\begin{quote}
If people stay five years \textit{[in London]}, then they will stay longer. And if they do move they will, like many of us, be haunted and want to come back \ldots If people spent time in London when ILEA was around it gave their applications credibility because ILEA had a good reputation for induction, support, training, further study and experience.
\end{quote}

At the start of the 21\textsuperscript{st} century, when most of the country’s funding for education flows directly from government to schools, there is neither the respect for the creativity of teachers nor the funding available at local level to provide financial support to a group of schools so that teachers can be freed and given the space and facilities to work together to extend their own pedagogical skills and produce their own classroom resources. Nevertheless, such was possible then and was vital for the birth and growth of \textit{SMILE}. 
Chapter 4: Early developments

The chapter begins with a description of how the SMILE group started the process of creating classroom materials and coherence within the materials is discussed. The initial ideas about a SMILE classroom are introduced and the organisational structures and routines outlined. The Jewish Free School (JFS) experience illustrates some of the ‘growing pains’.

Starting work on the materials - a DIY co-operative

SMILE, then, had taken the decision to move away from whole class teaching. As we shall see later in the story, as the project matured and the learning resources developed, Smilers recognised that there might be occasions when specific tasks would work well in a whole class environment. But the backbone of the project was based on the vision that, in a SMILE lesson, each child would usually be found pursuing with enthusiasm his or her own individual mathematics programme (seldom in isolation).

(It is worth noting in passing that observers, in the main, did not understand how such enthusiasm could come about when there was no performance by the teacher, no whole-class teaching. As it was for most of the last century – only the few brave souls deviated – the current orthodoxy is whole-class teaching, that is, lockstep. Should they not be asking whether it is the absence of whole-class teaching that has enabled the creation of a high-achieving, independent-learning environment for all? Whole-class teaching can so easily create boredom because it excludes both those whose minds are racing ahead and those who cannot – or do not choose to – keep up with the pace set. Many criminal offenders blame boredom at school for their journey to prison. They report irrelevance of lessons and feeling lost in large classes where teachers had no time to recognise them as individuals with their own special talents.)

So the process of creating a huge bank of materials to support that vision began. Having recognised that to achieve inclusion we did not have to worry about which classroom a particular student was in, we also realised we had to change what went on inside the classroom. We were seeking a radical change of approach to learning – and we felt we had found it. As a result, the fire ignited at the ‘mixed ability groups’ conference in November 1972 continued to burn brightly as the participants demanded the wherewithal to go on fanning the flames of curriculum creation. I wrote in the first issue of Splash:

John Stewart’s description of his adaptation and development of Bertie Banks’s scheme attracted enthusiastic attention. It seemed that this scheme had much to offer other schools and could be improved upon if there were a bigger team to work on it. Several heads of department at the conference, including myself, had for long
been anxious to run mixed ability schemes in their own schools but had been more easily daunted than John by the size of the task of producing the appropriate classroom materials. We were very interested in working with him on a joint project and agreement was quickly reached by a group of 6 schools to co-operate.

The initial schools worked in a variety of ways to get the project up and running. The Splash article continues the story:

At JFS we decided the scheme should be given an early trial run ... in one first year class\footnote{As explained above, the first year of secondary school is now called Year 7.}, with other teachers being encouraged to join the class when free to judge the use of the materials in the classroom. They were so enthusiastic about the effectiveness of the experiment that by the summer half-term half the first year (four classes) was working from the material for at least some of their mathematics lessons.

The participating schools worked as a DIY co-operative and were ably supported by Denis Frost, introduced earlier and Warden of the Ladbroke Mathematics Centre.

As I wrote in that article in Splash 0001, many London teachers put in many hours of work before the end of the summer term of 1973 adapting Bertie Banks’s material, creating new tasks and presenting, for the consideration of their colleagues, material they had written and used in their own classrooms. In the process they had, as individuals, to learn to accept the direct and sometimes very severe criticism of their work by the rest of the group. Some spent a good part of their summer holiday still working on various topics for which there were no tasks ready. Through all this, Denis managed to stay apparently calm and unruffled despite the fact that his Centre had become a production outfit with himself as works manager, as well as continuing to fulfil its general advisory function to all the other primary and secondary schools of the area.

By the autumn term of 1973 the mathematics departments of 20 schools in London were working on SMILE as a team with the pupils in their first year and Ronnie Goldstein\footnote{A main scale teacher with only a few years of classroom experience.} had been seconded to Ladbroke as full-time co-ordinator. Jim Mayhew - who had been the initiator by creating the opportunity for John Stewart to meet other heads of department and to publicise his ideas - joined John and Ronnie in editing the material which flowed in from participating teachers. The three of them visited schools to observe and advise and Ronnie gradually took over supervision of the production side from Denis.

SMILE began gradually to attract further ILEA and other local schools, mostly by word of mouth. During the year 1973–74 other schools learnt about the scheme and realised what it had to offer them. Monthly meetings continued and others who were now interested joined the discussions and workshops which took place. The question of providing these ‘second phase’ schools with materials was finally...
Chapter 4: Early developments

answered by sending the first 300 carefully revised cards to printers and the tests and answer sheets48, which went with them, were also printed.

In 1975, the pilot schools were still using the duplicated material, backed up by work sheets of their own produced on their own premises. Several schools helped out with general duplicating when Ladbroke’s facilities were being stretched to breaking point. Of course, the project could not have grown and thrived without the financial backing it received from the ILEA but, throughout, all schools have recognised and cherished the fact that it was basically a do-it-yourself co-operative effort depending for its success on what was put into it by every participating teacher. And to these teachers it gave much more than a bank of material. They grew in stature as teachers, learnt to take criticism and offer it constructively, became more self-critical of their own work and of the quality of the material they put in front of their pupils.

This sense of an empowering co-operative is reflected in the introduction written by the editors at the beginning of that same first issue of Splash:

This magazine arises out of the urgent need, we feel, for communication – not only with the central body at Ladbroke Grove Mathematics Centre, but the communication between all the schools and teachers involved with SMILE. The success of the system depends on the enthusiastic participation of us as teachers, and so there needs to be an instrument by which we can all feel actively involved in the direction in which SMILE is moving.

But we had so much still to learn about writing materials that supported everything we wanted to achieve – and what we wanted to achieve also grew exponentially. Writing in 2005, Hilary Povey remembered how the production of material sparked off so much more learning about both mathematics and the learning process for her:

My earliest attempts at producing material for the young people to use independently make me blush with embarrassment. My only mental model of a successful work card was one which a student was able to work through without needing to question me, their peers or (most especially!) themselves about anything and which allowed them to get right some questions that they hadn't been able to get right before they started. Of course, there may be (rare) times when this is exactly what is needed – “I get the point of factorising and can see it’s really interesting the way it connects to the graphs but it always takes me ages – are there some quick ways to do it and can I have some practice?” – but it now seems to me that almost all worthwhile mathematical activity requires us to struggle with problems which are difficult for us, that stop us in our tracks and need thinking and arguing about, perhaps just with ourselves but for most of us most of the time also with others.

48 As explained more fully below, each activity had an entry in the Answer book which pupils used to mark their work and an entry in the Test book. The tests were taken together at the end of a batch or work and were marked by the teacher.
The students in my *SMILE* classes taught me these things – but I almost certainly wouldn’t have been able to learn them if I hadn’t had the regular, committed, even impassioned, involvement with other teachers trying their best to do the same job as me. So, in general, in step with my *SMILE* colleagues, I moved away from a ‘bite-sized,’ piecemeal approach to the curriculum and towards a model of learning which, keeping the individual student at the heart of the process, understands persons as fundamentally social and knowledge as in some sense a social construction and as socially constructed by us as individuals. This notion of the individual is not the neo-liberal, isolated and self-centred one for whom ‘There’s no such thing as society’ has resonance; rather it is the one in ‘one for all’.

**Tidiness kills education**

As Sylvia Ashton Warner⁴⁹ reminds us, “tidiness kills education”. Her struggle to un-tidy the New Zealand system has many parallels with the growth of *SMILE*. Her creative approach to teaching Maori infants to read - as opposed to the received wisdom of using the *Janet and John*⁵⁰ books - was never recognised for its brilliance by the national educational hierarchy of her own country, in spite of admiring recognition from abroad. By creating handwritten, personalised books for the Maori infants she taught, with hand-painted pictures from their own culture, and by giving them their own individually chosen words with which to start, she enabled them to learn to read remarkably quickly.

Although generally unrecognised, she did have minimal support from the system. One inspector recognised the inspiration in her work and found for her a typewriter with a special font so that she could produce these reading books with less intensive labour. Without his moral and technical support, she might never have achieved her remarkable success. But still, she was unable to subdue the general suspicion of unconventional methods and even now, despite having become internationally famous, is uncelebrated in her native New Zealand. *SMILE* had a similar vision and a similar history and, as we shall see, Jim Mayhew was the inspector who provided the equivalent of the typewriter.

This means, as well as looking forward to the technology of tomorrow and making full use of that interactive piece of technology, the computer, we must also look back to earlier innovators like Sylvia Ashton Warner, John Stewart or Jim Mayhew (about the latter two, more will follow) to discover what worked in the past. Should education be just a teacher-to-student one-way-transmission system? The process could usefully be re-interpreted as at least four-dimensional, with the student, the teacher, the classroom environment and the wider world recognised as having an input to make and with the process being multi-directional.

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⁵⁰ The popular British reading scheme during the 1950s and 1960s, published by James Nisbet and Company.
Certainly, we should question the extreme disjointedness of secondary timetables: a 40-minute fragment of X followed by a 40-minute fragment of Y, with no educational reasons for Y to follow X, nor any attempts by teachers to show links between X and Y – and probably five or six more such changes before the day is out, with all the fragments being apparently unconnected. Why has this format never been questioned? It is interesting to remember the enforced isolation of the various subject groups when writing the National Curriculum. No time was allocated for consultation between subject groups.

I often wished, when running a secondary mathematics department, that, rather than moving towards having a compulsory hour a day of mathematics, I could remove the subject from the standard timetable altogether. Instead I would have set up a permanently-staffed mathematics laboratory where students could come to sort out the mathematical problems they encountered as they studied other parts of the curriculum and, when they chose, study more mathematics for its own sake. I believe students would have come for help, that they would have recognised more links between different parts of the curriculum and that we could have made the place exciting enough for them to come back for the fun of it as well as for utilitarian reasons. Of course, I was never able to put my theory to the test because such unorthodoxy would have been unthinkable in the 1960s and 70s, even with the coming of SMILE. It is, of course, even more unthinkable today.

A National Curriculum, imposed from above is no new phenomenon. In 1911 Edmond Holmes, after retiring as chief inspector of elementary schools, wrote:51

...teachers of this country are the victims of a vicious conception of education which has behind it twenty centuries of tradition and prescription, and the malign influence of which was intensified ... by thirty years or more of ... “payment by results”.

The national curriculum of his day, he noted, told the teacher

what work done in each class and each subject would be tested at the end of each year by a careful examination of each individual child; and it was inevitable that in his endeavour to adapt his teaching to the type of question which his experience of the yearly examination led him to expect, he should gradually deliver himself, mind and soul into the hands of the officials in the Department - the officials at Whitehall who framed the yearly syllabus, and the officials in the various districts who examined it.

He could have been talking of the situation that prevails a century later. He was no less damning in his comments on the effects of this regime on the pupils:

What the Department did to the teacher, it compelled him to do to the child. The teacher who is the slave of another's will cannot carry out his instructions except by making his pupils the slaves of his own will. The teacher who has been deprived by his superiors of freedom, initiative, and responsibility, cannot carry out his instructions except by depriving his pupils of the same vital qualities. The teacher who, in response to the deadly pressure of a cast-iron system, has become a creature of habit and routine, cannot carry out his instructions except by making his pupils as helpless and as puppet-like as himself.

Yes, this does sound like a description of education at the beginning of the 21st century rather than the 20th - to Smilers at least. However, we can only hope that in time teachers may once again be relieved from prescription and enabled to be more adventurous, that they may be allowed once more to take control. Indeed, there is some hope: less than three years into the 21st century in one or two places some quite radical changes were already happening. For example, a primary school in Devon, with the backing of the LEA, had two students on its books part time. The rest of the time they are home-schooled. It’s an untidy arrangement of course, and not easily implemented while lockstep reigns, but the experiment seems to be working. In addition, in his descriptions of adventurous schools in the Times Educational Supplement (TES), Ted Wragg, who recognised the skills and wisdom to be found among teachers, gave his vision of the essential flexibility of the schools of the future:

The school of the future won’t have everything done by technology. There’s a guiding element to learning that teachers fulfil and machines can’t … Students will be citizens of a virtual college, and will study wherever is appropriate. They will be trusted to go where the facilities are, and to guide their own learning.

A prophecy that seems closely related to my dream (mentioned earlier) of creating an ever-open mathematics laboratory to be visited only when students chose to do so.

Even more of these radical changes need consideration, like designing timetables for individual students in which ‘the bell’ does not rule, so that too many fruitful trains of thought are not disrupted. Maybe age barriers too should be broken down. Some of these visions were already becoming a reality in SMILE classrooms from the early 70s on. Certainly, the SMILE organisation would make all such fundamental changes possible because it was designed by teachers in classrooms to give a framework for continuous planning and assessment of the individual study programmes they were creating for their own students. In addition, to meet that kind of challenge - and others that radical change would make necessary - teachers will have to be given the opportunity to become fully professionalised once again, moving away from prescription to take control of their own teaching and learning and, as a result, the learning of their students.
How is coherence created and understood?

It is worth pointing out at this point, when teachers began to write the SMILE material coherence was probably the last thing on their minds. Because they were to a great extent building a curriculum from scratch they were more concerned about whether they had enough material to keep their classes busy doing appealing and thought-provoking mathematics for the rest of the week let alone the term, or the year or a student’s whole secondary school career.

But the coherence or otherwise of SMILE students’ mathematical experiences was debated, and continued to be, throughout the life of the project. Non-Smilers found it a particular challenge as we can see in these two reports from inspectors. Its differences from the traditional approach to mathematics education caused some concern. From its initiation the outside observers’ greatest worry was that the individual SMILE programmes devised for students would lack cohesion. In the autumn of 2000 Eric Sewell, retired from HMI, took a backward glance from the 21\textsuperscript{st} century at the mathematics scene in schools in the early days of SMILE, commenting:\textsuperscript{52}

> My visits to ILEA schools using SMILE were not sufficiently frequent to achieve more than a partial view.

> SMILE was not unique in requiring a great deal of insight from teachers, as well as skill in handling assignment work. When I joined the inspectorate in 1966 I assumed that the profession would make the changes that new content and more appropriate learning techniques required. To achieve these ends a massive in-service training programme was needed, but sadly it never materialised. As a result, new ideas and approaches were misconceived and misapplied, with all the consequent criticism of recent years …

> Although SMILE played a substantial in-service function in bringing teachers together, the materials relied on a variety of existing resources, which when mixed together could lack coherence. Whereas coherence of the topics covered may have been achieved, one was less certain about the structured development of concepts and the associated learning experiences. There is a problem harnessing a group of people to achieve a common purpose.

Coming closer to home were the comments of comments John Bausor, an ILEA inspector for science. John was asked to extend his observation to mathematics classrooms when Laurie Buxton, Staff Inspector for Mathematics, was granted leave of absence. In his recollections of that time, written in 2001, it is interesting to note the same doubts about the coherence of the SMILE experience:

\textsuperscript{52} e-mail to Ray Gibbons
Not too long after I joined the ILEA Inspectorate in 1975 as one of the team of Science Inspectors, I was asked to help out the mathematics team in Laurie Buxton’s absence. After so long my recollections are somewhat imprecise, but I will attempt to put down the impressions I retain as a reasonably accurate and (I hope) unbiased account.

As someone who was convinced about the importance and validity of independent and individual learning (at the time I was directing APPIL – the Advanced Physics Project for Independent Learning – in the ILEA) the only significant criticism I made of SMILE was that it had no defined core, or essential set of cards which every pupil had to address. I suppose I saw this from the science perspective, where the perennial argument between science and mathematics teachers is about what pupils should be able to do at various stages. I think I could appreciate both sides of this discussion, but I always considered that there was a (fairly small) set of mathematical skills and ideas which every pupil ought to acquire (although obviously not all by the same age). So I would have welcomed the definition of a core set of cards which all pupils should undertake at a suitable stage in their mathematical progress.

I also considered that certain areas were very thinly represented in the published cards – algebra for example – but that may reflect my own particular views about what was important, and possibly would have been adjusted as time went on.53

The ‘core’ question raised in these two sets of recollections was the nature and the coherence of the mathematics topics being prepared for students, the structured development of concepts and the associated learning experiences being offered. The first question to be asked is whether there are some essential elements in mathematics that all students need, either to make sense of the rest of their mathematics course or as a basis for understanding other subjects, especially science or the wider world. The second concerns the pathways to be taken through the map of mathematics. Should each step of the way be obviously linked to other ideas already encountered or does coherence come in leaps?

The SMILE answer would be that the overall planning of each student’s mathematical journey can be charted visually in the pathways followed by the marked off tasks on the pupil’s individual copy of the Network they were building up and any coherence missing would be provided in discussions with the teacher. It is interesting to consider how we planned for our students before we had this two-dimensional display of possible journeys in mathematics. We recognised that we too had often just started at page one of the textbook and gone right through it, regardless of the fact that successive chapters often seemed to have little to do

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53 In 2001 John Bausor thought SMILE sufficiently useful to agree to dig into his memory and put together his recollections of the beginnings of the project.
with each other. What now seems even more incoherent, until the 60s there were separate textbooks for algebra, arithmetic and geometry, often taught in lessons under those three separate titles on the timetable, possibly by different teachers, which made mathematics even less recognisable as a coherent whole. But this after all is only one instance of the fragmentary presentation of the whole curriculum experience at secondary level, with different labels for each 40 minute slot on the timetable, each taught by a different teacher, possibly in a different room. How much do those teachers even in the 21st century liaise over the whole educational programme of a particular student?

But perhaps, in addition, coherence was not a priority for some Smilers because we recognised that our learning patterns in any area are pretty random walk-abouts. The process of learning mathematics, or any other subject on the school curriculum, might be likened to getting to know a new town. It may be that you are the sort of person who buys a map, studies it and gets a mental picture of the layout of the whole city before venturing out. It is more likely that your initial knowledge will be of places that are of particular interest to you and all you need to know in order to visit them is which buses or trains you need to catch and the name of the stop which will be the end of your journey. You may even travel blind if the city being visited has an underground transport system. This way your experiences of the city may at first be very disconnected but nonetheless vivid. Only later do you have the revelation that X is next-door to Y and begin to see that there are reasons why they have grown up in this proximity.

If you observe very young children starting to learn to speak you will see that they pick up words from here and there and use them long before they fully understand their meaning. They just try to match the situations in which they bring them out with those in which they heard them spoken by someone else. The appreciation of the overall structure of the language only comes very gradually.

The first concerns of the SMILE teachers for the tasks they were writing was that they should:

- encourage a look at some worthwhile mathematics
- be couched in language the students would understand without difficulty
- give opportunities to carry out mathematical processes
- offer practical experiences illustrating abstract concepts
- be within the capabilities of the student
- appeal to the interests of the student.

**Understanding the SMILE classroom**

The SMILE materials, because they were written for the purpose of learning - not just practising concepts already learned - are, to a certain extent, capable of standing on their own. Students, however, can only very gradually attain anything approaching full independence and, on the way, learners need careful guidance and support, not to mention inspiration, from a teacher. How is this achieved? A first,
perhaps rather crude, description of the basic organisation of the SMILE classroom is to be found in the initial introductory sheet of the Teachers’ Manual, extracts from which are reproduced below:

**Operation of SMILE in the classroom**

(1) On entry to a school each pupil is given a ‘matrix’ consisting of ten tasks. These cover a wide range of topics of which it is felt an eleven year old should have had some experience. These tasks, unless indicated otherwise, can be done in any order.

(2) On the completion of a task each pupil marks his/her own work using an Answer Book. If the work is satisfactory the teacher signs the task off on the pupil’s matrix and the pupil chooses his/her next task.

(3) When the ten tasks on a pupil’s matrix have been completed and signed off the pupil then does a short test for each task. These are found in a Test Book. At the end of the lesson the pupil gives in his/her book for the tests to be checked.

**Operation of SMILE in the classroom continued**

(4) In between lessons the tests are marked and a new matrix set on the basis of a pupil’s performance in the tests. The new matrix is set using the flow-network. The flow-network shows all the cards, their connections with each other and their level. The Teacher’s Manual gives the set of answers for each test.

**Operation of SMILE in the classroom continued**

(5) For each matrix a record is kept of each pupil’s work and performance by the class teacher:

(a) a list of the numbers of the tasks set, with their level written in at the front,
(b) the average attainment level,
(c) dates of starting and finishing,
(d) test score.
Merely following out this basic organisation did not, of course, guarantee that every member of a class developed a love of mathematics and a life-long habit of learning. More will be said in later chapters about what must happen within this framework of organisation to make the subject come alive. But at least this structure gives opportunities for inclusion in a way that the military marching-together of lockstep can never do.

A student in this situation is not for ever feeling herself compared at every step, very often unfavourably, with her neighbours. Being ill, or off school for some other reason - even truanting - she does not fall irretrievably behind the rest of the class.

She has her own goals - some of which will coincide with her neighbours' - but she will not find herself like the red queen running to stay in the same place in some hierarchy of achievement. Nor, if she happens to be moving more quickly than the majority, need she be held back by the slower pace of others. There is even the possibility that she can bring back into the class to share with her fellows some enriching experiences from the world outside.
More about classroom procedures

The SMILE way of classroom-life was also a mystery to supply teachers and those from other departments in the school who might have to cover the occasional mathematics lesson. Many resources were in use during a lesson and these had to be kept in order and available to all. The assessment of pupils’ written work was vital for forward planning and the preparation of individual programmes had to be kept up to date at every stage. Most important of all, during the lesson the teacher must be available at all times for the discussion of mathematics.

<table>
<thead>
<tr>
<th>Beginning of lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Give out folders</td>
</tr>
<tr>
<td>2. Get task sheets - each child has to find the sheet from which he is at present working</td>
</tr>
<tr>
<td>3. Unlock or get out equipment and paper.</td>
</tr>
<tr>
<td>4. The first child to need a piece of equipment must take the WHOLE SET, count the number, tell the teacher if that number does not tally with the number stated on the container and be reminded that he is responsible for returning the WHOLE SET at the end of the lesson.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>During the lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When a child completes a task he must take it to the teacher to be checked and signed off before starting the next one. This check is only very brief. If you know the work card well you will be able to see at a glance whether the work is more or less completed and correct. If not, try to judge this as quickly as possible.</td>
</tr>
<tr>
<td>2. When a child has completed his first ten tasks on the matrix he must do the test for each task. The test sheets are filed separately from the task cards.</td>
</tr>
<tr>
<td>3. When a child has completed his tests he must HAND HIS BOOK IN to the teacher. At the end of the lesson the teacher MUST make sure that these completed books are handed to a member to the maths department staff. The child who now has no exercise book goes on to do the game or puzzle which is the twelfth task on his matrix. If he finishes this before the end of the lesson find him another puzzle or game to do or suggest he helps a friend.</td>
</tr>
<tr>
<td>4. If a child says he has handed his book in during the last lesson and has not had it back look in the record file which is in the box with the other folders. The book should be there with the tests corrected and a new matrix made out for him to carry on. If the system breaks down and the book is not there or not corrected please send the child to a member of maths staff for help!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>End of lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stop 5 minutes before the pips and get everything tidied up. The task sheets may have got muddled - get a child to tidy them. All equipment must be put back in the right place. The supply of paper of various sorts will need to be tidied by a child. The folders must be returned in their carton to the right storage space. ASK FOR ALL COMPLETED MATRICES TO BE HANDED IN AND GIVE THEM TO A MEMBER OF THE MATHS STAFF.</td>
</tr>
</tbody>
</table>
If the usual teacher was absent, it was not an easy matter to ‘cover’ satisfactorily in any sense. I therefore produced the cover notes above for use at JFS. These may seem prosaic and obvious but lessons of this form were not usual and a smooth underlying organisation was essential if all children were to be able to proceed with their work without disruption.

This was at a time when SMILE classrooms were primitive, before there were filing cabinets and when the tasks on which the students were working were presented in a rather rough and ready form, mostly stored in cardboard supermarket cartons. However, the detailed procedures of the SMILE classroom had already been set – students, to feel secure, always need clear rules for the game.

**Growing pains**

Anxiety, evident again at the beginning of a new century, about the effects of mixed-achievement groups for mathematics, surfaced in the early seventies amongst those who had encouraged the abandoning of setting soon after mixed achievement groups appeared in the first year of comprehensives. At JFS, where we had since 1965 had mixed-achievement groups for mathematics in the first year, we were struggling to provide suitable learning material for students. It was because we felt we had failed our students that we decided (as noted above) to SMILE early, and so we continued, one year ahead of schedule, into the second year, causing much hard work because we were outstripping the production process. By autumn 1974 we had the possibility of continuing this struggle to find SMILE, or SMILE-type, material for the third year. Teachers were given a free choice whether to go on in the third year with SMILE or return to more conventional methods and so it came about that we had only one group continuing to SMILE into the third year. The other seven teachers opted to return to the traditional path with their third-year students, not because they had not valued the SMILE way but because there were not as yet sufficient tasks in the SMILE network at high enough levels and they did not feel they could continue to make the tremendous extra effort needed to keep pace with these students’ needs. All were still enthusiastically Smiling in the first and second year.

However, outside the department these reasons were not understood. It was thought that, if we had reduced to one experimental class in the third year (Year 9), it must be because the method had failed. Soon anxiety was expressed by parents and the headteacher about the one and only ‘experimental’ third year SMILE class and the department was ordered to disband the group, re-organising them into sets like the rest in that year.

One interesting aspect of this change mid-year was the complete confidence of the teachers that those SMILE students joining groups who had covered different parts of the syllabus had increased their independence sufficiently to have no trouble catching up. As one member of the department put it, “They will have no trouble filling the gaps because they have learnt how to learn.” And so, it proved to be.
Chapter 5: The next chapter in the life of SMILE

Reflections from Jim Mayhew three years after the event at Ladbroke begin the chapter. Now SMILE was becoming established, the need for careful planning and good knowledge of the materials was being recognised. Effective ways of working together were becoming organised and the needs of those new to SMILE, both teachers and pupils, were being addressed. First thoughts about public examinations (the subject of a more detailed later chapter) are shared as is a growing developmental agenda.

‘SMILE Please!’

In the second year of this experiment in curriculum development Jim Mayhew gave his view of SMILE’s progress to date and its future direction. He began by setting SMILE within the context of the ILEA’s approach to curriculum development.

Super Steve was born: the year was 1975; the place was the chemistry lab of a well-known comprehensive school. Thus began the play-back of a tape recording made by a teacher on an ILEA Resources for Learning maths course at the Sir William Houghton residential teachers’ centre in June 1973. The topic in this exercise was enlargement …

Tragedy had struck. Steve, previously an insignificant pupil had swallowed some of the revolutionary animal fertiliser and suddenly he had started to grow at a fantastic rate. His clothes ripped apart; he became too heavy for the stool which collapsed under his excessive weight (or should it be mass?); his head crashed through the ceiling; his voice became quite distorted.

The last words in the dramatised episode were drowned by the appreciative laughter of the other members of the course. What an exciting and dramatic way to introduce enlargement! Just the kind of thing we need to spark off enthusiasm for mathematics in uninterested pupils, a useful piece of innovation, an excellent use of the tape recorder in maths education, not just the predictable assignment on tape for backward readers. Everyone appeared to be delighted.

‘Rubbish!’ exclaimed a solitary but emphatic voice, ‘I wouldn’t use that with my pupils.’ A deathly hush as we started to pick ourselves off the floor. And then the arguments began to fly to and fro across the room: the pupils would really enjoy it - yes, but they would be uncontrollable; this would motivate them to investigate the idea of enlargement, - what about some real mathematics; it’s a break-through - nonsense, it is a gimmick…

Confusion? Rather, it is the essence of genuine curriculum development which we are trying to foster within ILEA. For the curriculum to change in those meaningful
ways which the majority of our pupils require, we need people who can produce Super Steve, people who can break out of our fixed conventions of content and approach and use their imaginations to produce exciting work. Equally we need to have people with conviction, who are prepared to say ‘Rubbish!’ when they feel that the developments are divorced from the realities of the classroom, whatever the source of those developments might be.

A maths/art workshop brought together people from separate disciplines, with a desire to explore areas of common interest, such as pattern, growth, order and movement. Links between maths and art are not the only links being explored by maths teachers in ILEA. Less obvious but perhaps more interesting are the links between maths and geography, sport and music, which are also under investigation. There is no doubt that the removal of subject divisions, when appropriate, will benefit all pupils.

But so far, we have been considering recognisable school subjects. Contacts with the local government research unit have produced interesting items of operational research (not yet canonised/fossilised as a school subject), which are extremely suitable for work with older pupils of limited mathematical knowledge: they are ‘real’ problems, recognisable as such even though they have to be treated in a simplified form; secondly, the mathematics required is not very extensive – in some cases the ability to add numbers and to draw a diagram is adequate.

One of the great advantages of teaching in the ILEA is that there are resources available to push developments. Such a large authority can concentrate resources where this is considered to be desirable. One example of the concentration of resources is in the development of computer education. This has been gathering momentum since 1967: by the end of the year over a third of our two hundred secondary schools will have computer terminals, with considerable time available on the school’s computer; batch processing facilities with a courier service are also available.

Perhaps you couldn’t teach in a large secondary school unless you had some ability to see the funny side of things. Within a group of ILEA secondary schools, you would be more likely to be told that you can’t teach there unless you can SMILE. The aim of the experiment is to produce materials that cope with individualised learning, starting with the first year but ultimately covering most if not all the work in a secondary school. It is a very flexible scheme into which material published elsewhere, even by the MMCP\textsuperscript{54}, can be easily slotted. The needs of all pupils - average, above average, below average - can only be satisfactorily catered for by an individualised scheme, this is the philosophy of SMILE.

\textsuperscript{54} The Mathematics for the Majority Continuation Project. Published by Schofield and Sims.
No soft option - planning in SMILE

SMILE was no soft option for teachers. The workload of individualising learning programmes is, indeed, onerous; and the job cannot be done at all without appropriate classroom materials for the students to use embedded in a very detailed assessment and recording scheme. However, within a secondary school mathematics department mixed-achievement groups mean that much more sharing can take place. At JFS, the group of eight teachers discovered they had similar problems cropping up in their first-year classes and that working together to solve them gave great strength to their teaching. Their pupils too could more easily be drawn into the process of planning their own work. This sense of problems and solutions shared was even greater among the larger group that met to continue the creation of classroom materials.

Of course, the workload was heavy and trying to get 100% response and full-time concentration from a group of 30 or so teenagers must always be a tough proposition. Failure to engage each individual is far less clearly evident when they are perceived as an undifferentiated group. HMI recognised this increased pressure in 1977 when they issued their report on SMILE. During 1975–76, they observed in 50 ILEA schools, some of the most challenging in London where without SMILE it is doubtful mathematics learning would take place. They wrote in their conclusion:

Effective work in SMILE appeared to require detailed knowledge of the materials and acceptance by the teacher of a changed role, exhausting work in the classroom, regular marking and recording, good organisation and frequent checking of equipment and materials. Any worthwhile innovation will make increased demands on teachers and, during this exercise, many teachers were met who were willing to make that effort required to ensure that SMILE was a success in the classroom. The best teachers had a detailed knowledge of mathematics, the material and the children; they used this knowledge, together with sound judgement and some initiative, to select appropriate and valuable tasks for their pupils. The teacher has a crucial role in the system: he determines the standard of work and the rate of working of his pupils.

SMILE planning was very different from that envisaged in the National Numeracy Strategy and often still espoused today where ‘manageable differentiation’ comes in three sizes only. My understanding of this is that it is neither possible nor desirable to give a full prescription of the learning that will take place as envisaged here:55 At the beginning of the mathematics lesson, write on the board the objectives for the whole class. All the pupils are to share in this process, listening as the teacher speaks, watching as the teacher writes, and then possibly making these objectives

55 Editors: we have been unable to source this reference.
their own by copying them into their own books (with the best of teachers they will have been written in pupil-friendly language). Likewise, at the end of the lesson, the class as a whole will consider what has been achieved with respect to these objectives.

It is indeed most valuable:

- for a teacher at the beginning of a lesson to make clear, to themselves at least and preferably to their students also, what their broader objectives are for the lesson, having planned carefully beforehand what areas of learning they intend to be explored and how they expect to get the ideas across
- for learners to make an assessment at the end of a working session what they have achieved.

But how far it is possible at the beginning to predict with any accuracy what will be learnt by whom is questionable. And, at the end, won’t there be 30 very different accounts of what has been achieved in that period of 40 minutes or so?

Some comments of an anonymous teacher in Kent writing about the 1960s show what might be called a SMILE understanding of what happens in a classroom:

In those days we were fairly devoid of jargon, but we probably believed in the chaos theory, apparently haphazard concept formation, self-motivated learning, child-centred education, citizenship … What concerns me is the current thinking – evidently the result of sound research – that to raise achievement, each lesson (and grouped activity within many lessons), needs a finely tuned learning objective to focus the child on the set task. My heart sinks as I recall my initial college training, when we were shown how children developed a multiplicity of schemata and concepts as they explored the classroom we had prepared so thoughtfully. How dare we imply that our students’ learning is limited to – or at least measured successful - by prescribed objectives?

Working together outside the classroom

A belief in this ‘chaos theory’ and the recognition of how differently individuals learn certainly loomed large in the build-up of SMILE material and meant that a variety of material was deemed necessary. Regular opportunities for working sessions outside the classroom continued to be essential to the development of both SMILE material and SMILE teachers, all of whom were willing to give up their own free time to do the required writing. Descriptions of these sessions of action-learning seem the best way of presenting the development of SMILE, the material and the teachers over the years.

Working weekends had early become a regular feature of the Continuous Professional Discussion in SMILE. Some of the locations chosen for these were, to say the least, unusual, giving experiences far removed from the smooth hotel venues chosen for work outside the classroom in the 21st century.
In October 1973 a weekend of work far from the bustle of the inner city was planned from dinner time on the Friday evening to lunch time on the Sunday. The matters for discussion listed on the programme show the variety of approaches that were evolving in SMILE classrooms, an extraordinary far-reaching and wide-ranging programme considering how recently SMILE had been born:

1. Is there a place for group activities and class activities?
2. What about open ended questions?
3. What about projects (e.g. investigation of packaging)?
4. What about the use of problems such as:
   (a) devise a method for finding how long the average penny stays in circulation;
   (b) make a weighing machine using an elastic band?
5. Do teachers favour:
   (a) a matrix of unconnected tasks,
   (b) a matrix with some linked tasks, or
   (c) a matrix with all the tasks on the one theme (module)?
6. In view of the limited resources, should we aim at quality over a restricted field? If so, what should this be?
7. Are we missing out on “proofs”?
8. Media other than work cards?
9. Integration with other subjects?
10. Assessment.

The programme looks like more than a full term’s work rather than a mere weekend’s, and also makes clear that there was no danger of indigestion through work-cards which was a worry of some of those looking on from outside. This list makes clear the way in which all members of the group were questioning – and continued to question – their own understanding of mathematics education. Furthermore, the programme I have found in my records has several other concerns noted in my handwriting, namely:

*symbols, geometry, area, logic, clerical etc., and remedial.*

Whether we also attempted to polish all these off during the weekend I cannot now remember. This weekend was the first of many where Smilers talked their way through days – and sometimes nights – getting to know each other better, honing their own pedagogical skills as they philosophised and worked on their classroom materials and generally developing into more expert leaders of ideas.

Further records suggest that all did not quite go according to plan during this weekend. In SMILE newsletter No.7 we read that:

*... following a splendid weekend in Surrey during which a thunderstorm (inside the building as well as out) left us without light for certain periods, some schools are actually still associated with the SMILE Project.*
The withdrawal of the Kent material from use in London seemed to be taken as an extra incentive to keep going. Rather than viewing it as a setback, the SMILE groups welcomed the challenge to rely more on their own creativity. The truth is that they had become much more critical of written materials and felt they could do better than most of the materials on the market. As noted above, HMI had commented that the best teachers had a detailed knowledge of the materials in use. This is one of the reasons why it takes so long to become a good teacher, why later ‘fast track’ schemes – and suggestions that no one who is worth their salt should remain in the same job for too long – need careful questioning. It is reckoned to take fifteen years to become a top-class heart transplant surgeon. If teaching is really about assisting in the development of interesting and perceptive minds might that perhaps take a similar amount of time?

**Experiencing the longer ‘course’**

Despite the enthusiasm and a willingness to write together in groups after school hours either in school or at the SMILE Centre, it was not possible to build up the scheme rapidly enough to keep pace with the needs without extra time being found to free teachers from their classroom duties in order to write. Furthermore, as well as giving out, they needed input themselves. During the autumn term of 1974 the ILEA organised the first longer course at which, according to John Tucker 56 “SMILE took off”. It catered both for those who were just learning to SMILE for the first time and for those who, to quote John again, “had already developed permanent grins”. During the course, participants were introduced to other developing schemes including the SMP middle-school project, “a well thought out attempt to reappraise mathematics teaching in the 8-13 age range,” wrote John, “from which SMILE could learn a good deal”.

It was not only from members of groups working on other mathematics schemes that Smilers learnt to improve their skills but from individuals who were wise in the ways of children’s learning patterns. Joyce Chester, then at Chelsea College, analysed for participants a number of SMILE assignments which had been designed to help the child with learning difficulties. Because she had studied for a long time the difficulties with mathematical concepts experienced by some children, Joyce was able to offer valuable suggestions and criticisms for further work. She once told a moving story of visiting a school where she got to know a small boy who had great problems with numbers. She asked him on one visit how his maths was going and he said, “OK, except for numbers – and there are so many of them!” She had nightmares ever after, she said, thinking of this boy knowing that he was to respond to his teacher’s question with a number. But which number? All the numbers in that infinite array before him were – as far as he was concerned – equally likely possibilities. The same Splash contained the worries of another pupil confused by number.

56 Editors: we have been unable to source this reference.
Numbers

Numbers, numbers, one, two, three,
Stare back from the page at me
Oh how they confuse my brain
Numbers drive me quite insane.
Sets, probability, the eight times table
Are all much more than I am able
Swimming round and round my head,
How I wish that I were dead.
I gaze blankly at my book, Give out a despairing look,
It’s not my fault I just can’t add
It doesn’t mean I’m really bad.
Square roots, matrices, volume too
I’ll gladly leave them all to you.

*Lynn Overington, 3rd Year, Pimlico School*

Another session that generated special interest was statistics, encouraging a small group to concentrate on producing material in this field for some time.

John Tucker in his review of the course went on to consider possible future developments asking what implications the course and the resulting interest shown by more schools should have for the next year’s course. His comments in Splash demonstrate the way SMILE continued to grow throughout from the roots upward, participating teachers choosing the directions taken by the writing through the choice of both format and substance of the courses provided for their own development:

… workshop sessions could be chosen with this in mind. It would seem advantageous to select urgent items and organise them on a group basis, with course members opting for one group for half a term; at the end of this time, needs might dictate a change in the groups available, and individuals might wish to change to another speciality.

This writing can be recognised as a part of the continuous discussion process which resulted in the 1975 longer course and further meetings at regular intervals after this. Here as usual the keynote was inclusiveness – the lectures on the longer courses were open to any Smiler free at the time.
Already by January 1976 in the pages of *Splash* the future is being considered and the essential elements of *SMILE* are being recognised, with structures being designed to protect them:

*The strength of SMILE has been the degree of teacher involvement it has enjoyed. SMILE is growing and there is a danger that size will inhibit the involvement of the classroom teacher … Area groups would increase participation, providing a forum for general discussion about, e.g., classroom organisation, the use of equipment, investigations; ground-level talk about major topics affecting SMILE e.g. examinations at 16+; the possibility of exchanging ideas or even staff; and perhaps eventually some local production of SMILE tasks. If you feel cut off by size and distance, help make sure your area group is the answer.*

**New to SMILE - the teachers**

As SMILE grew, teachers began to arrive at established SMILE schools and were plunged into coping with SMILE in their classrooms without themselves having ‘grown’ alongside the project.

Sarah Sharkey, as an experienced teacher coming new to SMILE, had written in *Splash* on the difficulties becoming familiar with the materials. She confirms that, although SMILE teachers might have solved their earlier problems, they had found themselves new ones. The problem they had faced from the beginning and, indeed, had joined together to solve, was to provide a suitable education for each individual in a learning group fully recognised as being of wide ranging levels of achievement in mathematics, needing to work at different rates and responding to different stimuli. This they knew they had not previously done - would not have been able to do - without the materials they were creating together and the flexibility of approach that their new resources made possible.

Sarah’s comments confirmed those of HMI that a good teacher has to know, in detail, *the mathematics* (any other subject could be substituted here), *the materials* and *the students*. For the best teachers, this knowledge must inevitably present never-ending problems: the student body changes from year to year with fresh personalities to fathom; the material should be gradually evolving to suit an ever changing clientele and evolving philosophies of education; and the mathematics (or whatever other discipline you choose to substitute in the argument) can always be understood in greater depth. Here it is a working knowledge of the material that concerns Sarah:57

*Introduction of teachers to the SMILE scheme of work.*

*I think that the most important thing a new teacher has to learn is the appropriate use of the network chart. It might be helpful if each person was given a loose

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57 *Splash* 1000, June 1976
structure for each year group (e.g. for an average secondary pupil do not follow the downward flow of the chart beyond level 4). Guidelines of this nature may be helpful until the teacher is more familiar with the individuals in each class and with the material. It is impractical to expect a new SMILE teacher to “know” the cards and the repetitive emphasis of the scheme is almost pointless. What I think a new teacher can do is:

• be aware of the feedback from his/her pupils (if any) and
• try to understand the individual approach to the teaching of mathematics which the cards take.

I do not want to minimise the importance of the practical issues such as organising the room, being firm about unnecessary questions, pupils’ use of equipment, etc., but I do feel that success in this area does not make you, as an educator, confident that you will be able to guide and monitor the pupils’ work. The confidence builder, both in yourself and in the material as a medium of instruction, is the ability to use the network and to be aware of - and use - any feedback from the pupils.

New to SMILE – the pupils

But how do you start the pupils off? This was the question Ronnie Goldstein asked in 1981. Some eight years after SMILE had been first introduced into classrooms it was a problem still not satisfactorily solved. The problem of continuity when going from primary to secondary is of course a perennial problem for all secondary schools. Indeed, transition is a problem that will never go away as long as students move from one educational institution to another – or even from one teacher to another – whether in the SMILE organisation or any other.

The work and concentration of Year 7 students continues to exercise the minds of all teachers. For example, in 1976 the Mathematical Association’s Teaching Committee presented in the form of a conversation some of the difficulties of “taking over where someone else leaves off”.58 One speaker in this virtual conversation says:

The children who came into our first year this September were from thirty different primary schools. We couldn’t get adequate information on their mathematical abilities or experiences and their schools showed extreme variations in their approach to mathematics. We got hold of their syllabuses and no area of mathematics was untouched and little was common to them all. We tried to set the children roughly and we are teaching them by more or less conventional methods as whole classes. It just isn’t working…

I note in passing that it seems possible that the decline in the learning rate in this country in the first year of secondary school may be because, during that year,

the new students do not really know the school and the staff of the school have not yet had time to learn enough about those students’ personalities, needs, interests and aspirations to guide and enthuse them effectively. They are getting used to an entirely new educational environment, organised very differently from the primary schools in which they have spent the last six years. Perhaps it should be accepted that such a learning dip is inevitable during the settling-in period in a very much larger educational establishment. Should we therefore give time for settling in, and more thought to its smoothness, accepting a temporary change of pace?

It will always be difficult picking up the threads where someone else left off - even if that someone is in the same school. At that time Ronnie wrote that there was great variety in how Smilers tackled the problem.\(^5\) Some used the entry guide (more of that below); some use primary profiles (described in Chapter 3); and some gave each incoming student the same matrix. Starting pupils off effectively tested the ingenuity of Smilers. What should be the initial mathematical experiences of the students on entering the secondary school? How can teachers get to know their students’ interests, aspirations and levels of understanding quickly enough to avoid boring them with what they have done before or sinking them in such deep mathematical waters that they drown?

_Splash_ 10101 tells of a group that had been meeting regularly to “produce an instrument to assist us all in providing new pupils with more appropriate first matrices.”\(^6\) Primary records were too varied to be of much use in planning initial programmes for many of the incoming students. Moreover, “while some pupils had been taught arithmetic and not much else, others can tessellate an irregular quadrilateral but can’t give the change out of a pound.” It was decided to devise a ‘test’, for want of a better word, but it had to be a very carefully constructed test which would diagnose the mathematical state of health of each individual in some detail. Some criterion-referenced diagnostic tests in use at Wandsworth School were taken as a template and a selection of tasks was chosen from levels 0 to 4 on the SMILE network and presented in increasing levels of difficulty, starting with levels 0 and 1, so that students could opt out when the going got too hard.

Anxiety was expressed at a monthly meeting where the group’s ideas were presented about a test being the first experience of mathematics in a new school. In more recent times the stultifying effects of testing on those who experience them do not seem to have been considered so seriously. Education today is seen to be held accountable to the general public rather than to that part of the population for which it is designed. In the case we are currently considering, however, secondary schools who chose to use this test arranged with their feeder primaries for students to take it in their last half term in primary school.

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59 _Splash_ 100001, June 1981
60 _Splash_ 10101, March 1979
How far should we go?

Already in the early 1970s, the SMILE group across London, believing in the efficacy of an individualised approach, was debating how far up the school their scheme should go. Should we now create material suitable for students in Year 10 and above or should the experiment be confined to the first three years of secondary school so that we could perfect the learning materials for that stage? At the conference at Beatrice Webb House at the beginning of December 1974 the motion that SMILE should stop at the end of the third year at least for the present was debated and I came across some dusty old notes I had made to oppose the motion. Some of the reasons given for SMILE continuing at least until the end of Year 11 were:

1. It provides a better method than any of those we have tried before because:
   - it removes harmful competition
   - it gives each child self-reliance
   - it gives each child a chance to develop his own talents and interests at his own rate, giving the opportunity to realise his full potential over five years.

2. If the spread of achievement and interest is greater at Year 10/11 than during the first three years, the greater flexibility of SMILE will allow a far wider variety of approaches and content to be fed in so that more educational needs will be met than is otherwise possible.

3. The growth of the team and its increasing experience means one can expect a higher standard of presentation and a much speedier output of material in future. Also, some schools have already SMILE-ised material for these years.

4. The impetus for development is here, now, why stop it? One can go on consolidating and perfecting any scheme forever without being fully satisfied.

5. Adopting SMILE in the 4th and 5th years does not exclude other sources and approaches at this stage. There is room for compromise here, and the need for it, just as there is earlier. If enough material cannot be produced it can be supplemented with other resources already within the schools.

6. The high flyer does not need less help and guidance than the rest. He is self-motivated, however, and can, if SMILE has been a good training in the first three years, more easily absorb other material that is not programmed in such detail as SMILE.
Chapter 5: The next chapter in the life of SMILE

7. Habit is a compromise effected between the individual and his environment. It is a compromise which is being constantly renewed. It seems unproductive to change quite radically the working habits formed in the first three years of SMILE. The child will have built up confidence in his habitual method of organising work and this confidence should not be undermined when many other decisions about changes are being made. One of the strengths of the British education system is its belief in continuity. Change needs to be evolutionary, not revolutionary. Keep the continuity of SMILE.

8. Economy of time: it takes time to discover and put into practice new methods of organising work – or having it organised for you. Why waste time on new ways of organising when you already have a well-trodden, adequate pathway you can take with ease?

9. The structure can cope with reluctant learners – a worthwhile quality in the light of ROSLA, the raising of the school leaving age from fifteen to sixteen, which took place in 1972).

HMI when they looked at SMILE during the academic year 1975-76 had comments about how far up the school they considered SMILE should go:

*It is important to decide whether the extension of SMILE for use in years 10 and 11 leading to a public examination should take precedence over the improvement of the materials used in the first three years.*

The question of SMILE and public examinations is the subject of Chapter 12.

**A developing agenda**

Even earlier than this, in December 1973, Ronnie Goldstein was considering a time when SMILE would have reached the public examination years. He described the revolution he was witnessing in the mathematics classrooms of the 22 London schools where SMILE was currently being tried and tested, took a forward glance and encouraged visits to SMILE classrooms.

*Considering the long-term development first, it may well be that a Mode 3 CSE syllabus*\(^{61}\) *will emerge, but that is necessarily quite a few years ahead and so any comment at this stage tends to be speculative. As far as the short term is concerned,*

\(^{61}\) The CSE had been introduced in 1965 to provide a leaving certificate for the majority of students in schools who did not take GCSE O-levels. There were two popular CSE Modes: Mode 1 – a syllabus and examinations controlled externally by one of 14 regional CSE Boards; and Mode 3 – a syllabus and examinations devised locally, by teachers in one or more schools, with external moderation.
the one most important task ahead of us is actually writing the work cards themselves. Children working at their own pace is not good enough. For the scheme to live up to its name and be truly individualised the work tackled by each child must be appropriate for him. It must be individualised in terms of direction as well as pace. In other words, as far as SMILE is concerned, there must be enough material available to give adequate choice at each point. Which means an awful lot of cards! The quality of the cards also leaves a little to be desired at present. Their layout and design need more attention. But work cards are certainly not the only medium which we can use to communicate with children. Tape recorders and loop projectors could be extremely useful aids for an individualised approach to learning and there is every possibility that, in the future, some of our tasks might be presented on a tape or a film loop. Other possibilities for the future include the use of ‘modules’ of work, centred on a particular topic, perhaps with the children using kits of consumable materials.

Obviously, in a brief description such as this I cannot mention everything that there is to say about SMILE, much less give a true account of the atmosphere in a SMILE classroom. Interested teachers will want to look at work cards and other materials for themselves. They will want to see SMILE in action.

Ronnie ended his article by offering to give more information or to arrange visits to SMILE classrooms.

During these early years Smilers continued to question their current practice as well as thrashing out their future plans. For example, early in 1975 groups were set up to work on the mathematical structure of the network. Five teachers were considering algebra, another five shape and a further seven number. A ‘low attainers’ group was set up and the material began to be used in off-site units throughout the ILEA. It was found to be ideal for planning and putting into practice programmes of work in mathematics for those whom teachers might be meeting for only a short time, those who had been turned off the conventional classroom. Many of these developments are covered in later chapters.

And so, like Super Steve who began this chapter, SMILE continued to grow in all directions at an alarming rate.
Interlude: Isolation or independence?

Although SMILE had begun by considering how the mathematical needs of each individual student could be appreciated and met, in order to understand what came next it is important to counter the common misapprehension that SMILE isolated students from each other and valorised the individual over the group. Nothing could be further from the truth and the pedagogies that developed would never have happened if that had been an accurate reflection of the SMILE philosophy and classroom practices. This interlude addresses the issue before continuing with the story.

Out of touch

In March 1977 a report by HM Inspectorate, critical both of mixed ability teaching and of individualised learning, was made public. Nigel Langdon, having Smiled for four years, responded to the criticism through letters in the press, explaining the opportunities the SMILE structure gave him for meaningful discussions of mathematics in the classroom:62

I was shocked by the willingness of the inspectors to blame mixed-ability teaching as a major cause of poor achievement in schools, and to condemn individualised learning shows them to be out of touch with classroom reality. Out of touch, because the most successful “traditional” and formal lessons are those with a high degree of individualised attention. Where the lesson is teacher-centred, the performance given may well be entertaining, attractive and well-prepared, but all available evidence shows that the learning tends to be passive and less meaningful for the pupils.

The particular complaints in the 9,000-word HMI’s report - circulated to chief education officers, training colleges and professional associations - are easily shown to be the bad practice of some teachers who are not earning their salaries. Indeed, the report is an example of the familiar tactic of choosing short-term poor expertise in a few cases to condemn long-term objectives. One could just as easily advocate the abolition of the Inspectorate because of that one inefficient HMI. The HMI report is wary of the problem of choosing appropriate tasks for secondary school children from widely differing backgrounds in primary schools. But what did we do before? We started on page one of book one, regardless.

The Inspectorate is very much aware that individualised learning is only one way of catering for mixed-ability teaching. Unfortunately for many teachers, the two are synonymous and the problems of one are seen to be the downfall of the other.

62 Taken from letters to The Guardian (15 March 1977) and TES (11 March 1977). Nigel Langdon, then head of mathematics at Christopher Wren School, London, later became deputy director of SMILE.
It is certainly easy for a teacher to rely heavily upon worksheets and to ignore discussion, but it is wrong to suggest that individualised learning precludes whole class dialogue. Class discussions that arise, or are engineered, in mixed-ability classes are far more meaningful to the children because they only occur when relevant to the work of the whole class. If only relevant to a group within the class, then the teacher organises such a group. (In some classes I have seen the children organise themselves into a group, when discussion was needed.)

Of course, the teacher must be aware of the role of language in these discussions since the spoken word needs to convey sophisticated information. But, far from giving the language a low status, I find that I talk with children mathematically far more on an individual basis than I could in a class discussion. I can extend the dialogue in line with each child’s verbal reasoning ability.

This individualised attention makes it possible to use a wide variety of approaches. Instead of being limited to a mode of teaching suitable to the class as a whole, the teacher is able to choose appropriate methods (language, procedure and apparatus) to suit the pupil. Quite the opposite to the report’s suggestion of limitations. Because of this facility, it is possible to guide the children at a pace suitable for each pupil.

Now for the report’s biggest mistake: why is it that, like most observers, the inspectors assume that “working at her own pace” means that each child is sitting back taking it easy? With the teacher functioning as a tutor she can ensure that the pupil is working at a rate and with methods and materials to suit her ability. It is far easier to get each child achieving her full potential when each is following her own course, steered and instructed according to the teacher’s knowledge of the pupil’s ability. I can extend the dialogue in line with each child’s verbal reasoning ability.

Having used an individualised approach [SMILE] during the last four years, I do not want to sound like a converted alcoholic or to evangelise a new cause. I do find, though, that many of the decisions I have had to make as a classroom teacher are concerned with problems that lay dormant when my lessons were more formal.

We can recognise that, after four years of individualised learning, we have a majority of pupils who have assumed the responsibility for their own progress and who are working because they want to. With that sort of motivation our fourth-year pupils are gathering momentum in developing concepts and in learning skills - to be compared with previous fourth year pupils, the majority of whom dropped out of mathematics at this age. I was prepared to suggest that maybe we have to pay for the better social standard that mixed-ability grouping produces with a lower academic standard, but I can offer my fourth-year pupils as evidence that the advantages of individualised learning are positive all round.

63 my emphasis
Not isolation but co-operation

These descriptions of Nigel’s classroom indicate the distinctive style of the Secondary Mathematics Inclusive Learning Experience64 - students with a variety of levels of achievement working on their own individual programmes but sharing ideas. This clearly does not mean isolated working and, when appropriate, as Nigel Langdon points out, SMILE classes experienced both group and whole-class interaction, especially when creative and/or investigative work was being done. A child working in isolation was rare because discussion and the sharing of ideas with friends and workmates as you go along is natural and is recognised as good practice by students and teachers alike. Talking to each other about your mathematics was encouraged and went on all the time.

An experienced teacher distinguishes easily, by the different quality of the sound, between work-talk and chit-chat. Considering her 2003 SMILE classroom, Bridget Perkins writes:

Students work in pairs, threes or fours; there are somewhere between six and eleven groups in a class (this changes from topic to topic).65

Discussion is of the essence in good teaching and learning and discussion was certainly abundant in SMILE classrooms. Indeed, a SMILE classroom was likely to be noisy. This was illustrated by an incident at JFS soon after we had introduced SMILE. My classroom was in such a position on the third floor that all sound from it filtered down to the headmaster’s study on the ground floor. One day he came storming into my room, perhaps expecting to have to quell a riot. He found instead a great deal of mathematical discussion going on. In future he knew that if he was disturbed in his study it was “just the maths department at work”.

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64 As we have noted, the ‘I’ in SMILE was first interpreted as individualised, then independent seemed to explain the philosophy better, but perhaps inclusive gives more of the flavour in the 21st century.

65 Splash, September 2003
Chapter 6: The SMILE materials and their creation

In 1973, in their introduction to a book of games, devised to develop children’s creative thinking, Michael Holt and Zoltan Dienes wrote:

*Trad maths, especially as it used to be taught, was largely about the tricks of the mathematical trade; the new maths, on the other hand, reveals the underlying laws that govern those tricks.*

It was the underlying laws that were in the minds of SMILE teachers as they steadily built up a mathematics curriculum in the form of a resource bank from which they could devise personalised broad-and-balanced programmes of work for individual students. No two people have identical needs; they do not require exactly the same provision of food, drink, clothing, medical treatments, nor are the same educational interventions appropriate to all. There are few services that can actually be delivered. You cannot, for example, ‘deliver’ health, all you can offer are treatments which, if accepted, are likely to lead to a healthier organism. Similarly, with education, you can provide the environment, the materials, the experiences but it is the individual confronted with all this who will decide how to respond, and no two responses will be the same. It was with these thoughts in mind that Smilers wrote and searched for materials to put before their pupils.

This vision and also the practicalities that had to be addressed in its pursuit are the subject of this chapter. It includes the use of commercial materials in SMILE, the editing process and the difference made by the appointment of a graphic designer.

Rapid growth: the practicalities and the vision

The direct control of curriculum development by teachers in the classroom inevitably caused administrative and financial headaches behind the scenes. SMILE’s increased in-house production of learning materials caused many problems for ILEA’s administrative departments dealing with supplies, printing, distribution and so on. In November 1976 Laurie Buxton received a minute detailing the problems:

*As you will be aware the expanding nature of the SMILE project is causing increasing problems as far as storage and distribution are concerned.*

*At a recent meeting Poulson of the Course support unit stated that it was only with the utmost difficulty that he had been able to reorganise his storage arrangements to accommodate the latest printing order which was much in excess of previous orders. . . .*

*However, when the Schools Sub-Committee considered the report on the framework of the 1977/78 budget last week you will be delighted to know that there was some strong support expressed for extra provision to be made for SMILE . . . i.e., recognising the success of the scheme and the importance it has now assumed within the curriculum, the committee were anxious that every effort*

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should be made to provide adequate accommodation, equipment and staffing to
cater for its development.  

These problems were increased by the determination of Smilers to have as
much variety of format as possible and, with all these requirements in mind, Ronnie
Goldstein took up the debate in Splash and also gave an overview of new directions:

**COMMENTS**

… There are over 50 ILEA secondary schools which use SMILE material, most
right across the board with either first years, first and second years, and now first,
second and third years in some pilot schools. Printed material has also been sold
outside ILEA with 2 units going as far afield as Denmark and Tasmania. There
are many more schools presently using the printed material than there are using
the pilot cards which we duplicate at the Ladbroke Maths Centre and so it is
noteworthy that cards 0301 to 0500 have now been printed. Some are A5 in size
and not our usual A4 and there are also several supplementary.

If this printing assignment has had more administrative complications than the
last one, the next one (assuming a next one there be) will be yet more problematic.
Entries 0501 to 0550 are nearly all commercial material.

At the moment this means work from SMP and Making Maths text books, MMCP
packs, and the Dime booklets. But if SMILE is to cater for children through the
secondary range we are obviously going to have to rely more and more on sources
which are readily available, and so this is an area which is bound to expand.

Not only do commercial texts provide us with an important source of material
but also they add to the variety of the SMILE classroom. Many of the children
whose comments have appeared in Kids’ Corner have been at pains to point out
that cards, cards…and still more cards are almost as undesirable as listening to a
teacher!! So, it is obvious that we must continue to provide a large variety of
stimuli for the children.

Using texts and booklets will help but much more importantly the children need to
be engaged in a whole variety of activities through the year, even though the week.
Reading between the lines of some of these children’s comments, it is not the use of
work cards which bores them. Work cards are just the medium. It’s what the cards tell
them to do. So … more use of materials and apparatus please, writers … and then in
classroom the sooner it is generally accepted that maths is a practical subject the better.
We need to aim, I think, for the sort of set up offered to the average science department.

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67 Assistant Education Officer/Secondary, Minute to Mr L Buxton from Don Venvell,
12 November 1976
The facilities we require for maths may be less sophisticated than some of those for science but they need to be available. Maths must be taught in a maths room, designed and equipped to be just that.

‘Investigations’ are another source aiming to ‘provide variety in the classroom and about 50 of them were introduced on SMILE cards over this last year. This is a particularly difficult area of work and there is certainly not space enough here to discuss it further. Personally, I hope very much that some classes have benefited from them.

The longer course, which has been devoted entirely to SMILE, has made inroads into the development of some project work and when certain loose ends are tied together we hope to produce some kits of stimulus material. This sort of work might be most suitable for small groups of children - again giving more variety to the experience of the children.

Closely connected with this is the production of AVA. Unfortunately, money is a constraining factor here and although much work has been done only two transparency booklets appear on the network.

There are two working groups of teachers, both of which were set up at the conference at Beatrice Webb House last year and have been meeting regularly since then. The ‘structure’ group is considering the mathematical content of SMILE - as it exists now - and also what should be created in the future.

The ‘assessment’ group is concerning itself with the formulation of a SMILE CSE exam and (looking a little further ahead), an ‘O’ level.

The fact that so many people are involved one way or another with the project is what makes SMILE such a lively piece of curriculum development. If SMILE cards are valuable, writing them is invaluable.

Ronnie Goldstein Advisory Teacher to SMILE

By September 1978 SMILE, at five years old, had expanded to 21 pilot schools who were receiving the material piecemeal and as soon as it was printed. This had been made possible through an arrangement whereby those schools transferred money in advance to the SMILE Centre. Over these five years other schools had become involved and had also begun to receive materials. The ILEA therefore gave further assistance in the form of financial loans enabling what had hitherto been pilot material – now some seven hundred cards - to be printed and purchased by all interested schools, both inside and outside the authority.

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68 Splash 0011, September 1975
As mentioned, the production of the materials was already causing many administrative headaches for the Authority. In 1977 an indication of the essential involvement of the Authority in the SMILE production process is to be found in notes of another meeting between the SMILE Centre staff, the inspectorate and the administration:

There was no vote for costs other than teaching and clerical staffing costs and finance was now required for running and developing SMILE ... At present printing orders were placed with Supplies Department and paid for by an overspending on the P.S.2 printing code vote. Mr Kaner hoped that the SMILE project would continue for at least another two years and it was felt reasonable to assume that production and sales of SMILE material would continue for another five years or so after the terminal date.

This involvement of the ILEA was vital not only to keep the project going but also so that teachers could keep control of the project as a later stage of this meeting indicates.

Looking at the size and the nature of the project, Mr Ragett did not feel it would be attractive to a commercial publisher. The possibility of a joint project was also discussed. If publishers were involved in a co-production, this would mean some loss of control. The editor would expect to come to meetings at which future plans were discussed ... Mr Ragett said the advantages of collaborating with a publisher were largely financial.

The advantage of bringing in the expertise of an editor would give a greater insight into production methodology. Mr Goldstein said that although he would wish to aim towards better production of the material, he would still wish to have a say in the methodology ... Mr Kaner felt that teachers would not be prepared to give voluntarily of their time to a project which would financially benefit the publishers.

So, it was recognised that the whole character of SMILE materials would change if it were absorbed by commercial publishers. Their first interest would inevitably be the economics of the project. The outlay expended on printing a great variety of items of different shapes, sizes, colours and textures in relatively small numbers could not be recouped but this kind of variety was considered essential if students’ attention was to be caught and held. The visionary ILEA enabled the project to continue to grow and expand whilst honouring its fundamental principles.

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69 Notes of SMILE meeting 25 November 1977 with Ronnie Goldstein and Peter Kaner from the mathematics team present and 6 others from the ILEA’s Centre for Learning Resources, the Learning Materials Service (LMS).
It was a rainy day and the playground at Southfields School was very wet.

"Why on earth are you crawling across the playground?"

"Got to Sir. It's for maths."

"But you'll be filthy. Who told you to do that?"

"It says so on my work card, Sir. It says: ‘How many ways can you get from the maths lab to the school gate?’ Well, Sir, I've walked it, I've run and I've hopped ... so now I ......

Southfields School

Figure 7: From Splash 0001

The materials and their organisation

From the beginning the fruits of all the activity was a steady flow of classroom tasks being tried out in classrooms, edited and eventually entered into SMILE's network. SMILE's grid was dynamic, being constantly recreated. It was built up initially on a set of large wall-blackboards at Ladbroke Mathematics Centre. Chalk lines drawn down the boards divided the topic flows. Pieces of string pinned across the board indicated the levels of difficulty of the tasks produced. This framework was fixed, everything else was fluid. As each task was completed its number was written on a piece of card and, after much discussion at the scene, the card was blu-tacked to the blackboard at the level and in the flow that seemed most appropriate at the time. That position was quite likely to change more than once before the task reached its final resting place as further use in the classroom proved it more or less difficult than was first thought or demonstrated that the concepts students were learning from it were different from those envisaged when it was first written.

But still the situation was fluid. Looking at the network in a few years' time it was quite likely you might find that particular task had disappeared altogether with others having taken its place. The curriculum evolved with changing requirements and philosophies.

It could also change according to individual needs. When it seemed there was nothing suitable to help a particular child over a particular hurdle, some task already there could be adapted, or a new one created, specifically to meet that child's current need. Indeed, as time went on, pupils were encouraged to create their own tasks. All these could be written on the pupil's individual network and also go forward for consideration for the printed network and so made available to all.
Overall teachers could now ensure that the mathematics programmes of study on offer in their classrooms were (almost) tailor-made to fit each child. Furthermore, teachers found that forward planning was much more precise than before, calling for careful study of the progress of each student as shown in written work and records. Even more detailed assessment was carried out in the classroom - the work of listening had to be more intense, involving careful, thorough discussion with individuals about the work they were doing. For SMILE teachers, gone forever were the days when they could decide to have a night off during the week and ad lib on a favourite topic the next day. Proposing a change of that sort was no longer acceptable to the learners. If each individual programme of work was not there, planned and ready, severe reprimands awaited the teacher from those students who were waiting for the next matrix (work programme) and who were prevented from purposefully getting on with their own particular set of tasks – for pupils individually did begin as never before to take possession of their work.

As the ‘pack of cards’ grew, a structure group was formed at a working weekend to look at the overall design of SMILE with a number of subgroups each with a different brief. Jeff Kutcher wrote in Splash 0011:

*We dealt with the structure of the syllabus, each sub-group designing flow charts of topics that should be covered through a five-year period of secondary school maths. Existing SMILE material was then filled into the flow charts and the relevant gaps in topics noted thus giving some direction for those occupied with writing new material (although this was by no means the only criterion).*

So the material being written for the mathematics classroom was analysed and individual tasks were built into sequences according to:

- levels of difficulty
- inter-relation within topic flows
- alternative routes for higher- or lower-achieving pupils.

When new material was offered for consideration, Jeff explained, questions to be asked before acceptance and editing for inclusion on the SMILE network were:

- Are there any gaps to be filled in the written material for development of this, that or the other topic or concept?
- Can one find an alternative approach to a concept?
- Is it possible to write one card combining the content of several already-existing cards for high achieving pupils?
- What mathematical language should be used and how should it be introduced?

But Jeff recognised the essentially bottom-up approach of SMILE, the enthusiasm engendered by the freedom given to mathematics teachers to devise their own curriculum and the reliance of the project on the creativity of those teachers to decide on its future direction:
There is still an incredible amount of work to be done and the direction SMILE takes in the future depends on the contributions and criticisms of the teachers using SMILE.

The contributions and criticisms did continue because that passion for mathematics and for firing students’ imaginations with exciting ideas persisted. What is more, teachers recognised that the environment in which these ideas were implanted influenced their development.

All working groups were enthusiastic, Jeff continued, meeting in the evenings at the Ladbroke Mathematics Centre, discussing and arguing the various problems over cups of coffee and sandwiches. For those still gripped in debate, after the building had been locked up, there was the choice of three local pubs to which to retire. Even at that early stage there was a dream of putting the SMILE network onto a computer file where a new task could be fitted into an appropriate flow as soon as it had been produced. This proved to be pie in the sky. Meanwhile the framework continued to be strengthened and extended as cards were added with blu-tack to the large wall blackboard.

Laurie’s assessment of SMILE in Splash 0010 continued:

What is SMILE now then? … SMILE has, unlike so many attempts at change, a really solid basis. It sprang from the needs in the classroom, was constantly tested back there and developed, as all schemes should be, by the teacher in the classroom. This is your genuine article – curriculum development as it should be.

Making use of other people’s ideas

However, life was far too short, even with this large team, to create new assignments for each individual learner. By September 1975, Splash 0011 was giving views on future developments of the resource bank. “If SMILE is to cater for children through the secondary range” wrote Ronnie Goldstein, “we are obviously going to have to rely more and more on sources which are readily available, that is, commercially produced resources.”

There was some good commercially produced material – SMP and Making Maths, for example – lying unused in cupboards in various schools. Some of this was given its place on the blackboard, and later in the printed networks. More positively, some materials created by other innovative groups, such as DIME, Leapfrogs and MMCP, was highly prized by the SMILE team as it embodied the characteristics that encouraged creative thought in their students. The page from the Teachers’ Manual shown below gives the reasons for the integration of commercially produced material into SMILE programmes of study.

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Splash 0011, Sept 1975
Chapter 6: The SMILE materials and their creation

Commercial material

What?
Any generally available, published material which it is considered would suitably be supplementary or complementary to SMILE cards.

Why?
No work card system can be exhaustive without running into possibly tens of thousands of cards.

There's plenty of very good stuff around, so why not use it?

How?
Work cards and booklets will simply be given SMILE numbers and put into the filing cabinets. Answers and tests will appear as normal.

The advice continued:

Sections of text-books, however, will require a cross-reference system: suppose, for instance that we wanted to make questions 2 - 7 of Exercise C on page 142 of SMP(E) into SMILE entry 0847. The network would contain simply 'SMP 0847' and this would be written onto the child's matrix. The child would then be referred to the SMP sheet which will be supplementary to the task lists and will have to be displayed in every SMILE room. The child would then of course look up 0847 on the SMP list to find the details he requires.

Later, a great deal of exciting commercial material was included most of which would not fit in the filing cabinet!

Figure 8: Some of the commercial material included in the network
The editing process

Of course, the majority of tasks finally printed for use in the classrooms of Smilers were developments of those already tried out with some success with the writers’ own students. The original creator of a task would offer a draft for the editing group’s consideration. Editing was a harsh process. You were left in no doubt if your presentation was lacking in any way! The scrutiny given to each offering was detailed, ensuring that the mathematics presented was sound, the language student-friendly and the format appealing. The drafts refined in editing sessions would then go out with comment sheets to be tried in SMILE classrooms and the comments of teachers and pupils would be taken into consideration for the final write up. This process continued throughout the active life of the project (although, towards the end, because of the politically enforced constraints, in a very attenuated form.)

Just how did this happen? Initially as has been noted the editing was done by Ronnie Goldstein, Jim Mayhew and John Stewart but very quickly a group of teachers had taken over. Again, Splash\textsuperscript{71} explains the editing process that evolved:

When a new idea, arising from the classroom or from a writing workshop, is produced as a rough draft it is most likely to be tried out in the classroom first of all. This does not always happen because the task may well be the result of an activity of which the teacher already has some detailed experience.

After the first draft has been tried with two or three children (and perhaps modified as a result) it is sent to the editing file at the SMILE Centre. Editing is carried out by a quorum of teachers who have been involved with SMILE for some time and have a lot of experience with work-cards and other learning materials.

At this stage the discussion about the suggested activity puts it into one of three categories:

(i) accepted as it stands
(ii) accepted with minor modifications
(iii) rejected because more modifications are needed.

Since Charles Snape, the graphic designer, has taken part in the editing, very few suggestions now fall into category (i). Charles’s expertise with design gives much clarity to the ideas and presentation of SMILE.

If some modifications are thought necessary the outcome depends upon whether the editing group feels that it can do them on the spot. If some lengthy alterations are required the decision is made to refer the activity back to the writer with some suggestions as to how it could be adapted. If this happens it goes through the cycle once again.

\textsuperscript{71} Splash 10001, June 1978.
For activities which are accepted, a consensus of opinion determines the level (and the topic flow) for the network. The next SMILE number available is assigned to it.

Preparing a draft during a workshop at the SMILE Centre enables the designer to be brought in on its presentation at an early stage. One prepared in the classroom has the advantage of arising out of the work children are doing and so can be guaranteed some future success. Whichever way, the final SMILE task is the result of detailed discussion and trials of ideas. As a result, the network is becoming a collection of really good ideas for the classroom.

There was a time when the draft was written on Monday; tried out on Tuesday; sent to SMILE on Wednesday; edited on Thursday; final draft on Friday; back in the school, printed the following Monday. Now that commercial printers are used instead of hand-cranked Roneo duplicators it takes a little longer, but three to four weeks is not too bad!

Improving presentation: the influence of a graphic designer

The name Charles Snape has already cropped up in these pages and one of the most significant steps forward in the SMILE process, raising the quality of the finished products, was the addition of Charles to the team in 1978 as graphic designer. From the beginning the authors and editors had recognised the importance of presentation and appropriate illustration. In particular, many early geometrical concepts are based on a visual understanding. Charles was given the job of overseeing the production and presentation of all the materials. Before that stage was reached he had sat in on the editing of the material, listened to the discussion about how pupils had reacted to the trial versions and heard explanations of the objectives for each task being put forward. The world in which we were working was becoming ever more sophisticated in the presentation of arresting and seductive images. The Age of Advertising had well and truly arrived and the teenager was used to being persuaded by packaging.

Charles, as he sat in on editing, learned more mathematics as he went along while at the same time providing the doubtful customer’s point of view which helped the original authors to simplify their information and instructions making them more accessible to the reader. After that process Charles packaged our ideas in forms that had an immediate appeal to the clientele. Having him as a full-time member of the team meant an integration between mathematical ideas and presentation which could not have been achieved in any other way. This aspect has proved even more important over the years as advertising has become increasingly sophisticated and the visual image has been made ever more seductive.

Appointing a graphic designer had of course meant more finances coming from the ILEA’s central coffers—something that the politicians have made almost impossible today. The importance of this Authority backing has already been touched on.
It was essential not only for an acceptable standard of presentation but also to safeguard the freedom of the writers to create materials they considered appropriate for their pupils, taking into consideration all their variety of first language, ‘race’, gender, social class and the widest possible range of achievement.

The work and influence of the graphic designer developed over the years. Charles, the first designer, came from outside mathematics and he learnt much of the subject on the job while educating his colleagues in some of the important elements of presentation. The second designer moved to the job from working as a member of a SMILE department, having started out with design training. A letter\textsuperscript{72} written by Hilary Povey (then director of SMILE) gives some indication of the vital role played by the graphic designer, not only in the creation of more visually motivating images in materials produced for everyday use in the classroom, but of ‘extras’ in the form of magazines for students and teachers. (\textit{Splash} has featured from the beginning of this story; more about \textbf{Factor} and \textbf{Investigator} below.)

\textbf{Waves of new material}

Two waves of new material (each approximately 25 separate items) are to be produced each year. Each wave will include approximately 20 A4 or A5 workcards plus a small number of special items. The special items might include a set of posters, a jigsaw, an enveloped puzzle, a pack of materials for group work, a booklet of activities. (Samples enclosed.)

Eleven half day meetings are set aside for editing discussions with teachers and the centre staff. The Graphic Designer is a full member of this editing team and is expected to contribute both in the discussion about the nature of activities from the perspective of mathematics education and also by initiating ideas about style, content and presentation.

Subsequently he prepares roughs for extensive discussion with other members of the centre staff. When these are approved he engages and supervises outside work to obtain illustrations, typesetting and, on occasions, paste-up. He organises proofreading and corrections and produces finished artwork.

Except for the print buying, all aspects of negotiating with the printers is done by the Graphic Designer - all print specifications and the passing of proofs as appropriate.

\textbf{Existing materials}

The volume of SMILE material now in print is enormous and is constantly in reprint. This involves a considerable amount of work. Before material is reprinted, the Graphic Designer organises and supervises corrections and alterations to

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\textsuperscript{72} Letter from Hilary Povey to SMILE departments, 10 December 1985.
existing materials. This always involves complete redesign of some materials and the production of new artwork after discussions with teachers and centre staff. Over half the material is reviewed in this way each year.

In this description, Hilary mentions some of the more innovative materials in terms of format – posters, sliding puzzles, jigsaws, boxed puzzles – that could only be introduced with the close collaboration of a graphic designer. Charles displayed as much initiative as the rest of the SMILE team and in February 1978 he was already writing in Splash of the possibility of a children’s magazine.

**Factor and Investigator**

At the monthly meeting questions considered were:

- Would there be an interest in a children’s magazine?
- At what age/academic level should it be aimed?
- What content should it have?
- What about format?
- How often should it be issued?
- What charge should be made cost and who should pay?
- Are enough teachers ready to take on another regular commitment?

From this discussion Factor eventually emerged, with Charles as editor-in-chief. It was produced twice yearly with Charles responsible for half the copy, both researching and writing material. In addition, he was wholly responsible for all aspects of designing and print production.

Charles also instigated and was co-editor of Investigator, the ‘newspaper’ for teachers, which was produced twice termly. This involved him in participation in the working group of teachers, producing copy, inviting contributions from
others, selecting articles, editing, design through rough artwork, commissioning artists, producing diagrams and illustrations, taking photographs, and all stages of production.

But, as has been foreshadowed in some of the earlier chapters, SMILE was also becoming pedagogically innovative. No longer satisfied with replicating in individualised form the conventional approaches to teaching and learning mathematics, inspired by each other and by their pupils, they thirsted for more, in their classrooms and in their ways of working together. This is explored further in the chapters that follow.
Chapter 7: Expanding how we thought about learning and about ourselves

Interspersed throughout this chapter (and later in the next Interlude) are accounts by participants of the SMILE conferences held each year and funded by the ILEA. The emphasis on this experience is justified by the vital role the conferences played in the life and work of Smilers. They gave that essential space for Smilers to expand how we thought about learning - and about ourselves.

Increasingly, deep democracy, amongst ourselves and in our classrooms, was seen as fundamental to all that we were trying to achieve. The theory of action learning helps conceptualise this process.

They did it their way

A sense of how we all worked together ‘in our own way’ is important in understanding how SMILE developed and how it embraced quite revolutionary change. This description of one of the early SMILE conferences held in the year 1975–76, three years after the initial course organised by Jim Mayhew. It had as its theme SMILE in the classroom. It gave a focus to the never-ending analysis of what was happening in Smilers’ classrooms and the search for better ways to organise them for more effective learning to take place. The topics for the four discussion/workshop groups, through which all would circulate over the weekend, were:

- Organisation of the classroom
- Investigations
- From classroom to maths room (posters, etc.)
- Maths for the Majority Continuation Project (MMCP).

But even some of the apparently mundane issues were infected by wider and deeper issues. In Splash 0111 Dick Gmiterek reported:

73 Splash 0111, March 1976
With regard to the classroom, teachers were urged to encourage children to be creative and explore mathematical ideas together rather than just learn processes. “Children should be mathematical investigators,” he said, “and so too should teachers.” Then followed a thorough investigation of the bar.

On Saturday the conference split into groups each of which spent some time in four different workshops … Ray Gibbons presided over a discussion on classroom procedures; Ronnie Goldstein had us working on investigations; Peter Kaner's group worked through the material for the MMCP; and Nigel Langdon’s group designed and made posters and wall displays. … The therapeutic atmosphere of poster production attracted many overworked souls. Nigel provided lots of materials, equipment and books. Many ideas were “borrowed” and many more generated. As there is a lack of commercial material there are possibilities for publication of good ideas. At least two area groups are continuing this work.

Ronnie Goldstein helped stoke-up our insecurities by making us work through some of the SMILE investigations. (What do you mean there’s no right answer, sir?) Although much is said about open-ended exploratory learning I suspect most of us are still pretty traditional about the sort of work we set. It is this shift of emphasis which should be our next (and by far the most revolutionary) step. More than mixed ability or individualised learning it will generate hostility and misunderstanding amongst parents, heads and, most of all, many mathematics teachers. Furthermore it will be more demanding of our teaching skills than anything that has so far been done.

The conference struck a nice balance between discussion and activities, and was generally enjoyed. Enough time was available for general chat and discussion in the well-run bar. The last aspect is, in some ways, the most important part of a conference and a good atmosphere in the bar set the tone for the whole weekend … with morale-boosting effects.

I well remember preparing for my ‘organisation of the classroom’ sessions at that conference. Having cut out a multitude of shapes to scale to represent the plans of various standard pieces of furniture, a discussion on how that furniture is best arranged in the classroom and other such mundane issues, I repeated four times during that one day. The explanations given, as people drew plans of their own rooms and positioned furniture within them, proved remarkably inspiring and varied. Keeping close to the nitty-gritty of a teacher’s everyday life and questioning all the physical details of the immediate day-to-day learning environment provided an excellent vehicle for considering afresh the philosophy behind what was happening in that environment. Every detail, such as the selection and arrangement of the classroom furniture, supported a teacher’s aims. The questions asked and answered were in what ways the environment supported the individual learner in:
• finding unassisted the allocated tasks;
• accessing the concrete apparatus to model mathematical situations;
• giving space for using that apparatus unimpeded;
• discussing with others (including the teacher) tasks in hand;
• independent searches for information and references;
• sufficient privacy when using a computer to be unembarrassed by mistakes;
• providing quiet corners for individual reflection and investigation.

Although, as Dick has noted, John Stewart was no longer in London he had taken SMILE with him and he remained at the heart of the SMILE curriculum-creation co-operative. Splash readers could continue to share his ideas, catching his enthusiasm and recognising that, by working along his lines, they could achieve what they had previously thought was pie in the sky: They designed mathematics programmes more and more in tune with inner-city teenagers and, as closely as possible, fitting each one individually.

Working democratically

Hilary Povey, director of SMILE from 1984-1987 writing in 2005, explored how SMILE revolutionised teachers’ thinking about their classrooms and the changed role they found for themselves within them:

[The SMILE] way of thinking about knowing mathematics also democratises the subject. Learners in classrooms could now be seen as the makers of mathematics, not simply as those who are expected to receive passively the expert knowledge of others. Smile classroom practice also made it possible for me to work more democratically in other ways. Again, when I first Smiled, I thought all the important decisions in my mathematics classroom needed to be taken by me. I quickly learnt that this new way of working opened up opportunities for students to be much more in control of their own learning. They reflected for themselves about what they understood and what they didn’t understand, what their mathematical mood was today, who it would be good to chat with about some problematic mathematics, how they would record their work or present it to others and so on.

So much for changes in the classroom. But, intimately interwoven with this, the other wonderful thing was the way in which the project contributed to the professional development of the teachers fortunate enough to be involved. There were Heads of Department, some near retirement, through to young novice teachers like myself and everything in between all working together, sharing their expertise, their hopes and fears, their problems and solutions, and developing wisdom. The structure of the project instanced deep democracy with decision making resting with a consensus of those who participated. Any and all were welcome and could contribute. Fairly
early on, the then ILEA Chief Inspector for Mathematics, Laurie Buxton, argued with the assembly that a more conventional democratic structure consisting of elected hierarchies with committee members and such like should be set up. To his credit, even though he remained unconvinced by those of us taking an alternative stance, he allowed our will to prevail, whilst predicting an imminent descent into chaos! The project survived and flourished with this open structure.

This example illustrates the very considerable respect the ILEA offered its teachers. It was willing to pump-prime projects and support the energy and initiative of its teaching staff. It expected its teachers to be intelligent, creative and professional and so we were able to be so. I gained hugely from working alongside a committed and mixed group of teachers, all of whom were eagerly and regularly examining their own practice, sharing anecdotes and reflections about the exciting things happening in their classrooms. Throughout most of the time I worked in ILEA schools teaching mathematics, in common with a significant number of other teachers, I was seconded one day a week to work with colleagues at the teachers’ centre to make Smile happen. This seems almost unthinkable now – that an Authority and the Headteachers of its schools believed sufficiently in the powerful effect for good of their teachers’ active involvement in curriculum development and design that they were prepared to find the funds and the timetabling solutions in school to permit this to happen. But possible it was – and still is if we have the will.

John Stewart also had clear ideas about democratic ways of working in SMILE. There were important points of principle that concerned him (many of which seem to have been disregarded by national legislators of later years). From the beginning he had offered guidelines for inclusion:

1. No distinction must be made in the appearance or numbering of any resource material to indicate level of achievement detectable by any student.74
2. No authorship should be claimed by any writer. This would, John claimed, prove critical important on two counts:
   • No ‘important’ people could hijack control (‘And by god they tried,’ wrote John);
   • Co-operative work could be ensured (and the production process certainly forced people to learn to work together).

A third principle arose from initial work on, and funding of, the project. It is a further clarification of the implications of the second statement.

SMILE must be controlled by the teachers who use it, in response to their own students. Hence, it must not be published commercially.

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74 As has already been mentioned, the number allocated to a task merely indicates the order of production – card number 0050 was the fiftieth card to be printed.
Tony Brown argued for deepening the democracy for the students: students can choose for themselves if teachers don’t interfere too much but, clearly, that can only happen when they have got used to being given the freedom to do so. The characteristic of a SMILE classroom that always so puzzles observers is that the students seemed to be organising themselves. In other circumstances it has always been rare to find classrooms where teachers have loosened the apron strings. They have existed here and there, however.

Two historical examples can be seen as precursors of SMILE. Way back in 1911 Edmond Holmes described a whole school where this had happened\(^75\) - a school “not afraid to depart from the beaten track” in order to catch the interests of the child. “Two things” writes Holmes, “will strike the stranger who pays his first visit to this school. One is the ceaseless activity of the children. The other is the bright and happy look on every face.”

It was a small rural primary school and Holmes describes a day when, because of a series of emergencies, the school was left for a while without a teacher. When the Head returned having dealt with her emergency she found all the children in their places and at work.

> They had looked at the time-table, chosen some of the older scholars to take the lower classes, and then settled down happily and in perfect order. This incident serves to demonstrate that the morale of the school has somehow been carried far beyond the limits of what is usually understood by discipline.

Similar experiences are described by those who visited Prestolee School (and this group included Edmond Holmes) run by E. F. O’Neill, with the help for much of his time there of Gerald Holmes, Edmond’s nephew.

> There was a Lancashire elementary school which I used to visit between the years 1937 and 1944. It was in Prestolee, a mill village between Manchester and Bolton – a district not noted for its amenities. Immediately on entering the school you were aware of an unusually peaceful and harmonious atmosphere. The school was organised like a public library. Children were moving around, quietly pursuing various tasks. This state of affairs had been reached in accordance with one of Ostwald’s principles, by beginning with the actual interests of each child. You might ask a child of six, “What are you doing?” and receive the answer, “I am researching ducks.” This meant the teacher had discovered the child was interested in ducks and had said, “See if you can find a book about them.” I still have some books, written by these children, on the basis of what they had found out for themselves. Needless to say, not all the children were gifted. They were a living justification of Ostwald’s belief that nearly everyone can learn how to use books intelligently.\(^76\)

\(^75\) Edmond Holmes, *What is and What Might Be*. London: Constable, 1911

We see, then, that Tony Brown was following in a great tradition when he wrote following up thoughts arising from a seminar at the 1981 SMILE Conference:

Mathematics is an immense subject and most teachers quite presumptuously choose an area which they think the children they teach should know. The area chosen depends on the teacher's view of what is socially acceptable and relies on the acceptance of the myth by the children that the teacher is always right. The teacher's perception of this area is in terms of a well-developed language; the teacher's own language. The children need to learn this language to be able to communicate, which puts them at a distinct disadvantage. Not only do they have to learn maths, they have to learn it in someone else's language. Every oration or explanation is propounded in the teacher's language and subordinates the child's.

To cite an adult example: in seminars it is the dominant people who define what is spoken about and before long those who have not spoken feel left out because they have had the discussion taken away from them and their contributions feel awkward. The lecture situation is even worse where no right of reply is allowed until the end. It is no wonder that questions seem so banal when the questioner is obliged to fit his ideas into someone else's framework and quickly!

In the classroom the teacher is inevitably dominant, but should the teacher be so dominant as to muffle each child's words into an insignificant squeak? This squeak is all that teachers may hear and they use this as evidence that the child has nothing to say. The children want to learn maths for themselves not for the teacher - or they should do. It must be emphasised that the part of mathematics chosen is a political choice: anyone who identifies key areas is being subjective.

My own experience is that children who are given freedom to choose cover a large cross section of mathematics implicitly in the tasks they choose. It is wrong to assume that children will not make sensible choices given liberty. However, there has to be total commitment to such a policy. If the teacher intervenes too much the child's independence is destroyed. There is no need to introduce skills in a time dimension, they will be covered when the child is ready. If a skill is deemed socially essential, the teacher can suggest topics requiring that skill — no more, just suggest. Perhaps a large resource base is essential to avoid political influence in decisions, but ideas are all that the child needs. S/he can tell when s/he is doing something worthwhile and a sensitive teacher can be aware. It is the teacher's own insecurity if s/he feels she cannot keep an eye on things in such a situation. Of course, such a situation needs to be developed as does any teaching situation. Children must be taught to be independent which can only be done through praxis.

Investigations with the child being given less guidance each time is one suggestion for developing confidence. Simply exposing the child to ideas, e.g. MMCP Packs, is

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77 Splash 100001, June 1981
enough however. It needs to be stressed that there is a difference between showing what is available and showing what to do with what is available. The children’s ideas are far superior to the teacher’s because they are their own ideas and they believe in them. Groups develop naturally as children seek to share their ideas. Concerns about matrices, tests and other such nonsense really must seem rather silly in a class of genuine individualists. SMILE cards used in the ‘ten cards to the matrix’ format hack up the subject brutally, … taking away any scope for invention. Sure, they are a good source of ideas but not when they have a time dimension and context.

On exams there seems to be a dilemma. A common exam for individualists is nonsensical. However, if one exists one can imagine the SMILE cards being covered so as to make the questions possible. But who is the SMILE CSE for? Employers do not seem that interested. The myths that surround their conception of maths are different from the myths the teachers have. The myths that the child has stand somewhere in between and up a bit with the parts they have discovered. Up a bit because they are the only parts that are worth a light.

**Combining theory with practice**

*SMILE* gave teachers the opportunity to sharpen their theory in education and in mathematics and to put their theories into practice. This is what made the project go on ticking.

The thoroughly integrated process of creating a curriculum and developing their own professional skills and knowledge may be seen most clearly perhaps by scanning *SMILE* INSET programmes. Whole-day and after-school courses were held at the SMILE Centre and annual *SMILE* conferences, always residential and held over a weekend, were held out of London. These became increasingly popular over the years. A note concerning the March 1977 Conference, which really applied to conferences in general, clearly indicates the central role of the local education authority in all this:

…As in previous years the cost of accommodation, food and all expenses (including travel) will be borne by ILEA and there will be room for 50-60 people.

This arrangement meant that any teacher serving in the ILEA could attend a conference out of school hours with the minimum of negotiation and red tape and with no cost to themselves or to their school. Now that the government has an increasing obsession with ‘Lonely Management of Schools’ the situation is far less flexible. In general, courses are now paid for out of individual school funds and there may be conflicts where an individual teacher’s professional needs do not correspond exactly with the school’s overall development plan. The importance of well managed residential conferences arranged for a number of schools is evident.

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78 *Splash* 1010, February 1977
in all the descriptions of SMILE. The reports of a further two SMILE conferences that follow make this clear.

The report by Tony Chennells from Holloway School of the 1977 Conference at Plaw Hatch Hall gives the flavour of the discussions demonstrating that, although all were weary after a week of teaching, they dived head first into a remarkable amount of mathematical activity and thought about mathematics, about classrooms and about presentation in the various working groups. It clearly demonstrates ‘action learning’.

Getting from north to west London on a Friday afternoon wasn’t on, I missed my lift by half an hour. Then a quick dash to Victoria, huge queues at the ticket office, the chap in front of me does his ‘cheque book, no pen and what’s the date?’ bit. I catch the train on the run to spend the next hour in the company of hostile bowlers, brollies and ‘country life’. Two familiar faces at East Grinstead station and a lift on the way. Ronnie saying ‘the heating may not be up to much’ (he’s a joker, there isn’t any). Plaw Hatch Hall, grim exterior, huge Gothic doors, nasty bell-pull, Boris Karloff must be around somewhere.

However, a drink and dinner and things are looking up. Ronnie’s introductory talk outlined the programme in the context of previous conferences, with the emphasis moving on from organising the classroom to inspiring the nature of the classroom activity.

The less said about freezing cold bedrooms the better. We were organised into groups for Saturday and spent a session on each of the four topics: Group work, Investigations, Links with other subjects and Anything but work cards.

**Group work - Ray Gibbons:** We looked at material from different sources, some in the development stage, and discussed the reasons for organising some group work. Well, a change is as good as a rest for starters. Then there’s the co-operative working aspect. [Experiences] were discussed, interpreted and reported. Small groups seem to be best, started by the teacher and then left to get on until the reporting back. The material needs to be carefully structured to avoid frequent requests for help, and choosing the group members has to be considered if they are all to get something out of the activity. What about starting with those kids who often like to work together on the same cards? Not many people had tried group work, but the benefits to be gained from encouraging cooperative methods of working and active discussion of the subject seem worthwhile.

**Investigations - Ronnie Goldstein:** We worked on one of the SMILE investigation cards and the discussion arose out of the work. Firstly, the card involved a lot of ‘finding out’ so perhaps it is better tackled as a group activity. With an introduction from the teacher, this would also help to overcome the puzzled/hostile reaction I’ve noticed when the open-endedness of the task makes the activity seem pointless to start with.
Chapter 7: Expanding how we thought about learning and about ourselves

Then into the investigation, compiling and analysing the results. Is there a pattern? Can we express the pattern mathematically? How do we record the work? Which leads on to the problem of assessment. We looked at one of the investigation problems from the proposed ‘0’ level exam and talked about the ways of looking at a piece of work that had not been conclusive. The ability to be able to set out one’s method of working is obviously critical.

If we are aiming for an enquiring approach to problem solving, the investigation cards are on the right lines but don’t seem to be used much. What about trying one as a class activity to start with?

**Links with other subjects - Jeanne Coker:** Because of a rearranged programme I missed part of this session, which involved writing material linking maths and geography. The piece of work I looked at required measuring distances from a real map and working out best routes from London to the south coast assuming different speeds for major roads and motor-ways. The usual discussion over imperial/metric measures arose, but the point is a wider one.

There is some good material around but the critical factor for the kid is what his own set of teachers are up to. I suspect that the lack of a consistent approach in some basic areas (language for a start) is important in fostering the ‘it’s all a bit pointless’ attitude. If there is a link to be made, either inside school or outside then we should be making it. I gave a CSE class a small 24hr train timetable and some simple questions. Amongst all the other confused reactions came ‘but we haven’t done these before.’ Whichever way you look at it there is one person who’s not had good value for 10 years’ schooling.

**Anything but workcards - Nigel Langdon:** Starting points - a never ending diet of workcards, possibly in other subjects as well, and a wider use of the senses. Taste - dividing a packet of cheese into fractions and then eating them. A bit laboured perhaps, but we often remember things through odd associations. I liked these - a cardboard box with solid shapes inside, a hole to put your arm through, now describe the shapes you can feel - or, close your eyes, imagine a given number, then transpose the digits in different ways. There were lots of posters, slides multi-media packs and so on. Of course, it all takes a lot of energy/enthusiasm and I daresay money to get together and use effectively, but why not? We’re in the business of stimulating minds, not filling endless exercise books full of ‘work’.

Meanwhile during Saturday and on Sunday morning more informal groups were at work for those specifically interested in the CSE exam (Jan Allcorn), the ‘0’ level exam (Sarah Sharkey) and remedial material (Chris Stolz).

**Last, the talk by Professor W.W. Sawyer.** After coffee, a delightful two hours impossible to report on without shorthand. Two main themes - practical experience
leading to understanding and letting the abler lads race on as fast as they can. There were lots of anecdotes, all pertinent: mechanical gadgets, card tricks, amazing feats of memory; one or two over-generalisations perhaps, but overall the distinct impression of a lifetime spent finding fun in maths and passing it on to others.

And so, the pleasant after Sunday lunch feeling evaporates, back to scruffy suburbs with Monday morning looming - all that’s left are the faint strains of the band at the Mathematician’s Ball, and the star guests, Mr & Mrs Nometry and their horse Trigger. (I forgot to tell you what time the bar closed).

Continuous action learning

Below is a copy of the back cover of Splash 1111 giving the programme of courses for the 1978 spring term together with what is in the pipeline for the summer.

Figure 11: The programme of activity in Spring 1978
Chapter 7: Expanding how we thought about learning and about ourselves

It is important to note that the leaders – or facilitators – for all the spring term sessions are entirely home-grown, either SMILE teachers or members of the ILEA advisory team. The summer term programme starts with two sessions by members of the team but the second leader, Peter Kaner, is speaking in a dual capacity as he was the mind behind MMCP. This innovative material was amongst the commercial material used by SMILE. It fitted perfectly into the SMILE pattern because its modules were packs based on mathematics in use and designed for group work. The two later sessions of the conference were also about commercial material, again innovative – DIME and Leapfrogs – with leaders who had played a part in their creation. (SMILE kept in close touch through the years with both these projects.)

An evocative picture by Charles Snape helps us catch the flavour of the next conference.  

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Figure 12: Artwork of SMILE Conference 1978, Chatsworth Hotel, Worthing

At least the Chatsworth Hotel provided warmth and comfort – and even the height of luxury, TV in the bedrooms if anyone could drag themselves away from arguing about mathematics.

With all this discussion of mathematics and of the materials and the learning patterns of the students, the quality of teaching and learning in the classroom could not but improve regardless of the type of classroom organisation preferred.

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Splash 10000, April 1978
Action learning for the students

At the end of all this discussion, what did SMILE teachers think constituted the task of the teacher. Lecturing? No. Introducing ideas? Yes, but how? SMILE teachers might suggest that the essence of good teaching is:

- continuously assessing every pupil in a class;
- providing appropriate tasks on the basis of this assessment;
- promoting discussion on how to tackle the tasks set and on the concepts underlying them;
- pointing out the connections between what may at first appear to the students to be a variety of disparate mathematical ideas.

This is all somewhat at odds with the government’s vision over the last twenty-five years or so. Margaret Brown reminded the mathematics education community in December 1999 of what David Blunkett had said the previous January. He said:

Numeracy is a vital skill which every youngster must learn properly. Yet for perhaps thirty years we have not focussed on what we know works. The new daily maths lesson will ensure that children know their tables, can do basic sums in their heads and are taught effectively in whole class settings.

However, Margaret’s article had a question for its title: Is more whole-class teaching the answer? She concluded that the quality of teaching is more important than the organisation:

… it’s not whole-class, group or individual teaching but rather what you teach and how you interact with children that matters.

The SMILE teacher would agree wholeheartedly but they would follow on from this to argue that the best classroom format to generate the climate in which students can indeed “learn properly” is a setting and a pedagogy where:

- each student is working at a programme that suits her as an individual,
- students are given responsibility for organising their own work,
- discussion of mathematics, both with fellow students and with the teacher, is most easily provoked and
- flexible grouping for different purposes is most easily managed.

But although all would agree with David Blunkett’s assertion that numeracy is a vital skill, we might consider that the meaning he gives to “learning properly” is sadly inadequate. ‘Knowing your tables’ can mean being able to chant them without a mistake. It can mean being able to respond with the correct number

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80 Margaret Brown, “Is more whole-class teaching the answer?” Mathematics Teaching 169, December 1999
when asked for one table fact. Or, as H. G. Wells indicated, an understanding of the structure of those tables, the links between all the individual facts.

Of course, some learning by heart is useful - but it is not sufficient. As Askew and Wiliam in their review of research comment, ‘knowing by heart’ and ‘figuring out’ support each other in pupils’ progression in number. And, as for being able to do basic sums in your head, what are basic sums and what is it useful to be able to ‘do in your head’? When he made the quoted comment, did David Blunkett understand that it is this deeper learning that we need in the classrooms of our schools if we are to create a numerate population or, indeed, does any politician have any idea what ‘proper’ learning is or what ‘works’. We are left pondering on what it is that works - but that we have failed to focus on for some forty years.

Throughout this book, chapters contain descriptions of the SMILE classroom, and how students learnt within it, as well as comments on the depths of mathematical understanding to be encouraged. This chapter finishes with one such description. In 1977 Bob Doe visited Sarah Sharkey’s third-year class at Christopher Wren. This was a school that had always had its share of problems, even today after being renamed and rising again. But my recollection of the maths department when SMILE was in use was of a lively place – but on the whole not too lively - with mathematical displays everywhere, including the ceilings.

In the TES in 1977 Bob Doe reported “calm not confrontation” in Christopher Wren. He was an unusual visitor in that he recognised some of the mathematics being created in Sarah’s classroom. He reported a lot of chatter, and even the odd bit of whistling but, he says, Sarah barely had to raise her voice to be heard. Only once during the lesson did she have to keep the noise down. He goes on to describe the atmosphere and some of the mathematical activities in which the students were engaged.

There is hardly room to move between the desks crammed into the room. Thirty odd boys are working at different tasks with varying degrees of diligence. Mostly they are using individual work cards. A few look rather bored but none will admit to a dislike of mathematics.

Sarah is at the front of the class helping a boy with a problem involving overlapping circles. She could just tell him what he needs to know, but instead she asks leading questions, trying to get him to solve it for himself. At the same time she deals with a more or less continuous stream of other queries, usually quite trivial. …

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81 Editors: we have been unable to source this reference.
83 Bob Doe, “Calm not confrontation”, *TES*, 10.6.77
She is not too busy either to redirect the game which two other likely looking lads halfway down the room are having with a mathematical puzzle called Sidings. She cannot see any signs of the mathematics this is supposed to lead to, she tells them. “It says play several games,” they remonstrate, pointing to the instructions. “Eight games maximum”, she rules, and soon they are scribbling in their exercise books.

At the back of the room a boy has drawn several squiggly patterns with a spirograph apparatus, which he now fiddles with spasmodically. By the beginning of the second lesson with this he has clearly still totally misunderstood the instructions on the worksheet, and his efforts so far seem aimless.

At the end of the lesson Sarah checks on the boy’s progress. According to her he is a bright but shy boy usually quite at home with algebra but apparently lacking in manual dexterity. In a normal class teaching system, she would probably never have found that out, she says.
Chapter 8: Why not try this?

At the end of an earlier chapter, we noted that as SMILE continued it became more innovatively pedagogically. Not just rejecting whole class organisation as paramount, Smilers also wanted to challenge the individualised equivalent of ‘talk and chalk’. We recognised early on that pupils simply following instructions had its downside!

![Small Smiles](image)

This chapter and the two that follow are concerned with some of the ways, through the materials themselves as much as anything else, we challenged and extended their own practice. In this chapter, we look at developing group work; applying mathematics to everyday situations; responding to a variety of teaching and learning contexts; beginning to use computers in the classroom; and trialling ‘thinking’ tasks.

The need for variety

As early as 1975, Ronnie had stressed in Splash the importance of variety in the SMILE classroom and the need to give students a wide range of experiences. In the same issue of Splash John Tucker wrote about the previous year’s SMILE longer course, mentioning a talk illuminating media neglected by SMILE— the use of tape, slide and film. He expressed his disappointment that work on such media...
(“so desperately needed to bring the scheme to life”) had to be curtailed before it really got going because of lack of finance. Nevertheless much innovation in the materials was achieved.

**Learning to work as a team**

If feedback from students was vital to teachers as an indication of their development process, the students themselves - SMILE teachers believed - also needed to talk to each other about their mathematics and to share their ideas. By 1976, Smilers were searching for ways to prevent their students becoming too introverted as they worked on their own individual programmes. How could more co-operation and discussion be generated? Work in groups must be provoked. As I recall, the first task designed specifically for group work (long since ‘axed’ in favour of better stimuli but worth recalling in order to demonstrate the development of thinking of SMILE teachers at that stage) was *Regular Tetrahedron Study Group 0676*.

*Regular Tetrahedron Study Group* was an activity for eight people. It presented eight separate sets of instructions for the making of a tetrahedron:

![Regular Tetrahedron Study Group](image.png)
Chapter 8: Why not try this?

• with straws and pipe cleaners,
• with cocktail sticks,
• from a net drawn on isometric paper,
• from a plait, also constructed on isometric paper,
• by fitting together two parts of a tetrahedron (2 versions)
• by folding *Any Old Envelope*, illustrated below, and
• by designing a box into which the cocktail stick model would fit.

A final card headed *Discuss* asked the eight members to get together when they had finished their individual tasks to look at the completed models and answer some questions about them together:

• What have the models in common?
• What is different?
• Are they all regular (faces all exactly the same)?
• What shape are the faces?
• How many faces, edges and vertices has a tetrahedron?
• Why are these solids called tetrahedra? (Use a dictionary to help.)
• What is an equilateral triangle?
• What is packed in regular tetrahedra?
• How do they pack together? To find out make 8 more tetrahedra (one each) using card C (the plait method).

And so on, with a final instruction to make a display of their work – models and commentary.

![Figure 15: A tetrahedron made from an envelope](image)

Hilary Povey described her experimental use of this task as part of the trialling process before editing.\(^6^0\)

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\(^6^0\) *Splash* 1001, October 1977.
I was given a trial version of Regular Tetrahedron Study Group (0676) and asked to find out what the response of first years was. It was a success, generating interest, involvement and hard work.

What part did I play? I chose 8 kids and sat them round a large table. I talked to them for about three minutes — they would not be doing their matrices for a few lessons, they would be working as a group, they needed to share out the work — and I helped them to decide who was going to do what. I left them to get on with it, only giving them the amount of supervision, help and direction I would expect if they were doing their own matrices. I noticed who had finished and who needed extra help, etc. and suggested who might help them. Even so, of course, they did not all finish work together but the puzzles in the pack provided a source of talk and activity that kept them all involved. They saw the connection between the puzzles though I had not. I helped the last to finish and then sat down with the group for five minutes. I showed the group what they had done so far.

Next lesson I told them I wanted them to discuss the questions on the discussion card and having started off the discussion of question 1 I left them to it. One member of the group spent his time whispering rude words to the others who were of course riveted by this diversion. When it became apparent that the whisperer was going to do nothing else I removed him from the group entirely and he went back to his matrix. The discussion then took place. After twenty minutes I returned and sat down with the group for about ten minutes. I went through the card asking them what they had decided and added a few bits of my own. I then explained about the display and gave advice about how and who and what. Most of the display was finished by the end of the lesson. For the third lesson some went back to their matrices, some finished the display. A fourth lesson would have been a mistake.

What special factors were in my favour?

I had a very small class, I knew them well, and they are used to group work from Primary School and from most subjects in Secondary School.

Hilary’s detailed analysis of her role in this trial of new material, and the introduction of a changed method of working for pupils, was clearly an important part of her continuing professional development which, as a remarkably thoughtful and effective teacher, she would probably have carried out without any outside influence. However, writing up her dissection of the events in the classroom was useful not only to her but to all readers of Splash, giving an invaluable spur to exploration of new approaches by the whole group. So here is the other side of the coin, the continuing professional development. It takes a long time to grow listening, reflective teachers.

The question of what size units were best suited to facilitate learning continued to exercise Smilers. A whole class of thirty or so would-be-learners still seemed — except on very rare occasions — much too large a group, whether for discussion, for
absorbing or working on ideas, or for listening to a teacher. The individual could move forward on many fronts but had too few opportunities to discuss what had been learnt or to seek help with what was still inexplicable. The small group of four to eight students still seemed to be an ideal size of learning group but handling group work – like individualised approaches – was a skill that took a lot of learning.

In 1980, 40 heads of mathematics departments met to discuss *Aspects of Secondary Education* noting the comment “oral work was too often limited to brief responses from a few pupils in answer to questions that provided no opportunity to exchange ideas or examine hypotheses.” Whilst it was felt that this criticism could not be levelled at SMILE classrooms, teachers recognised that much of the language used was painfully low-level and discussion was not sufficiently sustained. Group work was once again seen as providing a way forward.

Richard Hale turned his colleague’s attention to the fact that although much SMILE material had been written for groups the ordinary teacher was often daunted by the amount of pre-planning and organisation needed for these tasks. He suggested that it might be less daunting to start considering getting pairs to work together: “many tasks written for the individual can very profitably be done by two.” SMILE record keeping could be an inhibiting factor, he said, and he urged his colleagues initially to stop worrying about record keeping for a while – who should be given credit for which parts of the work? Richard described a high spot in his own experience as listening to two 3rd year boys arguing for a whole lesson about *Wage Bargaining (0792)*. The task sets up a plausible scenario detailing how much a managing director, a foremen, a skilled and an unskilled worker are currently paid and then presents arguments that might be put forward by management, union and so on about a wage increase. During the time the boys worked on the task they debated the dilemma faced by the foreman (should he side with his mates or the management?), trade unions, workers’ co-operatives, and they even learnt a great deal about simple percentages.

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85 Splash 11101, September 1980.
Mathematics for the citizen

Partly with the lower attainers in SMILE classrooms in mind, the writing week in July 1978 had the theme Mathematics for the Citizen. Alec Williams, co-author of the Mathematics for Life series and a prime mover in the Mathematical Association’s Diploma for Teachers of Low Attainers, joined the writers on the first day. He put the question, “Why mathematics?” and talked of methods and principles. These sessions were followed by a critical assessment of existing materials and the rest of the week was devoted to the writing of material under the headings:

1. Maps
2. Shopping
3. Computers
4. Meters, gauges, etc.
5. Wages, bills, tax, etc.
6. Statistics
7. D.I.Y., Measurements
8. Timetables and directions

The week was written up in Splash.86

SMILE Writing Week

If a stranger had climbed the stairs to the top floor of Middle Row Primary School during the week 10th-14th July 1978 he might have found a group of adults engrossed in children’s mathematical games. Twenty or so lucky teachers, who had been released from the rigours of ordinary school life, were meeting together to prepare material for fourth and fifth year low-attaining Smilers.

On the first day, Alec Williams from Hull addressed the assembled company, describing the importance of teaching the slow learner, not only those mathematical skills which will help him cope with everyday life, but also those which will assist him in making the choices which could enrich his life. … In the afternoon, in groups we planned the preparation of work covering a topic of our own choice, bearing in mind the assumptions we were making of our pupils’ ability and previous experience. We were then invited to come together again to pull each other’s efforts to pieces.

The rest of the week was spent in groups of five or six preparing packages of material for inclusion in the SMILE network. We were aiming to work at topics from everyday life, and were looking for mathematics already there in the topic rather than artificially imposed upon it. The topics considered included banking, buying and insuring a car, designing a kitchen, calculating the cost of running electrical equipment, rates, advertising etc.

86 Splash 10010, September 1978.
As the week progressed the activity became more frenetic, with individuals rushing off to banks, post offices, electricity showrooms or to Ray Gibbons, who had an amazing treasure trove of goodies (although she couldn’t produce a copy of the Factory Act!) for relevant and up to date information. Occasionally during the week, we came together to report on the progress of our various projects or to discuss a more general point, for example, to what extent we thought it advisable to try to cater, in our material, for the different racial groups in our schools.

Coffee and tea breaks were religiously adhered to, except that on the last day the cups were brought to the workers rather than the workers taking themselves to the cups. In fact, it took the offer of a glass of wine to drag us away from our endeavours on that day, so deeply had we become involved with them.

Responding to specific needs

SMILE teachers were working hard to enhance the learning of mathematics but mathematics was not the only concern of the group. The SMILE materials and way of working were also increasingly seen to have much to offer to students in special circumstances. The SMILE classroom was ideal for learning many of the lessons of citizenship: having to be tolerant to all sorts and conditions of your peers, taking responsibility for shared resources, welcoming different philosophies; and helping those who those who arrived from different culture to feel at home in a new environment. Many of those who had just arrived in Britain were to a great extent excluded from what was on offer in the way of education because of their lack of understanding of the language in which it was offered.

Materials were written with just these students in mind – students who would otherwise have been seriously disadvantaged - not only to make progress in mathematics but also to increase their ability to communicate in English. In November 1982 teachers of Tower Hamlets and North Westminster schools met to review the work so far undertaken for children who had language problems arising from recent immigration to Britain. The possibility of a guide book/dictionary of key words in six languages is a possibility. The activities which were being piloted had the dual purpose of developing language in a mathematical context as well as teaching some basic mathematics. Shanta Iyengar of Tower Hamlets convened the English as an Additional Language working group and invited other teachers to join.

Another asset of an individualised scheme is that it is invaluable for those whose education is so often disconnected. Those excluded from mainstream school because they have in some way disrupted the system and who have been offered alternative provision in offsite centres, for example, or those who have to spend periods in hospital, say. In February 1981 we find correspondence proposing a short

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87 Splash 101001, November 1982.
course on SMILE and mathematics education in Off-Site Units. A letter sent out to the units gave the draft programme:

**1-day session (before Easter)**

*What SMILE is and what it might have to offer small units?*

(a) a description of SMILE and its philosophy
(b) a look at some SMILE materials and the commercial references included in the scheme
(c) a discussion led by teachers who use SMILE and who work in off-site units.

**4-day session (before Easter)**

Visits
We would try to organise a visit if possible for each course member to an off-site unit using SMILE.

**½ day sessions (in Summer Term)**

Looking at some particular aspect of SMILE - What materials are available and why?
Calculators
Low attainers
Everyday maths
Investigations

**½ day session (in Summer Term)**

Open session
We would use this session to take up issues raised, during the course, that need further discussion.

The letter concludes:

*The aim will be to provide teachers with practical information about what is available and, through consideration of (1) the way of working and (2) the structure and content of the materials, to raise and discuss the underlying issues of what and why in mathematics education.*

Many others trying to respond to the special needs of different groups of students recognised the value of the SMILE materials. On Splash’s January 1980 NOTICEBOARD there is a reference to children with sight problems: 88

A small group of teachers from Linden Lodge and New River Schools are adapting and translating relevant SMILE cards into Braille. The initial task of translating about 50 SMILE cards and the necessary back up material are providing

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88 Splash 11010, January 1980
the Media Resources Officer and staff at Linden Lodge with a lot of work just at the moment. If there are any other teachers who would be willing to help with this hurdle could they contact Sue Simmonds at Linden Lodge.

That same issue of Splash had a note about a More Able Workshop mentioning the resources that had already been produced two of which were Series Geometrically and the investigation of Base -2. Series Geometrically uses geometric dissections to set up some infinite series and asks the student to work out in each case their finite sum. Base -2 invites the students to explore what happens when -2 is used as the base in a place value number system. It is a rich enquiry which leads to a deeper understanding of terminating and non-terminating decimals and of arithmetic processes.
And, on another page, a Low Attainers Workshop notice lists eleven activities “at this moment” being circulated amongst the teachers who attended a workshop at an earlier weekend conference.

Although developed originally for mixed achievement groups, SMILE pedagogy and materials were found invaluable in other circumstances. The SMILE way of working is ideally suited to short stay institutions such as offsite units, hospital schools and individual tuition centres in which teachers are taking over where someone else left off – or gave up – and giving a short-term injection of ideas. Cathy McKinnon describes how she used SMILE in an Individual Tuition Centre.89

Individual tuition, formerly home tuition, is a provision for pupils who are not attending school for a variety of reasons. For juniors this is a 6-hour week and for secondary pupils it is 10 hours. Pupils are assigned to a teacher who is paid on an hourly rate for the individual tuition of that pupil. In Hackney the service is centre-based. Groups can be organised in various subjects – art, mathematics, drama, science, child development, geography, photography, English. Most of us feel that this is essential for pupils who very often are deprived educationally and socially. It is in this context that we take great pride in having developed our teaching of mathematics through the use of SMILE.

Hackney Individual Tuition Centre has been using SMILE for 4 years. In these 4 years mathematics has developed to become an important and component part of our Centre. Our SMILE mathematics room is a busy, happy place, full of achievement for both teachers and pupils.

Most of the pupils on individual tuition have less than a positive attitude to school. They will frequently have missed a lot of schooling, will be under-achieving and greatly lacking in self-confidence and self-esteem. In addition, many of our pupils have difficulty in building and maintaining personal relationships. Our most important task is to build confidence, self-respect and a sense of achievement. SMILE has enabled us to work to our pupils’ strengths.

Before SMILE, given the limitations individual tuition imposes organisationally, mixed-achievement mathematics groups were almost impossible. Now the individual matrix makes mixed ability and vertical grouping possible. This is very important for pupils who need to develop social relationships. The flexibility of SMILE also allows us to set group work and to encourage co-operation on tasks, games or on the computer. Competition between pupils seems to be centred more on how many matrices have been completed rather than level. The use of the computer within the SMILE room has been helpful in further encouraging co-operation between pupils.

Basic arithmetic skills seem to improve by avoiding them! This nonsense cannot be quite true, but the child who has failed and failed again does not want to be given another ‘times table’ to write out or to be told to practise those things that have proved so hateful and frustrating in the past. By seeking tasks that explore different areas and give some immediate sense of understanding and achievement, we try to build the confidence that is necessary for any progress. A certain volume of work does wonders for the ego and sometimes even leads to miraculous improvements in basic arithmetic skills. It is the variety and richness of SMILE material that allow us to build on pupils’ strengths rather than exposing their weaknesses. With SMILE pupils can achieve some immediate success at their own level. One fifth year boy who came to us in February had spent most of his four and a half years at secondary school being excluded from lessons and was so proud of completing his first two matrices that he took the work home to show it off. He had initial difficulty in making a yellow and blue cube (SMILE 1522). Later his joy in succeeding with the Soma cube was apparent when he took pleasure in making it over and over again.

SMILE is the invaluable source and guide, but it is in no way restrictive. Indeed, it has encouraged us to look at supplementary materials, especially concrete teaching aids, games and puzzles and to build links with other subjects. In particular there have been fruitful exchanges between mathematics and art. The SMILE scheme was initially ordered by an art teacher. At present a geography teacher is preparing a geography/mathematics project, possibly for GCSE extended work, and a photography group is planning a project for photographing patterns of buildings and a display for our mathematics room.

It was largely non-mathematics specialists that set up and continue to use SMILE at our centre. We are indebted to SMILE and to the SMILE Centre and workers
for their support. Being a small part of that team, we have improved, our pupils have benefited and some of us, both teachers and pupils are even enjoying our mathematics!

The computer has arrived

How can we improve the quality of learning with the use of the microcomputer? was a question asked from the beginning of SMILE. With computers being introduced into schools, it was the mathematics departments that found themselves responsible for computer studies, so it was teachers in those departments who had become the experts in programming. How could they use this new technology to facilitate the learning of mathematics? The individualisation of the SMILE classroom made it ideal for introducing work on a single computer - which for many a year was all you would find in one classroom– a small group could be studying mathematics with the aid of the computer while the rest were using a variety of other resources to help them visualise abstract concepts.

In 1980 at a Computer Writing Week where some programs were demonstrated we began to learn to handle this new-fangled technology together, rather as we wanted our students to learn their mathematics in the SMILE classroom, sharing our difficulties and learning from each other as well as consulting from time to time the ‘experts’ who might have come to help out. The pattern was once again one of action-learning. David Wells’ advice for mastering the facilities of a computer still holds good – if you can’t program anything, get a good programmer to lead you through a handful of easy routines, rather than wait for an over-subscribed course. We all know the frustrations of misdirecting a computer, a frustration perfectly expressed in a verse I saw maybe around that time in the computer suite at The Mathematics Centre in Bognor Regis. It so perfectly expressed the relationship of operator to the computer that I have never forgotten it:

Oh, how I hate the wretched thing
I do believe I’ll sell it.
It won’t do what I want it to
But only what I tell it.

There may be no better way of learning to be accurate and precise than communicating with a computer - a useful lessons for all learners.

At the writing week David Johnson, then Shell Professor of Mathematics Education at Chelsea College, talked about educational computing in the States and shared his belief that writing programs forces children to think more deeply about their mathematics. He reported how a girl, who perfectly well knew the standard definition of a prime number, preparing to program the machine to generate primes in sequence said: “Now I must decide what prime numbers really are!” The need for accuracy and precision were clearly brought out.

Three programs were developed during the week:
Chapter 8: Why not try this?

**Zap** – where two identical shapes one fixed and one moveable were to be made to coincide. The available commands were U, D, A, B, REFL, ROTA and TRAN x,y

**Fizzbuzz** – an adaptation of the well-known classroom game. The user can choose which two numbers are to be Fizz and Buzz and receives instructions on how to proceed when the numbers come up on the screen.

**Spirals** - inspired by SMILE investigation 0728 Spiral Patterns.

Figure 20: Spiral patterns, 0728, originally an acetate booklet showing how spiral patterns are created

Spirals showed how the computer opened up the investigation field which continued to be SMILE’s favoured approach to the study of mathematics.

For the academic year 1982/3 Mike Tunbridge was attached to the SMILE Centre staff as the computer programmer while spending part of his time at the Inner London Education Computing Centre. He first sent out a questionnaire to all SMILE schools to discover what computing facilities were in schools for computer assisted learning. In Splash he made it clear that he was not a replacement for all those teachers in schools who had been responsible for producing the 29 programs already in existence but an extra resource to help in the carrying out of other ideas born in the classroom.

It is worth remembering how limited computing facilities were then and how SMILE, probably because it could make effective use of just a few computers, led the field. Of the 23 schools replying to his questionnaire: 9 had one 380Z machine, 12 had two and only 2 had three. Only 4 had one exclusively for maths department use, but 20 had access to a machine by individuals during lesson time for SMILE activities. The specifications of the machines was also very limited. 21 schools had had at least one 380Z with high resolution graphics but only 5 schools also had colour. 19 had dual drive, double sided machines but only 4 schools had access to a machine with more than 32K. Plans varied from “480Z networks” through “a micro on wheels” to “get the Sinclair micros working”.

The presentation of the software packages steadily improved and reached such a high standard that the teachers could write for parents in 1986 that:

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90 Splash 101100, April 1983.
SMILE teachers have produced two suites of mathematical programs called MICROSMILE and The Next Seventeen. Both have been widely reviewed and complimented in the national press. They are considered to be among the best in the world.\textsuperscript{91}

**Trialling Think-Lab**

Interesting deviations from the individual matrix approach in the organisation of work in the classroom are revealed in the trial in 1980 of some commercial material that it was thought might make a valuable addition to resources used generally by SMILE teachers. Trials of the Think-Lab devised by the Science Research Associates (SRA) were made by three different SMILE Schools – Christopher Wren, Forest Hill and Trinity House.\textsuperscript{92} The material consisted of a set of problems on cards colour-coded according to the type of problem presented and numbered according to the level of reading difficulty. The cards had been designed to promote mental agility, problem solving, and reasoning strategies. The reports of two teachers who used the material with several of their classes, describes variations in the SMILE individual matrix approach.

Sarah Sharkey reported from Christopher Wren School:

*At Christopher Wren the work was given to pupils throughout the ability range in years 1 to 4. Teachers generally used the work as class lessons: the pupils were seated in groups of about 4 and each group was given 5 cards, say, to work on. All pupils responded most enthusiastically. When they had finished a set, they could swap with another group or select a new set from the box.*

*The most prominent features of the tasks were:*

1. Their obvious suitability for group work. Teachers who did not structure the class in groups reported spontaneous groups forming as a result of the work. It was noticed that in almost all groups there was a high level of discussion and involvement on the part of the pupils.

2. There was a tendency on the part of most - although not all - pupils to want to justify their solutions to others. This resulted in a more precise use of language and in a considerable degree of thought as to how best to present the solution(s).

3. The pupils derived an unexpected amount of fun and pleasure from the work. They obviously enjoyed bending their minds to these problems/puzzles.

4. The presentation of the work and the quantity of reading involved had given rise to misgivings on the part of the teachers. The response of the pupils, however, removed any of the doubts we had over these aspects.

\textsuperscript{91} SMILE: A Guide for Parents
\textsuperscript{92} Think-Lab, Splash 11101, September 1980
Chapter 8: Why not try this?

It is difficult to describe in words the tremendously enthusiastic response of the pupils to this work. I am at this stage unable to comment on the lasting effect of setting 3 or 4 cards on an individual’s matrix as we have not had time to experience this in any extensive way.

I can see a place in the mathematics classroom for this work and intend to purchase a set for the next academic year. Hopefully, I will then be in a position to give a more analytic account of its uses and worth.

Mary Clark reported from Trinity House School:

I have used the SRA cards during ordinary SMILE lessons with 1st, 3rd and 4th years. (I did not have a 2nd year class) and they have been very successful with children in all these classes whether the cards were written down on the child’s matrix or just offered as some new material to try.

1st year lesson

The SRA cards were attempted by four members of the class who I thought would particularly welcome something new. One girl rejected them and decided she would like to finish her present matrix first. It was interesting that the remaining three girls all chose cards with grids on them. Marcia did not want to work with anyone else but quickly reached a solution and was happy to stop at this stage — I suggested she should look for another solution and she found two more. Then Pauline chose to do the same problem but without reference to Marcia. Pauline and Lisa achieved a solution fairly rapidly. I suggested they might look for more solutions and then compare with Marcia’s results — when they had done this they were surprised to find that none of their solutions were the same (thus between them they had found 6 different solutions).

Pauline and Lisa chose another problem and Pauline gave me an answer immediately she had read the card. I suggested a fact of the problem which I was sure that she had not taken into account and she went away. She told me when she handed the card back at the end of the lesson that Lisa had got another solution and therefore she wanted to try again next lesson.

Pauline and Lisa also worked on a third problem but did not reach a correct solution (“correct” in the sense that it did not satisfy all the conditions) before the lesson finished. However, Marcia noticed their problem and stayed for the whole of break (without prompting from me!) trying to solve it but did not succeed — she is going to try and solve it during the weekend.

3rd year lessons

Two girls, Loraine and Judith, used the cards because it was convenient to give them new work on their matrices. They worked both independently and together
on several problems. They seemed absorbed in the work and Judith, who often gives up rather easily, did not today. At the end of a lesson she was in the middle of a problem which she agreed to continue with next lesson.

In the following lesson, Judith began a new matrix and later on carried on with yesterday’s unfinished problem. When I next went to see her work, I found that she had started yet another problem — (she seemed to be addicted!) Loraine had been working on her ordinary matrix for most of the lesson but late in the afternoon I noticed a loud argument between Judith and Loraine — a very heated discussion about one of the problems.

The reaction from all the children who have used the cards has been very positive and the cards have appealed not only to particularly well-motivated children. More than one child has volunteered to take home a problem begun in a lesson and continue with it until satisfied with the solution(s). I like the inclusion of surplus information and the children who have noticed this or had it pointed out have been intrigued as generally in maths they are presented with exactly the data necessary to reach the expected conclusion.
Chapter 9: To SMILE is to investigate

Investigation and problem solving gradually became more and more important in SMILE, both as an attitude of mind in the classroom and built-in explicitly as activities were written. So much so that the approach warrants a dedicated chapter.

Investigations - what are they?

Another major development for SMILE teachers was the use of investigations. John Stewart was a key influencer in the movement of SMILE towards a more open and problem-solving way of learning and teaching mathematics and generously shared his understanding of investigative work and of what he had learned so far. In a talk at the 1979 Conference he maintained that the most useful medium of learning was the investigation. He expanded in Splash.93

**Investigations are those problems in which the procedures for solutions are not clearly defined and where the assumptions made can lead to a variety of outcomes.**

**The creative processes involved in investigations model closely the methods of the real mathematician. There is very little of this in the mere recollection of the algorithm and its application.**

**Common to all creative processes, investigations can create real learning situations, they can stimulate curiosity and can give increased work satisfaction.**

**Investigations provide the experience of collecting and organizing data, encouraging the development of problem solving procedures and, the desire to learn more. I believe it is an essential part of a maths teacher’s education to investigate mathematical problems – in fact to do some mathematics regularly.**

John’s was not a lone voice - hardly an issue of Splash exists that does not have a detailed discussion of at least one investigation. Analysing Splash’s contents from June 1981 to November 1983, for example (excluding 100101, March 1982, a special issue detailing exam procedures), the average amount of space in each issue given to posing, exploring or explaining teaching approaches to investigations was over 25%. A high proportion when you consider that Splash gave all information about all administrative matters such as dates and times of meetings, content of new materials, exam moderation processes, etc. From very early on John Stewart had been presenting investigations he had discovered - or thought up himself – and tried out with one or other of his classes in Splash, giving comments on progress through them and comments on the skills and understanding he considered his students had gained from them.

The nature of the investigative tasks had a style very different from the adaptations from Banks’s original materials. It is the pattern common to many SMILE tasks

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93 Splash 10110, May 1979
– a lead-in experimenting with a few simple cases followed by an open invitation to continue to investigate as far as seems appropriate to the student, or group of students, involved with room for a final generalisation – the kind of creative work described by John Stewart above. This is a typical example.

This investigation can be started haphazardly but it soon becomes apparent that there is need for organisation, otherwise, how do you know you have found all possible configurations for a particular number of arcs? It can be tackled at a variety of levels of difficulty. The shortest task going as far as a study of 5 arcs is a useful exercise for getting familiar with the terms ‘arc’ and ‘node’ and making decisions in these circumstances about definitions of ‘sameness’ and ‘difference’ – even at this stage some organisation is necessary. If the investigation goes as far as looking for a relationship between the number of arcs and the number of possible configurations, a generalisation, it becomes a much more mathematically sophisticated task.

It was not only SMILE students who were investigating. The following exchange from Splash shows that teachers took just as great an interest. It gives an indication of the position investigations had in SMILE and that teachers too were doing

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**Figure 21: Loops, 0393**

**LOOPS**

If this is a node .
And this is an arc .

There would only be one way of drawing one node and one arc (if we do not allow loose ends):

One node two arcs would give us:

or

How many different diagrams can you get with

1 node and 3 arcs
1 node and 4 arcs?

etc.
mathematics – investigations, puzzles and problems. Because they were keen that their pupils should share this enjoyment, investigation became perhaps the most characteristic activity in many a SMILE classroom.

**Teachers investigating too**

In 1980 Ronnie Goldstein wrote:\(^9^4\)

*I’m very fond of this investigation, Some sums (0422), because it allows almost every child to start and develop some results quickly. The question posed is ‘Which numbers can be made from consecutive sums?’*

*For example:*  

\[
\begin{align*}
5 + 6 + 7 &= 18 \\
10 + 11 + 12 + 13 &= 46
\end{align*}
\]

*After some random searching the children can be encouraged to systematise their work. For example:*

\[
\begin{align*}
1 + 2 &= 3 \\
2 + 3 &= 5 \\
3 + 4 &= 7 \\
4 + 5 &= 9
\end{align*}
\]

\[
\begin{align*}
1 + 2 + 3 &= 6 \\
2 + 3 + 4 &= 9 \\
3 + 4 + 5 &= 12 \\
4 + 5 + 6 &= 15
\end{align*}
\]

Clearly all the odd numbers can be formed and so too can multiples of 3.

*Further investigation indicates that all numbers can be made except powers of 2. If this is true it is certainly not clear why, I have never been able to prove anything …*

Dylan Wiliam responded:

*In playing about with this investigation I quickly became convinced that powers of two could not be done, and were the only ones that could not be done. After playing about I came upon this proof. To prove that powers of two cannot be written as the sum of consecutive integers, assume the contrary …*

The argument was then presented in full.

*… So our assumption was false. It is also possible to construct an algorithm for finding a representation for any number that is not a power of two. This algorithm can also predict how many ways each number can be represented.\(^9^5\)*

\(^9^4\) Splash 11101, September 1980  
\(^9^5\) Splash 11101, September 1980.
Learning to value visualising

The stress in the early part of this century on mental mathematics – provided it is a solving of problems in-the-head, not just answers to mental arithmetic questions – is a new recognition of the importance of investigating. A 1980 SMILE example was provided by Sarah Sharkey:96

MENTAL GEOMETRY

I had a breakthrough the other day in the SMILE classroom. At this year’s conference I attended the Geometry workshop which brought together and extended some of my recent but tentative thoughts on mental geometry. The other day a pupil in my first-year class went to the cabinet, took out a red cube 0363, immediately screwed up her face and came towards me saying that she didn’t think she wanted to do that task. I said “Come here. Now, close your eyes. Imagine a cube. What size is it?”

She … It’s a 4 x 4 x 4 cube”

(Hardly surprising, since I think this is the one shown on 0363).

Me Take the top off and look inside.

She I can’t it’s full up.

Me Put the top back on. Open your eyes.

… Now let’s do it again. Imagine a cube. What size is it?

She It’s the same 4 x 4 x 4.

Me Paint it red all around the outside.

I then proceeded to ask her how many of the little cubes had 3 red faces, 2 red faces and then 1 red face, which she answered after a bit of thought each time.

Me Now take the lid off. Are there cubes inside?

She Yes but they’re not painted.

Me Strip the cube of its outer layer and tell me what’s inside.

She (very excitedly) It’s another cube!

Me What size is it?

She No it’s not … a cube. Yes it is … it’s a 2 x 2 x 2 cube.

Me How many cubes have red faces? Now go and do the card.

96 ibid
This took, I'd guess, about 5 mins. I don't think I'd ever really thought that mental geometry was possible amid the general activity of a SMILE room, but at some level it was, and is, and I thought I'd pass the information on.

Even if we did not yet have the sense of where everything fitted we were at least recognising the importance of developing that sense and exploring many other aspects of mathematics that took another twenty years to come into the limelight. In the next Interlude, we are told about a colleague who, after an annual SMILE conference, was to be found sitting in the staffroom dissecting cubes in his imagination. Now, at the beginning of the twenty-first century, mental mathematics is all the rage and we have a professor of mathematics writing in the Times Educational Supplement about imagining holding the opposite corners of a cube between thumb and finger and asking what shape one gets if one slices it down the middle. But, back in 1982, Laurie Buxton was urging us all to do this kind of imagining. He reported on the Geometry Group at that conference:

This group tackled two issues that may interest a number of people.

We discussed an activity called “Mental Geometry”, (to be conducted with maximum concentration and quiet) designed to enhance pupils’ powers of visualisation. Those involved hope shortly to recover from their own exertions in this exercise.

We then considered an alternative and perhaps complementary approach to the usual entry through shape, which takes points, lines and planes as the basic elements and deals with their intersections and the regions open and closed, which they define.

I have a good amount of material available and can either discuss it with interested groups or provide some written notes if you contact me at Tyndale Maths Centre.

New to problem solving

In many SMILE classrooms in the ‘70s and ‘80s problem solving and investigations were new. In this strange new world questions in mathematics no longer required responses such as “5 oranges” or “36 miles”. There may not even be ‘an answer’. That is part of what you have to find out. The whole approach is something that needs to be experienced and worked on with students and in the 80s many Smilers were eager to try it out with their classes. Ramesh Kapadia from the Polytechnic of the South Bank, London, described how he went into a local school to work with teachers to introduce this new way of approaching mathematics.  

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97 Splash 100010, November 1981

[121]
Ramesh wrote:

I began each lesson with a short description of what I wanted the children to do. I told them they would be doing a problem very different from the usual mathematical questions where an answer is usually fairly immediate. I explained why they would be working in groups of three or four - to discuss ideas together. I also said that they would be expected to write a report of their investigations …

I started off a class on this topic from each of the four years, the work being continued by the teacher concerned with the particular class. There were some varying reactions.

Generally, classes started work quickly. They seemed reasonably happy to work in groups though too many questions were asked of the teacher rather than within the group. Some children began counting each small line segment, ending up with answers like 220 lines using a 10 x 10 square - some counted while others tried to use multiplication. No-one thought of looking at 2 x 2 squares etc. until it was pointed out to them. A few tried easier problems but generally this had to be pointed out by the teacher.

In looking for 2 x 2 squares many divided the whole into non-overlapping quarters (e.g. 4 on 4 x 4 square) and had to be shown how to look for others. Again, children often had to be shown how to look for 3 x 3 squares etc. This enabled most groups to begin attacking the problem in a more systematic way - listing the different types of squares obtained they soon saw the patterns of squares. Some pupils had difficulties in describing the different types of squares (small, medium, big - running out of adjectives). A few groups completed the listing involving squares and saw that 100 was never obtained. The suggestion of looking for rectangles or other shapes usually came from the teacher. The patterns found varied from one year to another.

One other important general point was that pupils were very reluctant to write
anything down, particularly in words. They would happily explain by talking about what they had discovered but were loath to actually write it down. Their written work showed little evidence of how they had reached their conclusions. They had to be persuaded to write anything down, at best getting to

\[ 6 \text{ lines} = 5 \text{ squares}. \]

Obviously, they saw ‘\(=\)’ as a magic all-pervading symbol. I didn’t find a single example of a discovery being expressed in English. Perhaps this is not surprising but, if teachers feel it is important, clearly more emphasis needs to be placed on expression in mathematics. Clearly, they were not used to working in groups - each pupil was given paper to write on (to help with control in the classroom?) so they tended to work individually or perhaps in pairs, often asking for the teachers’ help at points of difficulty rather than the rest of the group. They would need regular group work to benefit from it properly. As far as tackling an investigation is concerned, pupils were not put off by it, their attitude was quite encouraging. Most made some attempt and some progress. They managed to find some patterns but could not explain the reason for them.

What did pupils learn? Was it beneficial, worthwhile? Is it mathematics? These are difficult, rather contentious questions but, nevertheless, they need consideration. Initially pupils should have thought about what the question means (particularly that ‘square’ means more than just the unit square) and what ‘to investigate’ means.

Virtually no pupils actually did think about the question; either starting to draw a \(10 \times 10\) square or being stuck. Pupils were expected to develop a suitable algorithm to count squares easily (multiplication): a vast number managed this for unit squares but not so many for bigger squares. The next step is to try to count squares on a square configuration. It was clear that a \(10 \times 10\) configuration was no good but few saw what to do instead. Most had to be told to start with a simpler problem (an important step in problem-solving). Many pupils had difficulty in counting the bigger squares but usually understood the method when shown. They learnt something about counting exhaustively as an idea in mathematics - quite often crucial (i.e. considering all possible cases). Those who got this far often saw the pattern involving square numbers but almost never the actual reason from the diagram.

Finding patterns is important, some pupils learnt something about the patterns and the process without asking if the pattern is always there (perhaps a sophisticated question). Those who got to the stage of considering rectangles or adding on squares were still doing it on an ad hoc basis. This is not to belittle that method of writing, as much high-level mathematics is done on that basis at least initially and sometimes longer!
Overall perhaps not much mathematics was learnt. However, the work is still progressing and this is written after only one lesson. Certainly, the mathematics skills are quite different from those normally taught in lessons. Working in groups was not particularly successful - a greater exposure to such a method is needed for it to be effective. The expression of mathematical ideas was also poor - a lot more practice is required if it is felt to be important. As an activity, pupils seemed to enjoy tackling a problem and would probably gain more out of trying to solve problems if a number were done during the year.

Ramesh then summed up what he saw as being the benefits of investigations. They require from the pupil:

1. Thinking initially about what a question means (instead of answering directly)
2. Trying to decide possible lines of approach
3. Following through various ideas systematically
4. Developing suitable notation/symbolism to represent results
5. Being exhaustive where necessary
6. Developing a suitable algorithm
7. Expressing oneself coherently, in English.

Investigations becoming established

By 1982, investigations were an established part of SMILE. An investigations forum was established and the conference that year included a seminar on “starting investigations”. Extracts from reports back from these seminars were a rich source of starting points and examples of students’ work and reactions. These were reported in Splash and later compiled into an Investigations Handbook. Two examples are given below.
We thought no more about it until I happened to go into one of Sheila's classes one day. I couldn't believe my eyes. The classroom was filled with square paper everywhere. Sheila's students were working on square dissection tables. She told me about the history of square dissection and how it had been used to solve various mathematical problems. She showed me some of her own work, which was impressive.

Chapter 9: To SMILE is to investigate

More square dissection....

In the previous lesson of Square, the teacher introduced the concept of square dissection. I would like to follow up by discussing the use of square dissection to solve mathematical problems. I think it is important to understand the task in detail before attempting to solve it. The work of Charles H. roy illustrates this point. I think...
Figure 22: Square dissection, Splash 100100, January 1982 and Splash 100111, June 1982
Chapter 9: To SMILE is to investigate

Figure 23: Completing the square, Splash 100111, June 1982
**Investigations in the Teacher’s Manual**

As investigating was becoming a core activity, the third page of the Teacher’s Manual was devoted to this activity.

Investigations

**What?**
Anything which presents a stimulus to a child to explore a situation in his own way.

Rectangle diagonal was an early favourite.

![Rectangle diagonal](0439)

**Figure 24:** Rectangle diagonal, 0439

Here the investigative process is described with reference to it.

Different children will achieve different results. But there should be some common stages

1) **Exploration**
   Draw several different rectangles and count the squares along the diagonal for each one.

2) **Classification**

3) **Hypothesis Making**
   Can you spot any likely rules?
   e.g. for a square \((n \times n)\), the diagonal passes through \(n\) squares.

4) **Hypothesis Testing**
   Draw some more squares to check the above hypothesis.

5) **Proof**
Chapter 9: To SMILE is to investigate

The Teacher’s Manual also explained why investigations were important …

Why?
Mathematics is creative. Children must learn to do mathematics as well as appreciate what mathematics other people have done. They need to make their own decisions as well as using accepted conventions.

… and, as always, practical considerations were considered.

How?
For investigation cards the entry in the answer book will take the form of helpful suggestions and will be used for further stimulation when the child is stuck. The answer book will become a source book.
There will be no tests for investigations. Investigations will not appear on the network since most of them can be done at any level.
There is a list (tm 2a) for reference and it is absolutely essential that:

(a) teachers are familiar (up to a point) with all investigation cards used.

(b) teachers discriminate very carefully as to which children do which investigations (if any).

The following suggestions are made from experience of children doing investigations within the SMILE context:
1) Use the last cell of the matrix but mark it in some way to show that it is not a game or a puzzle.

2) Talk to each child before he starts his first investigation so that he understands clearly the different nature of these cards.

3) Encourage the child to make his investigation an extended activity lasting perhaps a week.

Sharing thinking
The engagement with investigations is one of the many examples of SMILE continuing to provide opportunities for more discussion of mathematics, educational philosophy and pedagogy and out of this more writing flowed.
At this point it seems useful to consider approaches to mathematics in the classroom and here the thoughts of Morris Kline and Nel Noddings about investigations in the field of morality are enlightening, especially because they both compare the methods with those of mathematical proofs.

Starting the discussion of moral matters with principles, definitions, and demonstrations is rather like starting the solution of a mathematical problem formally. Sometimes we can and do proceed this way, but when the problematic situation is new, baffling, or especially complex, we cannot start this way. We have to operate in an intuitive or receptive mode that is somewhat mysterious, internal, and inconsequential. After the solution has been found by intuitive methods, we may proceed with the construction of a formal proof. As the mathematician Gauss put it: “I have got my result but I do not know how to get (prove) it.”

“A difficulty in mathematics teaching”, wrote Nel Noddings, “is that we too rarely share our fundamental thinking with our students. We present everything ready-made as it were, as though it springs from our foreheads in formal perfection.” This is just what makes the reading of mathematics so difficult in parts. Half way through a proof we may read, “substituting x for y … we get …” and with that substitution everything falls out so simply. But one is left with the frustrating thought how did the writer come to think of making that particular substitution? How did he (usually it is he) know it would work? It is important to ensure that this sort of frustration does not occur in the classroom.”

Figure 25: Exchange between Lee and Richard Hale

The exchange, above, between Richard Hale from Holland Park School and one of his pupils, Lee, is a sharing of that kind of fundamental thinking on both sides.

Richard wrote “Lee has contributed a number of striking solutions to investigations in Splash over the years and is now in the 5th year. We think this is a nice investigation. Perhaps you could send your solutions to Lee?”

**A final word from John Stewart**

The character of the learning experiences on offer was of paramount importance to Smilers. They wanted their students to be, in however humble a form, mathematicians inventing their own methods rather than technicians applying standard processes. I began the chapter with some words from John Stewart, who was still the leader in their vision for their students’ learning. It is fitting to conclude the chapter with another contribution from him:

*Investigations constitute one of the most important aspects of our assignments. They are designed to lead children into creative work - something sadly lacking in mathematics education generally – and to question-asking. Not the usual controlled safe questions our work generally allows but questions which come intrinsically from the child’s experience, questions the teacher might never have conceived, questions which the teacher might well be unable to answer. WHY? Because this process leads children to do mathematics, not to have mathematics done to them, to experience mathematics in a meaningful way.

It is important that teachers should be aware of the possibilities and be ready to learn something from their pupils. There is a need to give help and encouragement to explore situations, and teachers who have not had the experience will not be aware of what is needed of them. They are not simply easily ended assignments, quickly checked and signed off. They are pieces of work which demand more teacher attention but less teacher interference.

It is very easy to devalue work of this kind. Teacher expectation is powerful and sometimes cloaks teacher fear. Examinations should be an integral part of courses not ends, and the oft mentioned time ‘wasted’ on ‘work not in the syllabus’ is a root cause of much teacher anxiety and consequently pupil anxiety. No worthwhile learning takes place without interest and the creative experience present in investigative work brings about a greater understanding of mathematics. To accentuate the importance of this work it should be distinguished from all other work until at least the nature of it is understood by the pupils. It might help to assign such work on the matrix as the after-test occupation. Alternatively, one may wish to instigate group work and/or class activities based on the investigations as opposed to the more usual individualised approach.*

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100 Splash April 1983
101 John Stewart Splash 0100
Another problem that arises is the assessment of such work. There’s a parallel here with English creative work. A mark given to a piece of such work is difficult to justify. At Belper we have mode 3 CSE assessments, 50% based on the results of investigations and we assess by comparison. We put them in rank order and this at least takes away some of the falseness. There’s an investigation ‘An unfinished enquiry’ in this issue. Try it yourself. Put yourself in the pupil’s position and know what you are asking of them and perhaps why.

John concludes by pointing out how important it is for teachers to actually work on any given investigation themselves to put themselves in the pupil’s position. In that way, one can become more aware of what is being asked of the pupil and, perhaps, why.
Chapter 10: Celebrating diversity and combatting bias

As the SMILE project matured, the material was studied for all its biases. These concerns were an essential element of the developing SMILE philosophy of education, in which they recognised all teachers of mathematics had a wider role to fulfil, playing an active part in the whole development of their students, especially enhancing their social skills and showing them mathematics as a language being used in other areas of the curriculum and in life outside the classroom. This broad view is particularly well expressed in the proposal for a SMILE GCSE (about which, more later) put forward to and accepted by the Southern Examination Group in 1986. In the initial statement mathematics is clearly seen as an integral part of a wider curriculum and wider aims are therefore given, including:

- The intellectual development of the pupil;
- The pupil’s physical, emotional and spiritual development;
- The development of the pupil’s social awareness; and
- The realisation of the full potential of the pupil.

Espousing anti-sexism and anti-racism

As time went on SMILE continued to ask questions about more aspects of mathematics education, and the underlying assumptions and general themes of the education system of which they were a part. Early on Smilers had become concerned about the hidden prejudices being fostered by many learning materials concerning ‘race’, gender, ability and social standing amongst other things. An analysis was made in particular of the commercial materials that had been included in the network much of which demonstrated a bias towards white male images. But such prejudice was also found within the fold. In September 1980 the Holland Park mathematics department wrote to Splash:102

> We are writing to you concerning Factor No. 2. At a recent department meeting the ‘Factorman’ strip was discussed and a great deal of criticism voiced against it from an anti-sexist viewpoint.

In particular:

1. In the first instance a girl is shown puzzling over prime numbers;

2. The female teacher (Miss Multiple – what’s wrong with Ms?) is seen as failing to get the concept over to the class and she is rescued by the passing male teacher - who then becomes Factorman.)

102 Splash 11101, September 1980
As a department and a school we have recently put a lot of thought into analysing our material for sexist (and racist) content, including an analysis of SMILE materials – of which more in a later edition – and we are very concerned at such a blatantly sexist story line appearing in the new material, just at a time when we would have hoped people are becoming more aware of these issues.

We feel so strongly about this that we have decided as a department not to use Factor 2. We took this decision fully aware of the large amount of work which must have gone into its production and also fully recognising the excellence of much of the magazine. Nevertheless, we feel, especially after so much thought put into this very problem, that no other course of action is open to us. We are consequently returning our copies of Factor to the SMILE Centre.

Yours sincerely
Maths Dept, Holland Park School

It was not only teachers who felt obliged to fight the anti-sexist battle, Rebecca Whale in the first year at Lewisham School noticed a sexist assumption in a commercial reference task about set theory – that only boys play football. She wrote a letter Splash\textsuperscript{103} saying, “I know girls that play football. I feel angry and so would they. Some people think that boys are the football players of the world but that’s not so.”

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{image.png}
\caption{Letter from Rebecca Whale, Splash, 100001}
\end{figure}

\textsuperscript{103} Splash 100001, June 1981.
Another ‘ism’ SMILE was attempting to root out was racism. To this end, in 1983, a document was produced:¹⁰⁴

**SMILE Anti-Racist Policy**

As teachers we aim to encourage an active multi-cultural teaching approach. Against what background do we do this? We live in a racist society. One result of colonialism and imperialism has been the suppression of the culture and science of the Third World peoples and the creation of the myth of ‘European Science’ as a seamless body of truth. In this way it promotes the inferiority of black people and encourages white chauvinism. Too much of the way we teach mathematics shares in this. We do little to show that mathematics is the product of the thinking and achievements of all the people in the world. We must not allow the universality of mathematics to be lost.

Anti-racist mathematics teaching, therefore, must mean at a minimum:

1. Teaching mathematics with a strong emphasis on its historical development, showing how at each stage mathematical developments have arisen as the response of different peoples to the problems they had to solve – be they Indian astronomers, Egyptian farmers, Spanish navigators or whoever.

2. Deliberately seeking out knowledge of the mathematics of the Third World peoples and making it easily accessible to all children learning mathematics.

3. Making deliberate use of the different mathematical methods brought by children to the classroom – e.g. different counting systems.

4. Critically assessing the content of present mathematics from the point of view of its relevance to living in a multi-cultural society.

Such an approach may involve a number of different methods – case study materials (e.g. development of number systems), or study of particular civilisations – or it may require the deliberate inclusion of more historical background material with existing activities. So far as possible, such work should be linked to other progressive cross-curricular material.

The recruitment of a more culturally representative teaching staff will contribute immeasurably to such work.

Whatever the method, the aim is to promote the dignity of all peoples and to understand that mathematics has a vital role to play in this.

This policy was thrashed out at the 1983 Conference at which, in a discussion group on multi-cultural mathematics, the equivalence of multi-cultural and anti-racist was debated because the creation of materials and attitudes which are multi-cultural inevitably works against racism.

Much thought was also devoted to gender issues at that conference, considering, in the dynamics of the classroom, the tendency of boys to employ more attention seeking, aggressive and demanding tactics in mixed classes. Another group considered

¹⁰⁴ *Splash* 101101, June 1983.
role models, thinking up ideas for posters “depicting girls/women actively engaged in mathematics or posters which would promote positive images of women.”

Altogether, as Mary Clark reported, the conference proved to be “another SMILE weekend with many ideas to refresh the parts of the brain a well-known lager does not enhance.”

There was certainly something more than mathematics going on in SMILE classrooms. That other messages concerning ethics and respect for human beings, whatever their characteristics, were being passed on to students is shown by a letter written to Ronnie Goldstein and Nigel Langdon by some students from Norwood School. They did not like the way in which war and death were being used trivially in an activity on bearings and proposed an alternative.

Social and political questions continued to be in the forefront of the minds of the SMILE group. The eradication of ‘isms’ of all sorts from the classroom was one of their priority aims. At the 1986 conference the list of Saturday workshops included anti-sexism along with classroom action research and a variety of mathematical topics such as feely boxes, Logo (one of the Logo workshops was for women only, so that the tendency of masculine dominance in the technical world should not put them off), practical maths and puzzles. At another time there were anti-racism workshops for all. One of these was reserved for black teachers, in case some might not want to discuss issues of racism in a mixed group. Other groups looked at

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105 Splash 101101, June 1983
Chapter 10: Celebrating diversity and combating bias

materials which might legitimise “aspects of western culture and behaviour that could be questionable”. Institutional racism and subtle racism were also tackled in yet more groups. As wide a coverage of these questions as possible for every school was achieved by ruling that teachers should choose their groups so that no group contained more than one teacher from any school.

**Anti-sexist revisions**

The work to create equal opportunities for all children and to root out prejudice continued steadily and in 1985 a post was created for one day a week for a seconded teacher to support this aspect of the project according to the following proposal:

*The SMILE project has been producing learning resources for pupils for more than ten years. In the light of contemporary perspectives, some of the early material is now perceived as being sexist in content and presentation, and missed opportunities for providing positive role models abound. SMILE teachers express the view that the collaborative style of working encouraged by independent, resource-based work seems to be conducive to mathematical success for girls but regret the sex stereotyping of some of the material used in their classrooms.*

*The SMILE team is committed to pursuing an equal opportunities policy with respect to gender issues but the existing staffing and budget of the centre do not allow for sufficient pace in the process of amending early materials. For a recent reprint, time and money permitted only a one per cent revision – nothing like the order of change required.*

*It is therefore proposed that an experienced SMILE teacher be seconded to the centre for one day per week throughout the academic year 1985/6. The seconded teacher would set up and co-ordinate a working group of teachers who would first sort out priorities in the work to be undertaken and then redraft material produced in the earlier years of the project. They will not just be looking for text changes but also looking at the imagery involved. The seconded teacher will need to be experienced in producing learning materials either within their own school or for SMILE. The post will entail taking the redrafted material through to manuscript and then overseeing final artwork, initially with support and advice from other members of the SMILE team. It is also proposed that at the end of the period all ILEA secondary schools would be offered complimentary copies of the material produced.*

*The arrival of such material in the classroom would enhance teacher morale and have an immediate effect on how pupils see themselves especially with respect to their relationship to mathematics. It would also provide an opportunity for discussion with pupils of the issues surrounding equal opportunities and gender.*
The costs involved are as follows:

£1900 for supply cover for the seconded teacher
£1000 for origination of finished artwork
£1000 for printing of complimentary issue.\(^{106}\)

**Combatting sexism through the Logo project**

In 1986 the ILEA published *Secondary Issues? Some approaches to equal opportunities in secondary schools* the first section of which was aimed at changing the stereotyped images of the curriculum. Julie-Ann Edwards, then a member of the North Westminster mathematics department, wrote about “Girls, mathematics and Logo”.\(^{107}\) (It is important when reading the extract below to remember that what is described happened more than 30 years ago. The accessibility of computers and attitudes to them have of course changed over the intervening years.)

Before describing in detail classroom experiences of a number of girls working with Logo, usually in pairs, she looked at aspects of the SMILE/Logo learning environment best suited to girls:

*Experience indicates that girls use Logo as enthusiastically as boys in classroom situations…. In the atmosphere of co-operative learning the discussion of work is an important part of learning mathematics. Aggression and competition, which can be a problem when boys are in the majority, are redirected in the positive challenging of each other's ideas. Pupils are encouraged to explore mathematical ideas and share their work. This pupil-centred approach helps to create a comfortable learning environment for girls into which a computer can be introduced.*

*Logo is used within the mathematics curriculum as a means of problem-solving. It is one of the few situations which give pupils experience of direct feedback when they pose their own problems. It is an invaluable resource for extended work. One or two computers are set up … so that a pair or two pairs of pupils use them throughout each 55-minute lesson. The computer and screen are turned away from the class. This allows pupils the freedom to choose to share their work and removes the pressure often associated with achieving work of value on a computer.*

Julie-Ann goes on to list some of the myths about girls: not logical mathematical thinkers, naturally more creative, not interested in machines. She then argues that

*The use of Logo in mathematics classrooms gives innumerable examples of girls’ work that contradict all of the previous assumptions. Girls prove themselves to be confident mathematicians setting themselves ambitious goals and showing persistence and determination in achieving those goals.*

\(^{106}\) Anti-sexist revisions, *Splash* 111001 June 85 p 11

There follow four short studies of pairs of girls working at computers one of which is given below:

**Happy and Shafna** are third year girls, recently arrived from Bangladesh. Given some basic commands, they were observed over five lessons during which time they were making sense of the movement of the screen turtle - both its distance moved and direction. There was a point of transition from haphazard movement of the screen turtle to a sense of control over its movement. The girls discussed animatedly - in Bengali, in English, and in a mixture - just what direction the turtle needed to turn and how far so it didn’t hit the edge of the screen. They set themselves challenges, laughing pleasurably when they achieved their challenges.

It may seem a long time to allow pupils to explore the use of basic commands but this initial time is vital if pupils are to gain a sense of control over the direction of their learning and have immediate feedback to recognise the effect and importance of their own ideas. Computing appears to offer little of initial interest to girls and allowing time will help develop their sense of value and confidence with the computer.

Happy and Shafna remain keen to use the computer both in lesson time and out of school hours. If one arrives alone to use the computer, she is equally confident without her partner. Motivation and enthusiasm remain high. Their next goal is to draw a symmetry task from their mathematics lessons using the turtle ‘because we can make the turtle draw better than we can’. These girls know they are in control of their learning.

Some of Julie-Ann’s comments on the observations made of these pairs of girls working are given below:

The nature of the pupil-centred learning scheme these girls use in mathematics [SMILE] enhances many of the aspects of learning which make girls confident. It encourages discussion and collaboration, independence and self-reliance. Each task set for a pupil is selected for a purpose and at an appropriate level of difficulty so that the pupil is able to respond to a suitable challenge.

Importantly, the computer is seen as a normal part of the supportive environment of the mathematics classroom. Pupils are not removed to a machine-dominated environment to use a computer where the purpose for doing so may not be clear.

Control over setting a goal in Logo gives control over directing its achievement: girls are motivated by being able to use their own ideas and develop their own strategies. They set themselves an interesting range of challenges from simple mathematical goals and pictures to complex mathematical tasks and elaborate scenes.
Developing strategies within the experience of achieving their goal gives the girls a purpose for learning and experimenting with mathematics and maintains a high level of enthusiasm and interest in both mathematics and computing.

Girls are able to enjoy asserting themselves to meet challenges because they have created those challenges. No longer need they fear the aggressive sense of competition in meeting challenges set by someone else nor the failure of giving up in the face of difficulty.

Sharing the use of the computer fairly and systematically in the classroom means that girls don’t have to become aggressive to gain keyboard time. With the computer and screen turned away from the class, sharing the results of their work becomes a choice for the girls and not a right of the class or the teacher.

Girls are still unwilling to assert themselves to ask to use the computer - it is inevitably the boys who ask. Despite the high level of motivation shown by girls when using Logo in mathematics lessons there was only one pair of girls who actually asked to use the computer. Yet all respond eagerly to the opportunity. We must be wary of misinterpreting this lack of assertiveness as a lack of interest in computers or a lack of willingness to explore mathematical ideas.

We were interested to find that the confidence girls gain by having control over the way they choose to solve problems in Logo is transferred into the mathematics classroom. Some convert the mathematics they learn from a task into a game and challenge a partner to participate. Others discuss their work much more readily and confidently, listening to the ideas of others and reflecting on them. Partners who work on Logo together visibly share and discuss their mathematics work more. Our case studies show the potential and willingness of girls to benefit from computers within the environment of a pupil-centred mathematics classroom. Constructing a supportive classroom environment and careful planning of how pupils are introduced to the computer are essential if we are to make full use of the computer as a learning resource for girls.

All this shows, as we have noted before, that there was much more than mathematics being learnt in the best SMILE classrooms and that teachers never lost sight of the development of the whole child or of the quality of the social environment they were creating for the developing minds in their care. What is more, it is clear that this richness of context was supported in every aspect by the ILEA.
Figure 28: The SMILE Logo Teacher’s Guide
Interlude: Capturing the SMILE experience

Before looking at some of the more formal concerns of SMILE as it became more and more established - how could we help inspectors understand a SMILE classroom? what we were going to do about formal examinations? how should we explain to parents what we were doing and why? and so on, this interlude tries to capture something of what it was like to be involved, to experience the energy and engagement of teachers across the topics already discussed and many more.

There have been accounts earlier in the book about the annual SMILE conference which provided the biggest input to this powerful collegial experience. We step aside briefly here from the ongoing tale to consider just one more of them. We hear first from someone fairly new to SMILE and pretty much satisfied with how things went. And then we hear a more self-critical tone indicating how it almost never paid to be complacent - someone was always likely to be around the corner wanting to challenge your thinking.108

It was electric!

“Do you remember those conferences?” said John Hibbs, “They were electric!” The continuing dialogue on pedagogy and mathematics found in the pages of every Splash were an extension of what always went on at fever pitch and with sparks flying at SMILE Conferences. John Davies from Morpeth School when reporting on the 1982 conference hints at the excitement:109

This year’s SMILE Conference was my first and to be honest amongst my many thoughts whilst travelling to Avery Hill were such questions as ‘Will it be worth it? Can I afford a precious weekend?’

Friday evening soon dispelled any doubts. Malcolm Swan’s excellent lecture on ‘The Language of Graphs’ motivated us all. Imagine 80 or so maths teachers twisting their necks to make graphs appear ‘the right way up’; itching to tell the person next to them that their interpretation of a graph couldn’t be right; performing the mental equivalent of swinging one’s right leg clockwise whilst swinging the right arm anti-clockwise!

I certainly hadn’t experienced the latter phenomenon before but then I’d learned about graphs by studying the ‘grammar’ (co-ordinate, plot, read-off) instead of practising the language (change, steepness, over-all message, periodicity). For the uninitiated: try drawing (imagining) a speed/distance graph for the motion of a big dipper - using the usual positive and negative convention.

The ‘Eureka’ micro program which he demonstrated with its ‘story graphs’ indicated the ease with which kids could be motivated using this approach

108 Editorial comment.
109 Splash 100111, June 1982
(if teachers can be motivated anyone can!). Also, his examples of some kids’ interpretations of different graphs, whilst often hilariously funny, made one acutely aware of how badly this topic is usually taught.

Altogether, a stimulating start to the weekend.

There were 10 **Saturday morning** workshops.

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<tr>
<th>1. Micro</th>
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<td>2. Tests &amp; Answers</td>
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<td>4. Replacing commercial refs.</td>
<td>9. Statistics</td>
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My choice was ‘Tests and Answers’ - rather more mundane than Friday evening but an interesting and probably necessary experience for a new SMILE teacher.

Of the other workshops I know little, perhaps because our workshop continued through the morning coffee break and we even carried on formally in the bar during the free time before lunch!

However, I must mention that a member of our department hasn’t been the same since he went to the Geometry workshop. He spends most of his breaks sitting in the staffroom imagining the dissection of cubes and the intersecting of planes and emerges now and then to discuss terminology for figures he has imagined so that he can communicate them - sounds interesting; maybe next year?

More down to earth but equally exciting I’ve learned that some time during the micro workshop was spent looking at a relatively new piece of software called LOGO which makes it much easier for kids to perform some quite complex functions on the micro without first having to become excellent programmers. Sounds excellent news - maybe now kids will be able to tell the machine what to do instead of vice versa. Human beings rule OK!

**Saturday afternoon** was devoted to ‘Maths Across the Curriculum’ and we split up into 4 groups: - Art, Athletics, Biology and Geography. I got the impression that this was generally considered the weakest session of the weekend. Certainly, the athletics group seemed to lack any direction or even any consensus of approach to the topic. I felt that this area was one I hadn’t really considered seriously beforehand and any ideas that were generated during the session were so ‘raw’ that discussion was rather ‘in the air’. Hence nothing very concrete was achieved. Still raw ideas need refining - plenty of work available in this field then.
Only the art group seemed to get anything positive out of the afternoon.

For **Saturday evening** six seminars were arranged:
1. Starting investigations
2. Micros
3. The implications of Cockcroft for SMILE
4. How do you teach the more able in the 4th & 5th years?
5. Record keeping and school assessment
6. Class teaching in a SMILE environment.

Quite a number of people, including myself, were interested in ‘Starting Investigations’, probably reflecting a desire in many people to do more investigative work in the classroom and a lack of confidence in one’s ability to ‘teach it’ properly. No easy answers presented themselves but discussion gave people a chance to air their own experiences and approaches, a process which gave me some new ideas, helped me analyse my own situation more clearly and made me more determined to start more investigations with my classes.

Again, there wasn’t time to discuss the other seminars. We were into Saturday night’s fun activities before we knew it. Some, possibly, didn’t know it afterwards either!

It is worth pointing out that the ‘Class teaching’ seminar was a Friday night ‘pin up a notice and ask for names’ decision of an individual teacher. I mention this so that ‘non-SMILERS’ or ‘non-activist SMILERS’ get some impression of the teacher orientated/ initiated nature of SMILE both at the conference and generally.

**Sunday morning’s session** consisted of a lecture/workshop on ‘The Assessment of Children’s Investigations’ led by John Stewart.

John firstly talked about the relative merits of marking schemes for traditional examination type papers and investigations and then sent us away in small groups with some sample pupils’ answers to ‘trad’ type questions and a marking scheme to discover how different our interpretations of the answers and the marking schemes would be. And how different they were. In my group I remember one person arguing that he would give full marks for a particular answer whilst another argued that she would give no marks at all for the same answer!

After the coffee break John introduced us to the Wyndham School coursework assessment scheme which we used to assess some sample investigations, in pairs, so that we could compare results.

John’s argument was that assessing an investigation under the broad headings below would provide a more consistent assessment of a piece of work than the traditional explicit marking scheme.
INTERLUDE: CAPTURING THE SMILE EXPERIENCE

1. Formulating the problem
2. Carrying out the task:
   (a) mathematical strategies adopted and
   (b) level of mathematical argument
3. Evaluation and interpretation of results
4. Report as a communication:
   (a) organization and structure and
   (b) style of presentation
5. Personal contribution – use of sources

Judging from my experience this was in fact true!

This account of the SMILE conference has been mainly concerned with the formal sessions of the weekend but let me finish by saying that the conference was much more than that. I met people whom I hadn’t seen for a long time, I became better acquainted with people whom I had met briefly before and I met lots of people for the first time. With all I discussed experiences, problems and ideas so much so that I found the social contact just as rewarding as the rest of the weekend.

As I said at the beginning, this was my first SMILE conference. Subject to places, next year will be the second.

A cautionary tale

The number of new directions being explored at this conference alone makes abundantly clear that the thrust to “improve education” had been embraced. John’s doubts about the sessions dealing with links with other subjects were echoed in a further report in the same Splash which demonstrates the fragmentation of the curriculum resulting from the way secondary education continues to be organised into disintegrated disciplines with the allocation to each of time slots of 40 – 45 minutes.

However, in Splash 0001 when describing the beginnings of SMILE, I wrote that SMILE teachers had already “grown in stature as teachers, learnt to take criticism and offer it constructively, become self-critical in their work and of the quality of the material they put in front of their pupils”. Now, eight years on, at this SMILE conference I wondered if we were still as self-critical or whether instead we had become a little smug. The flexibility and forward looking that used to be characteristic of SMILE teachers did not seem to be much in evidence in the Saturday afternoon sessions and it was easy to blame anything but ourselves for this. By this time, I was an ILEA Inspector (Advisor) and wrote to Splash:

We were being led by experts from other disciplines who did not always “talk our language” or see things from our point of view. This presented a challenge
which perhaps we did not take up immediately. As steps were taken from the
territories of art, biology, physical education and geography towards mathematics
I saw little attempt at movement in the opposite direction. Talking to some of the
participants afterwards I realise that this may have been in part because such steps
need forethought and perhaps it is only now that sufficient thought has been given
for us to take a few tentative steps outwards from mathematics to see what our
pupils are experiencing elsewhere.

It is important as mathematics teachers that we take note of what is common in
our pupils’ backgrounds as well as what is differentiated. SMILE, by virtue of its
“I”, is well able to cater for the “seven-year difference” mentioned in the Cockcroft
Report (para. 342 and 436) but in our organisation, are we equally well designed
to exploit the common elements of our pupils’ experience: the map reading they
may do as a class in geography, the pulse rate investigations they may undertake
as a group in the biology lab, the use of space they may work out as a team in
physical education? All these experiences and many more have much to contribute
to the understanding of related mathematical concepts, and these may well need
bringing out in group or class discussions. Is our interpretation of SMILE flexible
enough to achieve this?

One comment I heard in a group on that Saturday afternoon made me
doubt it. My interpretation of what I heard was that SMILE, because it was
an individualised scheme, could not adapt itself sufficiently to take in that
element of group or class activity necessary to bring out the mathematical
implications of such common experiences.

But perhaps now conference members have had time to reflect on the forging of links
with other disciplines and are ready to take up the challenge again, both within their
school and in the wider context of a working group outside the school, where there
is more peace to philosophise and decide on action to bring about greater integration.

In Mathematics Counts (para 246) we read, “the many different topics which
exist within mathematics … should be presented and developed in such a way that
they are seen to be inter-related. Pupils need the explicit help, which can only be
given by extended discussion, to establish these relationships; even pupils whose
mathematical attainment is high do not easily do this for themselves.” If our pupils
do not even see these internal relationships easily, and we must agree that they
do not, how much more difficult is it for them to see the inter-relatedness of the
different subjects encountered in their whole school experience? If they are to be
“fully educated” according to T.S.Eliot’s definition, it is we who have to help them
“to have some sense of where everything fits.”
Chapter 11: What’s going on?

AS SMILE grew, the need began to be felt about how the project should explain itself outside those ‘in the know’. In this chapter, we consider communicating with parents, with observers and inspectors and with the press.

Communicating with parents

In spite of its continuing growth and success, there were many who still found the SMILE classroom confusing. Five years after his arrival as SMILE’s first graphic designer, Charles Snape described for his colleagues the bewilderment of many parents of SMILE pupils. Their children were experiencing mathematics in an entirely different environment, and with an entirely different flavour from the one they remembered from their own school days.\footnote{Charles Snape, SMILE and Parents, Splash 101010 January 83} As always, the SMILE approach was to collect a small group of teachers together who shared an interest in the problem and wanted to find a solution.

When I first came to the SMILE Centre I had no great passion for maths but five years later I am quite convinced that it is the most important source of learning. But would I like my children to go to a school that used SMILE? … Working with SMILE teachers, the most committed I have ever met, and working on SMILE materials, I am convinced. But somewhere deep down there still remain old prejudices. Is it maths? It looks too easy. It can’t be. Will my children be able to pass exams? Will s/he be some oddity when asked by a prospective employer what maths s/he did, receive a blank face at the word SMILE? As a parent I am not alone in my fears or lack of understanding. I believe that many parents find it difficult to come to terms with SMILE and aren’t sure how to play a positive role in their child’s mathematical development.

I think SMILE teachers owe it to parents and to themselves not only to be accountable but also to show the very positive force that SMILE is. Though SMILE might have its problems, have a good look at what other maths teachers are doing! SMILE is clearly the best thing around – but I need convincing! Can you do it?

Over the past month or so I have asked several SMILE teachers if they would like some form of document which explained the SMILE philosophy and the positive role that it plays in the development of children. And also, the positive role that a parent can play. Everyone that I have spoken to has said yes. What form this document takes – booklet, leaflet, video – remains to be decided.

If you think that parents should be informed and be in a position to help their children to get as much from maths as I do then come along to the meeting. Don’t
be afraid, we aren’t looking for people to do any work but we do need to know the kind of fears parents have about SMILE and what kind of answer you give them.

This comment resulted in the production of the SMILE Parents’ Guide. Whether this guide would have helped Hunter Davies in the problems he describes two years later in coming to terms with his daughter’s involvement with mathematics in SMILE classroom I am not sure.\textsuperscript{110}

*We went to Flora’s school last week for her First-Year reports session. … I took a long time talking to her maths teacher, and got nasty looks from the queue. All I wanted to know was the answer to a SMILE card, one of those dopey questions where you have to arrange things in a set order. I had spent a whole evening, and drunk a whole bottle of wine, just trying to work it out. When Jake came, the Boy Wonder, he stayed up practically all night, and he too failed to solve it.*

*I got the teacher in the end to admit he had not found the solution himself, but there was one, oh yes, it was not a cheat. Sometimes, so he said, not getting the answer can teach you more than getting it right. Pull the other one.*

**The SMILE Parents’ Guide**

So, to use the modern jargon, what are SMILE’s ‘targets’ and how are they achieved? What does go on in a SMILE classroom? The SMILE Parents’ Guide attempted to include parents in the day-to-day process of their children’s mathematics education and described for them what was happening in the mathematics classrooms of their children:

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Your child will be given a matrix of tasks (a list of about ten). The tasks can be done in any order so that the child has some degree or choice, organisation and flexibility. As each task is completed the pupil can mark it from an answer book available in the classroom, and the teacher will check it and comment upon it before signing off the work. When all the tasks have been done and signed off, your child will find and complete the set of tests relevant to those particular tasks. The tests are marked by the teacher (outside the classroom), and the test score is entered in the record book and gives both teacher and pupil some indication of mathematical progress. The teacher will use this information when setting the next set of tasks. From time to time, teacher and pupil will discuss the child’s progress and take joint decisions about future units of work. The work itself will be done individually or in pairs, in small groups or as a whole class activity, depending on the particular task. This gives the pupil time and space to share and discuss ideas on various topics of work.

**THE NETWORK**

For planning work in SMILE, and detailed record keeping, teachers use the network and record sheet. The network shows all the 1500 SMILE tasks arranged by topic and level of difficulty. The range of tasks gives the teacher a vast choice of work to set. The teacher has a network and record sheet

\textsuperscript{110} Hunter Davies, *Punch*, May 15, 1985
for each child and can see at a glance what work has been attempted on the various mathematical topics. The record sheet will contain details of the child's progress and of where help or encouragement is needed.

Figure 29: An individual's record showing a copy of the network and record sheet, SMILE: A guide for teachers

Figure 30: A section of an individual's network indicating work set, SMILE: A guide for teachers

Figure 31: A pupil studying her own record in the teacher's file, SMILE: A guide for parents
THE MATRIX

Using the network, the teacher writes a matrix (a list of about ten tasks). The matrix for a first-year child is unlikely to contain either all tasks at the same level of difficulty or tasks all on the same topic. The reasons for this are that children progress well in some topics yet experience difficulty in others. Children are encouraged to write down their opinions about the work undertaken in the comments section of the matrix.

THE ANSWER AND TEST BOOKS

After completing a task, the child is expected to mark their own work using an answer book. As well as giving answers, these books also contain explanations about how a solution is arrived at. Thus, a sensible child may well use the book when they are stuck, perhaps working back from the solution to a proper understanding of the problem. Most children use the answer book sensibly because they understand that there is no point in cheating by changing answers or marking incorrect things correct. They are encouraged to understand that by using the answer book badly they would in fact be cheating themselves; they know that if they pretend they understand something when they don't they are not going to make progress because the teacher will set inappropriate work.

Figure 32: Poster available initially from SMILE and then from Tower Hamlets AEI

At the end of the matrix the child has to do a test which is marked by the teacher.

As for the mathematics content in SMILE, the Parents’ Guide gives an initial explanation for the choice of the mathematics put before young students:
Both the way children learn mathematics and the mathematics they learn are different from the way many parents were taught. But some of the things known as “Modern Maths” are in fact relatively old. Mathematical topics such as sets, vectors, probability and matrices were first invented at the end of the seventeenth century. Other topics such as topology were developed early in this century. It is a combination of the older mathematics and the so-called modern mathematics that has made possible the technological developments of the latter part of this century.

The Guide also has something to say about the way mathematics is learned in a SMILE classroom.

Mathematics can be fascinating and exciting to study. The SMILE scheme aims to foster a greater understanding and enjoyment of the subject. It also aims to promote each individual’s strengths and encourage them to become self-reliant and responsible for their own mathematical learning.

It continued by referring to the wide variety of ways in which children could learn in a SMILE classroom.

**VARIETY OF LEARNING**

Variety plays an important part in children’s learning. SMILE provides both variety in materials and in working methods. In a SMILE class the children will be doing their mathematics in a variety of ways. Some children will be working individually, some in small groups. Occasionally the whole class might be engaged in the same activity. SMILE includes over 1500 pieces of work (usually called tasks). Each child will be working on a list of about ten tasks (usually called a matrix) at any one time. The nature of the tasks is varied. For example, some are familiar mathematical tasks, some involve 3-dimensional constructions, some involve using the microcomputer or a calculator and some involve gathering and analysis of statistics. Tape recordings, posters, packs of materials, booklets, TV programmes, worksheets, text books, reference books and more, create a stimulating environment.

**INVESTIGATIVE WORK**

Until recently a child studying mathematics had very little opportunity to experience the subject as a mathematician until they were at the end of a university course. Investigative work makes this possible even at primary level. In mathematical investigations children are given a situation and are expected to pursue it with little direction but much encouragement from the teacher. Children can then make their own discoveries and eventually start asking and answering their own mathematical questions.

**MICROCOMPUTERS**

Microcomputers are increasingly becoming part of the everyday life of a child in a mathematics classroom. The micro can be used in two ways. First it can be used to run pre-written programs which can give the children practice in a mathematical topic or set them puzzles and problems to solve operating a computer.
Second, it gives children the opportunity to write computer programs for themselves. The advent of a computer language called Logo has made this possible. Logo is a powerful language which allows children with no previous experience of computers to set and solve their own problems using a micro-computer. The computer programming language that was most readily available until recently to non-professional computer programmers was called BASIC. The problem with BASIC was that a fairly sophisticated mathematical knowledge was called for and quite a lot of work had to be done before the simplest program could be created. So far research seems to be indicating that children programming in Logo achieve a good understanding of the mathematics.

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**Indicators of learning**

Bewildered reactions to *SMILE* in action continued to be found not only among parents but among those who would have reckoned themselves specialists in classrooms – in particular HMI, well-versed in assessing conventional classrooms – but not brave enough to confess to being beaten by the unusual scene they observed in *SMILE* classrooms. One afternoon in the early 80s, however, a very experienced member of HMI observed classes in a *SMILE* mathematics department as part of an exercise initiated by the *SMILE* Centre to familiarise Her Majesty’s Inspectorate with this strange phenomenon. Drinking coffee in the staff room afterwards he had the honesty to comment that he and his colleagues had no benchmarks by which to judge that kind of lesson.

Smilers were well aware of the difficulty experienced in assessing a *SMILE* lesson by those unfamiliar with individualised, resource-based learning. Therefore, in 1984 a short paper was written to help observers in *SMILE* classrooms to make qualitative judgements about the activities they witnessed.\(^\text{112}\) It was hoped that the questions which formed the major part of the paper would help to develop techniques for assessing both the provision made by the teachers and the quality of the responses made by the students. The benchmarks this paper laid down should, it was believed, prove useful in judging the educational validity and effectiveness of *SMILE* classrooms. It is suggested that it should be the benchmark by which the incidents and ideas described in this book can best be judged.

In these times when narrow and limited judgements by Ofsted have become the norm, it is useful to remind ourselves of traditional HMI practice. When evaluating a mathematics classroom, where the learning approach is based on whole class teaching, there were particular aspects of behaviour of teacher and students which were already widely recognised as indicating good practice. When HMI were concerned to assess provision and response in 1979, their report *Aspects of Secondary Education* indicated that inspectors paid particular attention to:

\(^{112}\) *Splash* 110110 November 1984
Chapter 11: What’s going on?

1. the students’ oral communication with their peers and with the teachers, their ability to understand the printed page, and to write clearly for the benefit of others;

2. evidence of understanding provided by appropriate practical performance;

3. evidence of sustained work on any mathematical topics, including the ability to read from topic books or to conduct an extended investigation;

4. evidence of productive work in groups;

5. evidence of profitable links with other areas of the curriculum;

6. whether the students were willing to work independently or whether they needed detailed instructions on method every time.

Because SMILE was essentially a resource-based, independent style of learning, most frequently used with mixed-achievement classes, different modes of classroom behaviour were appropriate. The traditional qualities appeared in different guises. For example, far more student talk was expected in SMILE and movement about the room was essential when students were using a variety of resources. A pupil in a traditional classroom I was once observing declared that I could not be an inspector because inspectors ‘sit in the corner and wear suits’. It may not have mattered whether you wore a suit or not but sitting in a corner of a SMILE classroom would not give you a proper understanding of what was going on. The observer who sat as unobtrusively as possible in a corner to listen and watch would perceive precious few of the above qualities. So, observers have to be trained in a new art (and this is true to this day and certainly includes members of Ofsted). The paper produced was intended to form the core of such training.

Guidelines for assessing a SMILE classroom were presented in Splash: 113

- One of the most effective ways to judge a SMILE classroom is to work with the students, responding to individual requests for help. It is useful to make as detailed an analysis as possible of the work and behaviour of a number of individual students.

- Children in this environment will normally assume that another adult in the room is an extra source of assistance and this creates an excellent opportunity to recognise what work is actually being done, to discuss with the students the work they are undertaking and to observe the teacher without being intimidating or modifying too greatly the normal teacher/student interactions.

113 Splash 110110, September 1984
• It is also informative to study the teacher’s pattern of work, to look at the room itself and to find out what procedures for planning and assessment exist outside the classroom.

Below, an attempt has been made to focus on a small number of questions we think visitors to SMILE classrooms might ask themselves, and to give some indication of how they might find the answers to them. (It is important to note that questions referring specifically to mathematics could just as appropriately be posed with reference to any other curriculum discipline.)

The guidelines became those offered to visiting inspectors in SMILE classrooms.

What mathematics is being learnt?

The students: Ask individual students to describe their specific work.
Are students aware of what they are doing?
To what degree are students able to be articulate about their work?
Note the nature of tasks which children are working on:
investigations?
copy and complete exercises?
...  
...  
What is the content of the mathematics being done?
What mathematical skills are being used?
What text books are used by students?
Make an analysis of as many individual children’s work as possible.

The teachers: Note how much help and guidance the teacher provides.
Does she give answers or guidelines?
Note how she spends her time.
What proportion of the lesson is spent in conversations with students?
What is the nature of these conversations?

The room: Are posters/designs used to advertise mathematics?

Afterwards: Do the students networks indicate that a broad spectrum of mathematics is being covered?
Do the records indicate any sustained or extended work?
How conducive is the atmosphere of the room to mathematical thought and development?

The students: Is there movement in the room to collect materials/workcards?
...are all children taking advantage of the freedom?
Does the level of noise indicate a working atmosphere?
Note the number of children working at any instant.
Are all the children working most of the time?
Are most of the children working all of the time?
Note how many children are discussing mathematics.
How many children appear to be self-motivated.
What do the students think and feel about the work?
Note their response to you: what does it tell you about their expectations of a teacher?

The teacher: What learning techniques are encouraged; listening, discussing, questioning, reading, writing, drawing, using technology?

The room: Is there a sense of order?
Is there evidence of students' work displayed?

What are the teacher's control techniques?

The students: Select an individual's work-book and ask about previous work.
Has the student completed previous tasks?
Check with the student one particular task for thoroughness.
Has the student marked/corrected work?
Is there evidence of the teacher checking work?
Are students gaining high test scores at their level?
Do students wait a long time for teacher's help?

The teacher: Who decides what happens in the classroom?
How does the teacher exercise control?
Are students not working noticed by the teacher?
How does the teacher motivate reluctant workers?
How aware does the teacher appear to be of what is happening in the room?

Afterwards: Is the teacher aware of how much work individuals achieved: in this lesson? generally?
How knowledgeable is the teacher about individual students' performances in this lesson? Generally?
Is there a structure in the teacher's choice of work for students?
Are time limits set for under-achieving children?
Is the “seven-year difference” recognised in the range of levels of work being done by students?

The students: As far as one can tell, are levels of difficulty appropriate?

How much do the work assignments vary in level over the whole class?

Can you judge who are the lowest achievers? – who the highest? (Ask the teacher if you need help in this.)

What range of work (variety and level) is being tackled?

Does the teacher modify the amount of work for individuals?

Are students allowed some choice in the work they do?

Does this match their level of mathematical ability?

Are all the students being challenged by their work?

Does the organisation of the room facilitate easy retrieval of equipment and resource materials and generally provide comfortable working conditions?

The room: What equipment is provided? (computers, calculators, apparatus?)

How are the materials organised?

Are work materials replaced by students after use?

How is the furniture of the room arranged?

Is there a desk for the teacher?

What sort of books are used by students for recording their work?

The teacher: Note the teacher’s movement: is the general pattern of movement: teacher to students or students to teacher?

What planning/assessing goes on outside the classroom?

The students: Do they understand the underlying organisational structure used by the teacher in planning the work?

Do they have confidence in this structure and its implementation?

Do they have a clear idea of what to do next? of the choices open to them?

Do they have a sense of coherence about their work?

At the start of the lesson, can they begin quickly?

The teacher: Does the teacher spend classroom time on solely administrative matters?

Afterwards: Discuss one or two individual students with the teacher.

How knowledgeable is she about them?
Look at those students' records: how did the teacher arrive at each programme of work? How do their levels vary over a term? A year? How does the teacher deal with incorrect tests? What review procedures does the teacher use for individuals? for the class?

Communicating with the press

The national press were also interested in what was going on in SMILE classrooms. The headline If it all adds you can really SMILE was chosen by the Observer in 1985. Appropriate because, as we have endeavoured to demonstrate, SMILE adds up to both a way of working in the classroom and a unique collection of pupil materials. The way of working is to make the children responsible for their own learning. Having persuaded them to take this responsibility the teacher then has the complex and demanding task of providing them with the learning materials which will encourage their continued interest and effort. This would be an impossible task without the SMILE resource bank with its tasks that have been created for just this situation. A situation described with some insight by Hugo Davenport in the Observer article, comparing the experience of ‘really SMILING’ with his own confrontations with school mathematics.

It was just like old times. With sinking heart, I set off for school, my compasses in my briefcase. The ruler - a two-foot monster - seemed too long, so I left it out. Somehow my protractor had gone missing. Yet I probably wouldn’t have needed any of them. I was going for a maths lesson, but one which had about as much resemblance to the traditional sort as a visit to an amusement arcade has to a prolonged spell in the dentist’s chair.

Last week a report by school inspectors for mathematics recommended that long division, the bane of generations of schoolchildren, should be phased out in favour of calculators and microcomputers. The report which could also spell extinction for such old-fashioned instruments of numerical torture as logarithms, received the backing of Education Secretary, Sir Keith Joseph.

At North Westminster community secondary school, London, the brave new world of mathematics teaching envisaged in the report has already taken shape. The 1,750 pupils are learning under a system called SMILE and, if appearances can be believed, they love it. Gone are the serried ranks of anxious faces, transfixed by long lists of incomprehensible formulae. Gone too is the traditional maths master, features implacably set like an Aztec idol.

114 HUGO DAVENPORT takes a calculated look at the new maths: If it all adds you can really SMILE, The Observer, Sunday 28 April, 1985
At North Westminster, the maths classrooms are bright with visually-punning prints, attractive computer-generated designs in black and white, stained glass patterns, three-dimensional models and Chinese puzzle pictures.

A wall-poster announces: ‘Working together isn’t cheating. Using a calculator isn’t cheating. Finding out the answer from the back of the book and trying to work out how they got it, isn’t cheating. Cheating is pretending to understand when you don’t. That’s when you’re cheating yourself.’

The teacher, Mr John Harbottle, darts and hovers between small groups of pupils, responding to raised hands with brief clarifications. The students are all doing different things.

In the corner, two girls play a computer game called Rhino. Another shuffles pieces of plastic money around. A boy is joining up dots on a card making squares of different sizes to learn about ratios. One or two are doing tests from a book. ‘Harold Hare can run 10m before Dumbo-do catches him. . . ’

It looks like playtime, but Mr Harbottle explains it is far from mere amusement. The teaching is individualised, so the children work on different things relative to their ability and what they already know.

‘I’ve been teaching SMILE since I started teaching and I’ve found it much better. The quality and range of material makes it far more interesting, and there are fewer problems with homework because the material suits them individually.’

Half-a-dozen calculators are in evidence, of which Mr Harbottle has provided only two. He keeps meticulous records of each pupil’s performance in the tasks selected for them from the 2,000 cards in the SMILE system.

Mr Dick Gmiterek, head of the school’s maths department, said: ‘The whole system depends on making the children responsible for their own learning. This is part of the multicultural aspect of maths: as maths teachers, we have far wider responsibilities than just teaching them basics.’

According to the maths inspectorate, comparison with the traditional method would be too complex to devise. However, North Westminster says that last year 28 fourth-years and one third-year gained top grades in CSE or ‘O’ levels.

Relations between SMILE and the press were not always so positive as we shall see in the next chapter.
Chapter 12: Assessments, exams and all that jazz

Today the hue and cry raised about assessment and planning can be considered excessive. Because of the influence of the industrial trainers we have an assessment driven National Curriculum. “The National Curriculum imposes quality control and consumer labelling of educational products, like manufactured foodstuffs.”

All the national testing schemes are said to be concerned with assessing the pupil in order to plan ahead appropriately. In other words: assessment for learning. This is, of course, clearly not the case. The testing schemes are there primarily for reasons of accountability as a method of testing and assessing the schools, not the pupils. The custodians of the education system, Ofsted, when visiting a SMILE mathematics department, too often failed to recognise the detailed and flexible assessments of each child that had taken place taking place in the preparation for a SMILE lesson and that continued to be made throughout its course. During a visit to a well-established SMILE department one Ofsted inspector put a line through the report section headed assessment, marking it “not applicable”.

Yet, in SMILE, from the very beginning, assessment was recognised as important. The devising of each child’s individual education programme in mathematics was seen as a sensitive diagnostic process with judgements being made about the quality of the most recently completed programme of work by discussion between teacher and pupil in class, through choices noted in his book by the pupil in class and by the teacher in preparation time outside the classroom.

In this chapter, we take a brief look at the role of formative assessment in the day-to-day life of pupil and teacher. Most of the chapter is devoted to the initiation and development of the SMILE public examinations.

Formative assessment in SMILE

Very elaborate systems have been set up in this country over recent years to attempt to measure at regular, relatively short intervals whether children have learned. What they should be learning is a rather more complex matter, rarely brought into the equation by the administrators who make the rules. The SMILE team faced up to all these issues and knew that accurate formative assessment was essential if students were to keep interested and fulfilled.

An individualised system reveals more clearly than any other that accurate assessment is the key to effective teaching and formative assessment was, indeed, an early preoccupation of the SMILE group. As Dave Anderson wrote in 1977

“In a system such as SMILE one of the biggest problems for a teacher is making sure that each child is at the level most suitable.” Knowing where each individual

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116 Splash 1100, July 1977
stands, both mathematically and more generally, is the first requirement of real progress. Alongside the tasks that were created, books of hints and answers were also written for the classroom so that students could make for themselves a first estimate of their progress on each task. On the completion of a matrix (a batch of ten or so tasks), after checking their results for each task with the answer books, they turned to the test books to find the tests designed to be done on each task. These tests were used by the teacher outside the classroom to make a formative assessment of the position of each student on the network of activities in order to plan the next most suitable steps for their progress.

Dylan Wiliam, another eager early Smiler, looking back in 2005, wrote:

> Reflecting on my career, I can see that my experiences with SMILE gave me a head start on others because of the way that some very important principles were hard-wired into the system. Students couldn’t see what levels others were working on from the cards they were given, and the assessment, via the tests, allowed teachers to make the teaching adaptive to the student learning needs, which is still, in my view, the big idea of formative assessment.

He says that one of the things that intrigues him today as he continues to spread the word about formative assessment is how much of it we were doing in SMILE right from the beginning. A rather different view from the one he expressed in 1999 about the national tests while Professor of Education and Assessment at Kings College, London:

> the poor reliability and questionable validity of the tests simply do not allow us to draw meaningful conclusions about individuals.

**Beginning to organise for formal examinations**

Because Smilers recognised that it lay at the heart of all good teaching, assessment was always a priority item in the development of the materials. There was also concern that the final public examinations should form a suitable summative assessment of the course. As early as 1975 the group was beginning to plan a more formal and public assessment of the summative kind more appropriate to an individualised course. The discussions of suitable forms of assessment for the examination year were reported in *Splash* by Dave Evans.

> One of the subgroups that met and has continued to meet since the last SMILE weekend at Beatrice Webb House, is considering suitable forms of assessment during the fifth year. This task has proved to be no less arduous than we originally expected. This is probably for two reasons. Firstly, the content of a child’s SMILE course in the third, fourth and fifth years is by no means defined. Secondly, although we do not see ourselves as a revolutionary clique, many of the general principles which were unanimously agreed upon early in the discussion may appear to be outside the confines of the traditional exam set-up.
Chapter 12: Assessments, exams and all that jazz

The members of the group, and many other teachers consulted over the weekend, felt that there should be no formal written examination. Also, it should be possible to pursue the use of work cards and modules to arrive at the necessary level. This would necessitate a general “tightening-up” of the way in which the present tests are used and a more vigorous way of associating levels with the degree of complexity of a card. A weighted mean of the levels achieved over five terms of work (autumn year 10 – Easter year 11) would then be one possible method of giving a grade. Alternatives to this would include a proportion of project work or “open-ended” investigations or both. The choice of format should rest with the individual pupils at the discretion of their teachers. The method by which any of these or any other alternatives could be combined to give a final mark that does not discriminate against any combination is still under discussion. There remains an unresolved controversy as to whether or not the quantity of work covered over the five terms should be taken into consideration.

Since an examination of this format is not used by the Metropolitan Exam Board we were encouraged by knowledge that one of the alternatives offered to the Kent Maths Project by their regional exam board was that of 100% course assessment. Further to this KMP also have plans to extend their present arrangements to include “O” level as well as CSE by 1977. The SMILE group has not considered “O” level but was encouraged by the possibility of an extension along these guidelines.

Obviously, any suggestions arising from these meetings will have to be discussed in detail at a more representative level before a final draft emerges for consideration by the examination board. Hence, we are anxious to write discussion and constructive criticism along these or any alternative guidelines. Such comments should be passed to the Editor - we look forward to hearing from you all.

In 1976, Mr Jones, Head of Chelsea School, arranged a conference to investigate the possibility of setting up a CSE Mode 3 SMILE examination. Seventeen teachers (representing 9 schools) met at Hallam House in Clapham. Also present, to inform their discussions, were three examinations experts: Dr Charles Plumpton, John Sylvester and Nigel Warwick, together with four members of the ILEA’s mathematics advisory team. Sheila Madgwick, then head of mathematics at Pimlico School, described the event:117

Despite the miserable weather outside a warm welcome from Mr Jones on arrival – together with the offer of a large sherry - soon had everyone in good spirits. After an excellent meal John Sylvester of the LREB118 spoke to us about the mechanics of setting up the examination and - while some of us had initially hoped that the exam might be based entirely on course-work – he advised that if we were to have

117 Splash 0111, March 1976
118 London Region Examination Board
any hopes of negotiating successfully with the MREB that we should ask for 60% coursework and 40% examination. He was only too willing to offer advice and help at every stage in our future dealings with the MREB.

For the remainder of the evening we split into groups to work on the syllabus, the form the assessment of course-work should take and also the actual examination paper. A little light alcoholic refreshment served well to keep us going for a surprisingly long time into the night…

The next day the working groups went back into action spurred on by the positive proposals of John Sylvester the night before.

A large, appetising lunch which tempted us to overindulge was perhaps not the best way to prepare for a talk from Dr Plumpton of the University of London Examinations Board and Nigel Warwick who had been with the board but is now with the Schools Council and is particularly concerned with the ‘Common Examination at 16+’.

Dr Plumpton gave severe warnings of the inherent changes of Mode 3 assessment but - having perhaps dampened our spirits to a certain extent – then proved to be more helpful than many of us had expected about the chances of having a Mode 3 O level. He is at present negotiating with the Kent Mathematics Project and so is well aware of what is involved. He intimated that it might be possible to have an examination on 40% course-work, 60% exam. One comment of his that remained in all our minds was that ‘the trouble with teachers is that they always set questions which are too damned difficult!’ We tried to heed this as we embarked on setting our own questions.

At a final meeting of all the groups there was a triumphant feeling that a tremendous amount of work had been achieved:
- the group working on the syllabus were well on the way to producing one!
- the assessment group having had rather complicated ideas eventually came down to a fairly simple system based on the average attainment by each candidate on their final matrix;
- the group working on the exam had succeeded in writing a fair number of questions which at least passed with approval from those involved.

It was decided that we would try to negotiate for Chelsea, Christopher Wren and St. Augustine’s to sit the first CSE exam in Summer 1977 so that obviously there was still a lot of work to do very quickly. … At present the CSE syllabus and examination paper have now been submitted and plans are in hand to finalise work on the O level exam.
The difficulties were not all sorted out during that weekend. I remember clearly a visit paid by Sheila Madgwick and myself to Charles Plumpton to put the case for having investigations included in the examination papers. Dr Plumpton was not amused: how could such questions be marked? I pointed out that our colleagues in the arts and humanities seemed to have been coping with this difficulty satisfactorily for years so I saw no reason why mathematicians should be any less successful if they put their minds to the problem.

How shall we measure fairly?

The debates continued about how to ensure fair accreditation that did not distort the learning taking place in classrooms. Here is the summing up of one set of discussions:

As a final test for the course the following types of assessment seem appropriate to the group:

1. 60% course work assessment (grades based on attainment levels of tests done by the candidate in the last one or two years) with a further 20% each obtained from any two of the following: (a) a project, (b) investigations, (c) a presentation.

2. 80% course work assessment with the other 20% obtained from any one of (a), (b) or (c) above.

3. 100% course work assessment.

Course work: the network of tasks is arranged in levels 1-9. The examination grade would be awarded on the mean attainment level reached by a candidate in the final one or two years. Some breadth of coverage of mathematical topics in these years must be demanded.

Project: An extended piece of work done by an individual or group in which candidates are expected to choose their own follow up work after initial stimulus material has been presented to them.

Investigations: an investigation into mathematical aspects of a problem of an open-ended type, five of these being required for 20% of the final examination grade.

Presentation: A half or whole day’s supervised work by a candidate on a topic of his own or his teacher’s choice, presenting all he has discovered on that topic.

Within three years, in 1979, CSE entries across a large number of schools were becoming significant in number as shown below:
David Bain remembers

The Smiler most deeply involved in the evolution of the SMILE 16+ examination system was David Bain who tells the story of how it developed. The rest of the chapter is based on his writing and reflections. He was given, of course, as always happened in any SMILE activity, a little help from his colleagues from time to time, so should not be blamed for any excesses of expression in what follows.

The first examinations

The first SMILE examination was a Mode 3 CSE in 1976 with the Metropolitan Regional Examinations Board (later the London Regional Examining Board). Mode 3 examinations were those set by individual schools or groups of schools and moderated by the examination boards. The moderator was responsible for agreeing examination papers and moderating any coursework, whilst members of the Board’s mathematics panel were responsible for agreeing the cut off points for various grades with the moderators to ensure consistency between the various different examinations and the main Mode 1 Board set papers.

Until 1981, the examination consisted of one paper, which counted for fifty per cent of the final marks. The other marks were obtained from coursework (of which, much more later!) The examination paper had three sections. The first contained short compulsory questions, counting 30 marks and testing students’ breadth of knowledge. The second section was made up of six longer questions, counting 15 marks each, and testing students’ understanding of mathematical topics in greater detail. Students could answer all six questions, but only their best four answers counted. The third section, worth 10 marks, gave students the choice of two investigations. Again they could attempt both, if they wished, but only one counted. Students had two and a half hours for the paper, with an additional half hour if needed. It seems strange now, when you hear sixth form teachers complaining that students cannot sit three one-hour papers at the same time because of the pressure. Thirty years ago, it was not unusual for children of relatively limited ability to ask for the extra half hour and sit a three-hour examination in order to achieve their best.
But this was what Mode 3 examinations were about. Although, prior to the Cockcroft Report, teachers who set these examinations were keen that students sat examinations which enabled them to show what they could do, rather than what they couldn’t. Longer questions often gave some examples at the start. They were, thus, not a test of memory, but of understanding often requiring students to explain the mathematics in words.

**Why a SMILE examination?**

Why did we feel it necessary to have a *SMILE* examination? It certainly wasn’t that the examination was easier. Whilst some schools were able to improve their results significantly, others did not. Clearly it was important for the credibility of *SMILE* as a Project to have an attached examination, rather as current examination board courses have board recommended text books. More importantly, it meant we had an examination which mirrored the style of work that students experienced in lessons. It meant we did not have to teach for the examination. Rather, the examination was just something you sat at the end of the course. Individual students may not have covered all the course. This didn’t matter, as there was enough in each paper for all students to show what they could do. This was in stark contrast to much one saw in other schools, where teachers taught to the examination syllabus resulting in many in some classes struggling to understand and consequently sitting bored in examinations.

A second reason for having a *SMILE* examination was to encourage teacher involvement in setting and moderating the examination. Again, this was not the easy way out. It is much easier to leave the process to someone else. But *SMILE* teachers, particularly in the early days, were not like this. Many teachers involved themselves in helping to write examination papers. This often involved travelling to the *SMILE* Centre after a day’s work to join a heated debate about the appropriateness of individual questions. If you submitted a question, you could expect to see it torn apart, but usually improved, before it was considered suitable for an examination. In order to ensure fairness, this all went on at least two years before any question appeared in an examination. Indeed, it was often a shock to see a question you had first suggested appear two or three years later.

**What was being examined?**

As the examination system became more complex and GCE O-level and GCSE examinations appeared, it became necessary to have examination writing weekends. Many a weekend was spent writing questions. There was always a mixture of new and experienced teachers. It was a wonderful way to feel fully involved with the *SMILE* community.

In 1982, the CSE examination paper was split into two. It was felt that two and a half to three hours was too long for some students and didn’t give them the opportunity
to attempt the investigative questions to the depth required to obtain high marks. The first two sections were kept in the first paper, now reduced to two hours but still with an additional half hour if requested. Paper 2 contained the two investigative questions and allowed an hour with an additional half hour to attempt either or both questions.

Smilers believed that open-ended questions, asking candidates to investigate, should have their place in the examination. Investigations constituted an important part of everyday classroom activity and therefore pupils’ investigative powers should be examined at the end of the course. But [as we saw above] this was an idea that Sheila Madgwick and Ray Gibbons found was not easily accepted when they put it to Dr Charles Plumpton, chief examiner for the University of London Examination Board. He protested that such questions would be quite impossible to mark until it was pointed out that examiners of other areas of the curriculum had been coping apparently successfully with this problem since national end-of-course examinations had begun. It is possible that because elementary mathematics contains so much that is easily testable – Gradgrindian facts you might say – that the subject has traditionally been so badly taught and so unpopular.

Questions were often of the number pattern variety, but often involved a considerable amount of diagrammatic work.

From the start, there was a fierce debate about the appropriateness of investigative work being part of the examination. The arguments against were clear. Investigative work through its very nature should be open-ended; not all investigations appeal to all students equally; and it is easy for students to spend time on ideas that don’t work. However, in these early days of the examination, there were two counter arguments that won the day. First, if investigative work wasn’t part of the examination, some teachers would be disinclined to spend sufficient time on it in lessons. Second, and more importantly, if we felt this way of working was important, then it was essential that students who flourished with it were given the opportunity to do so in an examination. The rubric for the paper gives an indication of the sort of response expected. If appropriate the task would be followed by suitable paper on which to carry out the investigation, for example, centimetre square dotty paper.

Figure 34: Rubric from CSE Paper 2, 1983
Ten years later, with the introduction of the GCSE examination, the necessity to examine investigative work was felt less important and was more sensibly assessed through coursework.

From the start, there was a clear belief that longer questions should test understanding of both pure and applied mathematics. The question above on matrix transformations is an example of a question on pure mathematics, on a topic which is no longer taught to students in Years 7-11. Applied questions tended to relate to statistics. With such questions, real figures were used, not simplified and trivial examples. In 1987, a CSE question asked students to calculate a person’s calorific intake and to compare the average intake of people in different countries. Students interpreted real figures, relating the average calorific intake to the proportion of the population involved in farming. The last part of the question required students to use their knowledge of different cultures to explain results of countries which ‘buck the trend’.

**Outrageous bias**

The use of real figures and contexts for statistical questions sometimes led to some controversy. Certainly *SMILE* teachers would not have agreed that the ugly facets of human activity, such as war, should be banned from their classrooms. Most would have agreed with Howard Gardner that education is about introducing people to truth, beauty and goodness. Truth and beauty they would have considered could come from the study of pure mathematics. But to bring in goodness mathematics has to be applied. Gardner’s favoured topic for the study of goodness is the Holocaust, so war would certainly not be excluded from the curriculum by him. However, this is not a popular belief. When similar moral considerations were introduced into a question in a *SMILE* examination paper, an uproar was caused in the press.

On 10 June 1986 the *Guardian*’s headline was measured:

**Row as maths CSE examines arms spending**

But the *Daily Telegraph* blazed

**Outrageous Bias**

and the local *South East London Mercury* headlined:

**THE WAR GAME: Fury over kids’ exam on arms spending**

Over a pictogram showing military spending by USA, USSR, UK and West Germany (from the offending paper) Martha Wearing wrote:

*MPs are furious over a maths exam which they claim is aimed at politically indoctrinating schoolchildren. The CSE exam, sat by 15-year-olds all over SE London, is based on military spending and the arms race between the super powers. She quotes John Maples, MP for Lewisham West, as slamming the exam as a*
'blatant attempt at political indoctrination'. The exam has also, she states, come under fire from Peter Bottomley, MP for Eltham, who, she notes, sent a copy of the paper to Kenneth Baker, Secretary of Education, telling him:

This is quite clearly a piece of political propaganda. It is horrifying to think that mathematics is being taught to schoolchildren on this basis. … No one expects every question to be totally value free. But what people object to is to have a series of questions which are either politically biased or give the impression of indoctrinating children. If teachers expect this sort of questioning it means that during the year before the exam children will be exposed to biased teaching. I am sure the vast majority of teachers and parents expect politics to be kept out of exams.

All quoted the offending question (carrying, as they were at pains to point out, 15 per cent of the marks for that particular exam paper):

The money required to provide adequate food, water, education, health and housing for everyone in the world has been estimated at 17 billion US dollars a year – New Internationalist 1980
How many weeks of NATO plus Warsaw Pact military spending would be enough to pay for this?”
(Show ALL your working)

Questions were asked all round and Mary Argent, the moderator for that paper for the London Regional Examination Board, when asked to comment said,

I looked at the mathematical content and I personally feel there was nothing wrong with the questions. They are very good mathematically and set in real life context. I don’t think it was political propaganda although I know this is what some people are saying.

No doubt all readers will be relieved to hear the quote from the Head of Catford County that ends the article:

We certainly would not use missiles in regular maths lessons.

This might conjure up rather alarming visions of what might happen in irregular maths lessons. However, although one could justifiably argue that a mathematics examination paper is not the place to ask questions where the political content almost over-rides the mathematical, SMILE teachers certainly believed that in the classroom mathematics should be applied to problems of the world in which the students live. This included political arguments where so often arguments are based on statistical data. Nor did SMILE teachers agree with Baroness Cox that the exam question under scrutiny was:
dishonest, disingenuous and utterly unacceptable … it puts over to children a complex message in a way that reduces it to simple mathematics.

Rather, they considered such a question could help students to use their mathematical understanding to help them interpret such arguments and to assess their validity.

**Using calculators**

Throughout the examinations, students were encouraged to use calculators, where appropriate. Questions were set that required efficient use of a calculator.

**Where did the marks come from?**

As indicated earlier, only half the overall marks at CSE were obtained from the examination papers. The other marks came from coursework. However, unlike most others examinations at that time and since, the coursework mark was not obtained from special pieces of work done specifically for the examination. In contrast to other examinations, it was based on the ordinary work done in class. As every piece of work in SMILE had a level, similar to current National Curriculum levels, it was easy for these to be converted into marks which equated to CSE grades. Long before national debates about criterion referenced assessment, SMILE had such assessment for the coursework mark. At CSE, this mark was calculated from the last 80 pieces of successfully completed work from a student. There were stipulations about the breadth of work covered and the 80 pieces had to contain a proportion of open ended investigative activities.

Basing the coursework mark on this large body of work gave an accurate assessment of a student’s level and thus a fairer grade than that obtained from a written paper alone. There were issues. It clearly favoured the hard-working student and penalised the able but dilatory student. It clearly enabled motivated students to truly show what they could do, but others received lower grades than they would otherwise because they completed insufficient work. This was taken into account later at GCSE, where the mark was based on 50 pieces of work. A similar form of coursework was used at GCE O-level and at GCSE, although the proportion which it counted towards the final mark varied. For the higher tier examination at GCSE and at O-level, coursework counted for 20% of the final mark.

Coursework moderation for the SMILE examinations was extremely rigorous. Unlike the system generally used of postal moderation, SMILE moderation was done with the teachers present. Once coursework marks had been submitted, SMILE moderators met with teachers from the school with the coursework of all students. The moderators randomly chose to see the work of particular students. Whilst this system was onerous, both for the schools and the moderators, it provided a useful training exercise for schools, who valued the feedback they received on work. It clearly improved practice in schools in using the SMILE system. However,
it was expensive in terms of time. It depended on the goodwill of teachers travelling
to regional centres to have work moderated. It also required moderators to be released from their full-time work to meet with the teachers.

When GCSE was introduced, *SMILE* fell in line with other examinations and moved to postal moderation.

**The first *SMILE* GCE O-level**

The first *SMILE* GCE O-level examination was sat in 1981. Negotiation with
examination boards had started three years earlier and eventually *SMILE* chose to work with The Associated Examination Board based in Guildford. Their main O-level scheme had three papers – a multiple choice paper, a short question paper and a long question paper. For the Mode 3 examination, *SMILE* candidates sat the Board’s own first two papers, with a *SMILE* Paper 3. This paper, like the CSE, was written by a working group of *SMILE* teachers. The paper had to be submitted two years in advance of when it was sat.

The *SMILE* paper was two hours long. There were two sections: the first contained five conventional longer questions and the second two investigative questions. Students chose three from the first section, two from the second. Similar principles were used in writing questions, as at CSE, although Section A questions were more searching and Section B questions required answers of considerable depth.

Applied questions used realistic situations. For example, a question on gradients related to the topical building of ramps to provide disabled access to buildings. Students were encouraged to use iterative processes to solve equations, thus combining the ability to draw graphs of functions and use calculators effectively. Some questions were quite original. For example, describing the areas of figures in relation to fractions of the areas of a given circle and square.

As at CSE, the emphasis was on students understanding their mathematics. Consequently, questions were sometimes quite wordy. Questions also tended to mix a number of discrete areas of mathematics together. Thus, questions were less predictable than they have become in recent years at GCSE. They tested understanding rather than recall. It was less possible for teachers to train students for the examinations and thus the papers were a more reliable test of students’ ability. Sadly, the trend in examinations at all levels in recent years is towards the predictable, thus leading teachers to teach to the test, rather than teaching the subject to depth.

The quality of work produced by students was often exceptional. For example, an investigation of a Snakes and Ladders Board produced some remarkable responses.

**The arrival of GCSE**

In 1988, both CSE and O-level examinations were replaced by GCSE. *SMILE* negotiated with both SEG (Southern Examining Group) and the London Regional Examination Board which was later to become EDEXCEL. After much discussion,
SMILE agreed to work with SEG and from 1988 to 1993 had a successful GCSE examination, which built upon the good practice of previous examinations. The examination’s popularity grew year on year. For example:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of candidates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>11362</td>
</tr>
<tr>
<td>1992</td>
<td>16412</td>
</tr>
<tr>
<td>1993</td>
<td>17058</td>
</tr>
</tbody>
</table>

As with other mathematics examinations, papers were at three levels, with only three or four grades available at each tier. At Foundation Level, students sat one two-hour paper aimed at grades E, F and G. Intermediate level students again sat one two-hour paper, similar to that at CSE but aimed at grades C, D, E and F. With both these papers, the Cockcroft principle of high cut off marks, allowing students to show what they know, were followed. Students aiming at the highest grades, A–D, sat two papers: a 1 ½ hour paper of short questions and a two hour longer question paper. Coursework continued to play a large part in the examination at the intermediate and foundation levels, but less so at the higher level.

Particularly at the two lower levels, papers were long and attractively designed to stimulate students’ interest. As with previous examinations at all levels, questions were often original, joined different areas of mathematics together and tested understanding.

**The end of SMILE examinations**

When GCSE examinations were introduced in 1988, each examination board was only allowed a small number of syllabuses. In 1994, this number was reduced further with boards restricted to one or two different syllabuses. As a consequence, smaller examinations such as SMILE were discontinued. The SMILE Centre negotiated to have continued involvement and came to an agreement with the London Board. However, whilst initially examiners were appointed with a SMILE background to write papers, much was lost. Coursework followed the pattern of more traditional syllabuses. Writing SMILE papers was no longer part of good in-service training.

For nearly 20 years, SMILE examinations provided exemplars of good examination practice. The production of papers and moderation of coursework was onerous, but teachers gave willingly of their time to provide assessment for their students which was valid and reliable. The demise of the examinations was one nail in the coffin of teacher involvement in the project. Along with the annual conferences, it was one aspect of the project which regularly kept teachers in SMILE schools throughout the country in touch with each other. A large number of SMILE teachers acted as examiners and moderators. It is perhaps no coincidence that many of these teachers have gone on to become advisors, inspectors, heads of department, head-teachers and teacher trainers.
Interlude: A Pupils’ Conference

SMILE continued to diversify into other activities. One such innovation was opening up the SMILE Centre to pupils through day conferences, the second of which is described below.119

Last term saw the second SMILE pupils’ conference. There were 50 children present and they came with their teachers from two schools: St Augustine’s CE and JFS. The SMILE Centre was a new place for the children. The atmosphere was different from that at school, the ‘teachers’ were different and the other children were different. But none of that seemed to matter.

I enjoyed it at the mathematics centre, and I enjoyed doing the SMILE cards as well. And the smile card I like doing was this game you would have to play the games with cubes and there was this other school, name JFS and JFS stands for Jewish Free School. They were friendly and the teacher from JFS was helpful and through all the morning each of us help each other a bit …

Jackie Newby

The morning was for investigations. The children had been told that they should bring a calculator if possible and about half of them did. (Most children have access to a calculator these days, even if they don’t own one). The write-up below describes the work done by one child in response to the simple question: Find $\sqrt{50}$ as accurately as you can.

WHAT IS THE SQUARE ROOT OF 50?

The problem we had to solve was the $\sqrt{50}$ which means what goes on the side of the square (the number) to X by itself.

We know the $\sqrt{49}$ is 7 by 7 so $\sqrt{50}$ must be 7 and a bit but not quite 8.

Remember in metric 1/2 = .5 and you cannot have two in a number so to get half of 7.567 you write 7.5675.

I tried a number 7.01 = 49.1401 to small so 7.02 = 49.2804 still too small and you go on until you reach 50.000 etc.

This is how I did it…

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119 Splash 10010, September 1978. The sheet of problems and investigations which these children were given is printed in full in SPLASH 10001.
Clearly the ‘final’ result is not the most significant feature of this work; the child has learned a lot about place value and the meaning of decimals in a way far superior to any learning which might have been programmed. There was plenty of discussion during the work (with other children and with adults) about the meaning of the numbers. For instance, somewhere along the line he has obviously picked up that the number half-way between 7.567 and 7.568 is 7.5675. This is traditionally a very difficult point to get across to children.

For the children without calculators there was a choice of two SMILE investigations: Polyiamonds (0436) and Cube Moving (0408).
Figure 35: Polyiamonds, 0436

You will need: triangles, isometric paper and scissors.

Polyiamonds

There is 1 diamond.

There are 5 tetramonds.

Pentiamonds are made from 5 equilateral triangles. How many are there?
What about hexiamonds (6 equilateral triangles)?

Some polyiamonds will tessellate.
Investigate.

Some polyiamonds are the nets of solids.
Investigate.

Figure 36: Cube moving, 0408

You will need cubes.

Cube Moving

Slide one cube at a time so that cubes never leave the board.
How many moves will it take to move the cube with an X to the opposite corner?

Which is the best route?
Investigate for other sizes and shapes of board.
These were described via the overhead projector to the whole group. As it turned out everyone went for the Cube Moving - possibly because its description was more challenging.

… Then they showed us a Square game … In the corner of the Square at the top you wasn’t to put a counter there, and in the bottom in the left hand corner you was to put a different colour counter from all the others. Then you was to see if you could get the odd counter into the corner which was missing a counter. And to see how many moves it would take to get there … we found that we move 13 at the lowest on a 3X3 board. After that we tried a 4X4 board and the best mark was 2l. Then I tried a 5X5 board and the best route was 29 …

Lorne Davis, St Augustine’s

Most children did, in fact, find the rule for square boards.

… Apart from the fact that I fully enjoyed myself I found out some interesting. I found out to maths there’s always a rule. Take for instance the cube game. There was a certain pattern it was that you had to add 8 each time to your previous number …

Gbenga Abinveyo St Augustine’s

In the afternoon the children were free to involve themselves in one of the mathematical games which were displayed or to continue with the morning’s work. There had been a mammoth game of football - JFS v St Augustine’s - spontaneously organised at lunch time and so most of the children were happy to settle for something less taxing. Nevertheless a few did continue the morning’s work. Some chose different calculator problems to work on and others went on to look at Cube Moving on rectangular grids.

One group of girls who had been working on the Cube Moving investigation were happy to have some tuition in art from Charles Snape, the SMILE designer, in order to present their results:

… first of all we done our work on a piece of scrap paper and then on a bigger piece of paper with squares on and then someone came into the lounge to see how we were getting on he said we were getting on well so he said I’ll give you a big piece of cardboard and you can do it out better than that so we did and the teacher gave us some black Letters to title our graph we called ours can you find the rule?

Jennifer Syratt, St Augustine’s

For most children the day will certainly be one to be remembered and that, I think, is important even if the memories are not all mathematical ones.

… and Phillip had a speech to say to Nigel (Langdon) and after the speech Phillip said three cheers for Nigel hip hip hooray and we all said we hope to come here again soon and then we said good bye.”

Jackie Newby, St Augustine’s.
Chapter 13: External scrutiny: North Westminster SMILEs

In 1987 the Inner London Education Authority’s inspectors for mathematics, of which I was one, undertook a study to define more clearly the signifiers of a ‘good’ secondary mathematics department. The mathematics department at North Westminster Community School was one of the departments chosen for this study because it had for long been considered a model SMILE department. This chapter gives an account of that inspection and our resulting judgements.

A pupil focused inspection

Because we were concentrating on the assessment of learning rather than teaching, the plan was to focus attention on something which Ofsted thought in 2005 was its own new idea: pupil perspectives. Pupils were to be assessed by:

- interviewing them singly or in small groups
- studying their written work and discussing it with them
- looking at their long-term records
- observing each of them in a mathematics lesson
- obtaining mathematical profiles of them from their teachers.

Some measure of long-term shift and growth of the understanding of processes rather than present mathematical state was looked for. It was recognised that such shifts would have to be judged largely by the present mathematical state of individual pupils but it was felt that the present states of comparable individuals, or groups, in different years could nevertheless be indicators of shift. We recognised that we would need to spend a large proportion of our time talking with pupils, both individually and in groups, and with their teachers.

Because observation notes had already been written for the guidance of visitors to SMILE classrooms120 (and see Chapter 10), it was decided to take some of the questions listed there as starting points, refining and improving them in the light of comments from ILEA inspectors, advisory teachers and classroom teachers.

The school was involved from the beginning in the planning and preparation; the teachers selected the pupils who were to be interviewed and collected all necessary documentation. A little extra documentation on the selected pupils needed to be written for the exercise. A few weeks before the inspectors’ visit two advisory teachers, who had also been involved in the planning discussions, visited the school to try out on a group of pupils some of the questions that had been written for the pupil interviews and alterations were made in the light of that trial.

The aim of the exercise was to obtain a:

1. more precise definition of a ‘good’ mathematics department.
2. clearer understanding of how children learn mathematics in the long term.
3. clearer recognition of the type of mathematical profile which is useful to build up and pass on from teacher to teacher in order to develop a more coherent and continuous framework for children’s learning.
4. better understanding of what a department needs to enable it to set up the conditions most conducive to children’s learning.
5. better framework for the inspectorate’s future observation in schools, improving the observational techniques used in all school visits, including full inspections.

The importance of evaluating the exercise was recognised and it was agreed that any department involved must take a major part in this.

*Before the visit teachers were given a list of questions (which they had helped to devise) about general procedures in the department and about the characteristics and aptitudes of the pupils put forward for interview.*

**Findings: teachers’ knowledge of their pupils**

The mutual respect between teachers and pupils was evident in all that the inspectors saw, heard and read. The comments made by teachers about the pupils put forward for interview showed a detailed consideration of their potential, their organisational powers and their interests. Time and again the teachers saw a direct relationship between the confidence of a pupil and the standard and quantity of work produced. The development of organisational abilities was also recognised as crucial in the pupils’ mathematical development. Some particularly perceptive observations of teachers illustrating these points follow:

*The amount of work achieved by A has varied according to his confidence in his own ability to understand his work. This has seemed to me to be the driving factor for his first year, at least. Now that his approach and attitude are very positive, A is producing more - often choosing to do extra on things he thinks he doesn’t fully understand.*

*B has done 50 tasks so far. He has taken a great deal of time to reach a stable work rate. His concentration varies; very good at times, at other times appalling. Through the year there has been a steady, slow improvement, although a lot of the struggle has been with his organisation/work habits.*

*C’s attainment is improving with greater self-organisation. She works hard at understanding.*
I deliberately lowered the level of work set for D to stress the importance of producing a higher standard within any given context. This approach produced some excellent ideas while at the same time giving D the opportunity to learn first-hand the need for a greater responsibility toward his own education - how easy it is to lose momentum, to get distracted etc.

E has encountered the same problems as D. Unlike him however she has made better use of the opportunities - developing study skills. Because she now has a good deal of self-confidence in her organisational skills she has not got bogged down with self-created maths problems. When stuck she turns to different work, returning to her problem when the time seems right (to her, of course). As a consequence, she has maintained a better work-rate without developing the traditional hoop-jumping (and teacher centred) approach so typical of pupils of her ability.

The inspectors found the detailed knowledge shown by the teachers of the pupils interviewed impressive. It seemed to be one important cause of the teachers’ ability to match the work to pupils’ needs, abilities and interests. It was obvious that this knowledge was in no small part due to the considerable time put into the keeping of individual records. But no recording scheme on its own will bring about the level of understanding of their pupils shown by all teachers who were involved in this study. To the well-organised recording scheme must be added commitment, which all the teachers had in abundance. They were also self-critical, aware of the pupils who were not progressing as they had hoped, dissatisfied with their own part in this lack of progress and searching for ways to adapt their methods and materials to overcome it.

**The printed materials and how they affect learning**

After the teacher, the second most powerful resource in a classroom is the printed material available for pupils’ use. Teachers were therefore asked whether the material they used encouraged the following modes of learning: talking, listening, questioning, reading, drawing, writing and using technology. They were also asked whether their pupils had experienced group work, discussion with peers and with teacher and sustained effort on an extended piece of work. Teachers’ ability to encourage these modes of learning is inevitably closely related to the flexibility of the printed materials used.

All the ways of learning mentioned can be (and have been for the pupils interviewed) encouraged as part of the standard *SMILE* programme. The teachers also maintained that it is easy both to encourage and to credit pupil-initiated work in this framework; certainly much is done in discussion between teacher and pupils to encourage pupils to extend tasks set by following up their own ideas. The pupils are expected to comment on/criticise the tasks set and to assess their own work by making comments on their responses to a set task and occasionally on their understanding. Moreover,
the teachers considered that the nature of much SMILE material is intended to encourage cross-curricular work. One or two class lessons have attempted to bridge gaps, for example: language puzzles, statistics and geography. The material seems to encourage mathematical fluency. Written work is in general intelligible forming a good record for a pupil’s future use. In fact, the teachers themselves are surprised at how much use pupils make of their earlier work for reference purposes.

**Organising learning**

The department was dynamic, continuously developing policy and techniques. Because it had been using SMILE for many years, it had had time to develop a coherent approach to organisational matters. During the ten years or so that the department has been using SMILE it has given careful thought to improving the organisation and administration of the system as well as refining the pupil materials and their use. The result is some useful documentation which gives coherence to the work of all teachers. The departmental record-keeping handbook gives clear guidelines on such matters as: how large a block of work to set; how to check if it is felt that the level has been pitched too low; and the importance of recording all types of work the student may have done, including voluntary individual work, group work or a whole class activity.

It is important to let pupils realise that all such work is recorded and credited. It helps convince them that mathematics learning is not bounded by their own individual pre-set programmes and that, say, whole class activities are as important as the more conventional work. The introduction to the handbook gives as the three most important reasons for keeping very detailed records of each pupil’s progress:

- an individualised curriculum depends on precise information on the mathematical development of each pupil;
- records allow a higher degree of year-to-year continuity;
- records are used in external examination of coursework.

The matrix form is for student use (except only for the first column used by the teacher to set an initial programme of work). The handbook notes:

> … students should be strongly encouraged to use the comments space. Reflecting on the work done, deciding whether one has enjoyed it and why, whether one has learned anything from it, are among the most valuable activities that students undertake. The whole idea of a negotiated curriculum is dependent on engaging in active learning … The flexibility of the curriculum allows us to … respond promptly and positively and practically to students’ comments.

For each pupil interviewed it was hoped to assess the following: articulateness; confidence; awareness of the relevance of the tasks carried out; and ability to evaluate her own work.
There are unresolved questions about the kind of self-assessment pupils should be encouraged to make with respect to mathematical development, how it is related to self-confidence and to the attitude and assessment of the teachers. Certainly, it was agreed that the rank ordering of a class which used to be common was not productive and could, depending on the ranking, cause some pupils to be over-confident and others to lose what confidence they had. It is not so much a comparison with their fellows that is required, by their teachers or by themselves, but a measurement of progress against their own previous achievement. Such self-assessment brings with it a confidence in mathematical understanding and an ability to apply what has been learned. A sense of direction, both short and long term, is also required.

The majority of children interviewed liked mathematics; for many it was classed as one of their favourite subjects and for many first-year pupils it was top of the list. In the following section, both first and fourth years are considered together. In all cases the pupils were confident, relaxed and secure. They could all recall pieces of work attempted in the past, including some of the processes they had gone through and what they had discovered while going through them. They knew what was expected of marking their own work and were confident and reliable about doing it; they were familiar with the organisation of the resources available to them in the classroom and used them responsibly when a task dictated that they should.

There was a recognition of the value of discussing something that was proving difficult and pupils saw the usefulness of having such a discussion with a neighbour before turning to the teacher (partly to save time when the teacher was busy but also because they recognised the value of talking things through with a friend).

**Pupils’ responsibility and their comparisons of primary and secondary school approaches**

All pupils interviewed felt secure in the way in which the content of their work was planned and knew where they could make their own choices about the mathematics they studied. In fact, in the fourth year at North Westminster, negotiation had reached the stage where pupils interviewed felt they were in control of their own learning paths and that, where there was any disagreement between a pupil and the teacher about a work programme, it was the pupil’s opinion that would win the day. (Later the teacher agreed that this was often the case.) Such a stage may have been partly fostered by the spaces left on the individual matrices of tasks for comments from the pupils, together with a response space for the teacher. The former spaces were regularly used, inevitably with much repetition, but there were pleasing flashes of brilliance now and again. The teacher’s response space was used for lists of further tasks or, more infrequently, for some written comment in reply to the pupils’ comments. In one instance in the fourth year, where there were few pupil comments on the matrix form, the teacher had used this space to ask how he was to set new work in the absence of comments. The pupils by the fourth year
recognise and accept it as their responsibility to check and mark their own work and know that the teacher marks each test according to right and wrong answers.

Expectations of pupils were positive and flexible. The development of mathematical confidence was considered to be of the first importance for mathematical progress and, because in all cases the pupils were encouraged to take some responsibility for their own work, organisational skills were also recognised to be a priority for effective learning. It was clear that, where there was a recognition of the importance of developing pupil autonomy, the pupils responded to and valued the trust which was put in them to share in the planning of their own learning programmes. This suggests the importance for all teachers of mathematics to consider more carefully the learning skills they are encouraging and to make the increasing independence of the learner a central objective in any scheme of work.

It was considered important to try to assess how much continuity the pupils recognised in their mathematical education when moving from primary to secondary school. Although, nearly a year on, memories of primary school are perhaps now somewhat blurred, it seemed important to try to probe them. In discussions with pupils from the first year the memory of primary mathematics consisted mainly, and sometimes solely, of pages of sums and the learning of tables with severe public criticism from the teacher if they were not learned. One boy commented that the pupils “were not competing so much here”. He, in a class taken by a supply teacher, certainly took the opportunity to chat about other things than mathematics but whether he would have concentrated better given explicit competition with his peers seems doubtful. (See comments on pupil A – his regular teacher was well aware of his problems of concentration and was taking steps, successfully, to alleviate them.)

Pupils’ views of mathematics and its applications

Pupils were asked whether they thought mathematics occurred outside the mathematics lesson and, where they recognised it as doing so, what mathematics they had come across in lessons with other labels.

Pupils interviewed had some recognition of the use of mathematics made in other subjects. For all mathematics was recognised as cropping up in CDT, humanities (bar charts in particular were mentioned in this connection), business studies, physics and chemistry. One pupil (and there was not an opportunity in the group to follow it up adequately) expressed the opinion that maths occurred in everything.

Their views of what constitutes mathematics varied considerably. The following illustrate some of this variation:

*Maths is always the same; it couldn’t be different ... for example, English is about talking and writing, so you couldn’t do that in maths. Science is about practical work, so you couldn’t do that in maths either.*
A similar view was that:

*Science is about numbers on tubes and Bunsen burners. In maths all lessons are like this - reading and writing.*

Pupils with such a view will no doubt do well in a conventional sense because of the feeling of security bred by the sameness. Whether they will have the confidence to tackle unanticipated problems seems unlikely. There is no feeling for investigational work or for what can be gained by talking a problem through.

An opposite view was that

*all writing is not sufficient for learning and many other subjects, unlike maths, are all writing.*

Another view expressed was that maths was unlike other subjects in that the connections were not always explicit until made clear in discussion with a teacher.

Another comment - “Interesting work in maths is not too easy. Things you’ve done before - they’re boring” - suggests a liking for the challenge of mathematical thinking and a pleasure in the unexpected or unconventional approach.

Several pupils expressed a dislike of games that cropped up in math. This suggested that they had not stopped to analyse what was involved in the way of strategy, or what they had learnt in the playing. This suggests that games, if they are to be really successful learning tools, always need this second stage of considering what has taken place and trying to describe the strategies employed.

Hard work is seen by some to be memorising, and maths is not seen to be hard in this way. Pupils’ views of what mathematics “is” may be critical to their achievement; for example, a first-year girl who was making good progress recognised that mathematics is “about pattern and investigation”. Does a more limited view relate to more limited achievement?

**Plateaux and coherence in mathematical learning**

Both teachers and pupils recognised the possibility of depression setting in when a pupil gets stuck at a particular level of mathematical development beyond which they seem incapable of progressing for some considerable time. This might be a stage at which it is particularly important for a pupil to review the mathematical scene, a time for the teacher to intervene and help the pupil to take an overview of the mathematical concepts, skills and processes already mastered, to ask the question, “What is mathematics?” Attempting to answer this question might not only give the pupil more of a sense of achievement but also begin to develop that recognition of the coherence of mathematics which in the past has only been reached by the few. Gaining an awareness of the coherence of mathematics is a sophisticated process which comes to many very late (or not at all). Pupils were nevertheless asked whether they saw any connections between the different mathematical activities they carried out because recognised links were felt to be of great importance in the long-term learning of the subject.
As a teacher pointed out, a recognition of coherence is difficult to achieve because seeing connections is a highly individual experience and, if such an experience is to be generated by a teacher, the recognition of the critical time to point out connections to any individual needs delicate perception. It came as no surprise therefore that some of the pupils interviewed had recognised little of the connectedness of the subject. However, one high-achieving pupil in the first year did not think the tasks fitted together; in the fourth-year discussion the feeling was expressed that connections needed to be made clear by the teacher.

Mathematics across the curriculum - and in the environment - was found to be largely unrecognised by pupils. This is an area where more work needs to be done in spite of, or perhaps because of, the fact that the organisation of secondary education militates against it. Teachers felt that SMILE contained material that had been designed with the intention of looking at applications outside the mathematics classroom but none of them were satisfied with what they had so far achieved in this field. Nor did the pupils show any detailed understanding of the applicability of the subject. Perhaps something can be learned from good primary schools about the integration of subjects and environmental projects. How can co-operation on this matter best be organised? Can the maths support team help? Perhaps mathematics departments should have higher expectations of their colleagues in other disciplines, assuming that some mathematics is best learned in context and should therefore be the responsibility of those teaching other subjects. How can the time be found to get going the discussions necessary for the acceptance of joint responsibility? Does the North Westminster whole school numeracy policy help with this?

**Home involvement and homework**

At North Westminster the fact that many children travel some distance to attend showed a commitment to the school and its educational processes which was mirrored in the interest taken generally in the pupils’ work by those at home. This interest was fostered very successfully by the requirement that all homework – with a note of the time spent – had to be signed by an adult at home if it was to be credited to the child. The departmental record-keeping handbook states:

> The pupils time themselves and write at the end of their piece of work the number of minutes spent. Their parents initial this. During the next lesson, when the register is being called the pupils call out the number of minutes they have done and this is entered in the teacher’s register. The teacher should spot-check parents’ signatures at convenient times, such as when the books are taken in. Experience quickly shows which pupils are likely to try to fiddle the system.

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121 The introduction of the National Curriculum has if anything increased this problem. No time was allocated for discussion between the groups working on individual subjects. Each subject curriculum was developed in complete isolation from the rest.
The nature and quantity of work done at home was a matter of negotiation between teacher and pupil. “It’s up to you what you do and when you do it - for English and humanities it has to be done on a particular day,” said one first-year pupil.

It was clear that pupils knew they would not be allowed to drop below the minimum required, and, in fact, many did far more than the minimum. One or two pleasing examples of parents playing an active part in their children’s mathematical learning were found recorded in some of the exercise books studied and there was no evidence in the books seen of the common suspicion felt by parents of mathematical work different from that experienced by them in their own school days. Indeed, there were occasional signs of parental pleasure in learning with their children (a recording in one girl’s exercise book of a period of 45 minutes having been spent on one piece of work was further explained by a mother as representing 90 woman/minutes).

The practice of involving those at home in the responsibility of seeing that homework is done is commended and the strategies of making sure that all the work done at home is signed by a parent or guardian and then carefully entered in the pupil’s record was seen to be most effective in getting far more than the minimum time spent by most pupils on work at home, getting the pupils to recognise that what they do outside the class is respected by their teachers and getting parents or guardians to become actively involved in a pupil’s mathematical activities.

The SMILE mini-network, showing all the tasks available from the central bank, gives a visual impression of each pupil’s total mathematical work from the time she enters the school. The recording of each matrix of tasks, with test marks for each task, kept with the mini-network, also includes the mean attainment level for that matrix, a target date, the date it was completed, and any written comments the teacher thinks necessary. The department’s record-keeping handbook states that, on the matrix form:

… the list of tasks and test marks needs to be fleshed out with comments as appropriate. These can include: suggestions about work to set; comments about likes and dislikes; explanations of changes in level; explanations of other matters such as crossed off tasks, extra work, slow work rate and so on. [It should also include] information about: report grades, examination marks, letters home, conversations with parents and so on [plus] comments for hand-over at end of year.

The records are public so comments of a sensitive personal nature should be avoided.

As the foregoing illustrates, many refinements to the central SMILE record system have been developed in the department, during the years in which it has been using and taking possession of the scheme.

The detailed knowledge shown by the teachers of the pupils interviewed was impressive and seemed to be one important cause of the teachers’ ability to match the work to pupil’s needs and abilities. It was obvious that this knowledge was
in no small part due to the considerable time put into the careful keeping of individualised records. It is difficult to devise an assessment and recording scheme which is detailed enough to hold the information needed to create appropriate learning programmes for pupils and yet not too onerous for teachers to keep and to read. The SMILE recording scheme has the advantage of having been worked on and refined by several schools for many years.

The classroom

Each pupil interviewed was observed in a mathematics lesson during which the interviewer made general observations as to the style of the classroom and of the teaching-learning patterns and also had the opportunity to assess, and discuss further if appropriate, the work habits of the interviewees.

Those classrooms, all designated for mathematics, were visually stimulating mathematically and had a much greater abundance of resources available to the pupils than rooms which were used for a variety of subjects by a variety of teachers. The quality of work going on in all the classrooms visited was impressive in many ways. There was in general a sense of purpose amongst the pupils and evident in the work in hand.

In one instance a fourth-year pupil had completed a solution of a problem concerning a choice between different sets of rules governing an inheritance. This pupil’s solution involved graphing over time the different outcomes from each set of rules, interpreting these graphs and explaining the final choice of rule. The resulting work was put on display as an exemplar for anyone else who later tried the same task. Pupils’ work can so valuably be used in this way as teaching material if rooms are designated for mathematics.

Because only one lesson was in general observed for each pupil or group interviewed, it was not always easy to form a true impression of the variety of ways of learning which might be offered to a particular group of children. Certainly, observers did not have the sense that group work was successfully encouraged in any formal way although in most classrooms visited it was taken for granted that pupils would discuss their work with each other. It was recognised however that the first-year introduction to the subject contained a large element of investigating, usually on a whole class basis.

First-year conversations

Three first-year pupils, chosen by the school to represent, as far as possible, the normal spread of achievement in the year, were interviewed during their first few weeks in secondary school in the autumn of 1987. It is interesting to note in their conversation a disquieting stress on rote numerical work still figuring in the memories of primary school mathematics. Transcriptions of some of the conversations follow.
C: I like doing maths but I’m hopeless at it

I: What makes you think you’re hopeless?

C: I don’t know. Well, I can’t do my times tables properly because every time I learn them I forget them.

B: In the last three months in my primary school we did times, times table … It was fun though using computers to do it, to help you … I was really good at times tables in primary school and now it looks like … now I’ve forgotten. But the thing I wondered about was tables, times tables, why tables is called tables … I’ll ask that from Mr X today.

But other topics were remembered just as clearly and their general view of primary mathematics seemed wider and more exciting. The three pupils talked with enthusiasm about the work on symmetry they had just been doing:

A: We had to fit these shapes together to make a symmetrical shape … (pointing to example on page of cut out shapes) ’cept that one’s one that turns round so we got point symmetry cause it’s the same if you turn it round

Both A and B found similarities between the types of mathematics met in primary and that which they were beginning to experience at secondary school.

B: Most of it’s the same really. In my primary school we did all kinds of maths, maths on the computer … things like symmetry, spirals … we used to do SMILE games.

A: I enjoyed the work we did in primary school. I enjoy the work we are doing here too. We used to have this lady, she used to come and visit us, show us different programmes on the computer and taught us how to do these number sequence spiral patterns.

The importance of close links with primary school showed in the pride with which B announced that their current maths teacher had visited his primary school

B: Mr X used to come into our school … 4 weeks I think.

This group of pupils was very articulate and thoughtful. They had analysed what for them were good conditions for learning and the place of the teacher in helping or hindering their learning; they appreciated the teacher sitting down and learning with them and they appreciated the opportunity to work together and learn from each other.

A: With my teacher, he used to come and sit down with us and explain it and when the lady come in she used to teach him some things like games and things he didn’t know and he used to sit down and do them with us … We used to work in groups helping each other … If you’re working on your own on
something and you’re just told to go on and do something it’s a bit hard and
you don’t enjoy it much. When you work with other people …

C: I don’t understand the instructions the maths people give you when they say,
right go and do it ‘cos they used to do just that in our primary school and we
didn’t have the faintest idea what to do.

C did however recognise and accept the human frailty of teachers:

C: The very first teacher we had in the first year, she didn’t … because she was a
new teacher and all she used to do was yell at you if you didn’t understand it
because she was new, so she didn’t understand or anything, so you used to find
it really difficult.

Their views of assessment were perceptive. When asked how their teacher
would choose an appropriate SMILE level for each of them they expressed the
view that “he would decide how well we’re doing” in these topics. They were not
sure whether he would have seen their primary records but thought if he saw the
maths test he’ll get a fair idea ... But they were firmly of the opinion that tests were
not the only, or the best, means of judging mathematical achievement.

A: You’ve got to actually work with them to see what they’re like … I think they
should talk to them, do things with them and then they’ll give you a good
idea - but tests give you a fair idea.

Views as to the nature of mathematics itself were interesting. At first the word
only represented number but soon someone volunteered:

No, not just numbers … things like symmetry, spirals, different kinds of patterns
and all that … shapes. With maths you can do lots of things; it’s not just numbers
...

Other ideas quickly followed showing an acceptance of the widely-held belief
that without a knowledge of mathematics you cannot survive in our society.

C: History dates - what year, what month, what minute, what second … money,
shops, working in a bank, or a vet so that you can give the right amounts.

B: Everybody in the world needs maths or they might get conned.

One comment showed the differences between the vocabularies of teacher and
the pupils can cause difficulties. The word ‘graphs’ was not understood by any of

122 There is a reference in A’s comments to a consultant from the ILEA mathematics
‘group consultants’ scheme in which an experienced primary teacher with a
particular flair for mathematics was employed by the ILEA to spend a day a week in
each of four schools, spending the fifth day training with the rest of the authority’s
central mathematics team.
the three, and until ‘charts’ was substituted questioningly by one of them it was not possible to get any information about the graphical work they might have done at primary school. Then all the lists of surveys came tumbling out. There was no mention of any other types of graphical work but the enthusiastic listing of the work actually done showed how important it is to build on the foundations that are so obviously already there and not to give ‘more of the same’. It is important too to see that the stress is in attempting to interpret the data obtained and then perhaps to go on further from that interpretation. It was the conclusions which were remembered:

*B: Cornflakes. I think cornflakes came top. I wonder why so many people like cornflakes?*

The teacher felt that it was too early in his contact with these pupils to give individual assessments of them, although, in discussion and in the lesson observed, it was obvious that he was already gaining a great deal of knowledge of their interests and needs.

**The backgrounds of these pupils: primary records**

It had been difficult, as is probably the case in most secondary schools, for the mathematics teacher to get hold of the individual primary records during the first couple of weeks of the new school year. These records still need a better design so that the detailed subject reports can be circulated to the teachers concerned at the beginning of their contact with their pupils. An enticing start to their mathematics programme is vital on entry to secondary school and this is difficult to construct without some knowledge of previous experience and reaction to it. At the time of the pupil focus the organisation of the records had just been completed so that they were available for teachers’ use.

*A’s record:*

*The detailed mathematics section of the record was not filled in due to industrial action but a few photocopies of work were sent on and the general comment (which had been completed) in the primary record form was: good level of competence in all areas of the curriculum; particular aptitudes in mathematics, music, swimming.*

And even this scrap of information is useful to have.

*B’s record:*

*Although no stages (a, b, c) of the primary guidelines were recorded, the following comments were made: Sets - understands thoroughly. Numbers: - whole numbers to millions; shows quite a good knowledge of addition, subtraction, multiplication, division, long multiplication. Shows good knowledge of number and the four rules. Decimals, basic fractions. Geometry: - recognises a variety of shapes, work with nets, 3D cubes, geometric patterns. General observations: Always alert*
and enthusiastic - bright and ready to use new concepts. However results can be too rushed. Needs to work carefully. Capable of fair degree of competence.

C was noted as having reached stage c in all sections and the comments were as follows:

*C’s record:* **Sets:** - SMP Unit 4 Section 1. **Numbers:** - Good progress and sound development. **Measures:** - Good experience in all areas. **Geometry:** - C needs a little guidance and encouragement but has plenty of ability to succeed with maths. **Mathematics generally:** C works steadily and carefully and has ability to grasp all concepts tackled.

From the general records it became apparent that this was a pupil with ability in many areas, especially in gym, dance and drama but that she could push herself more with maths. One aspect of this pupil’s ability was highlighted: that she had choreographed and produced some excellent dance/gym displays. How could the spatial sense demonstrated in this activity best be exploited in mathematics?

**Back in the classroom**

All three, on their return to the classroom after the discussion, quickly got down to work in the purposeful, industrious atmosphere which had already been built up in this class. It was evident that A belonged to a co-operative group who helped each other. B and C were apparently more used to starting things on their own. The lesson was one where the class was trying the up-side-down calculator crossword and it was tackled with confidence by all of the three pupils interviewed. The class had been told something of the organisation of SMILE which all three were looking forward to starting soon. Meanwhile the class was working as a whole on activities which could be tackled at a variety of levels and with a variety of approaches while their teacher learnt more about them in order to plan appropriate work programmes for them.

**Third-year conversations**

Three third-year pupils were chosen to represent the spread of achievement in the year.

D had brought with him some work on anti-magic squares and magic squares which he explained as follows:

*It’s a 3 by 3 box and you’ve got the numbers 1 to 9 and you’ve got to put them in the box … then they’ve all got to add up to different totals, the diagonals and rows and columns. Now I’m on magic squares where they’ve all got to be the same … I think the anti-magic squares are the easier ones.*

E had brought “helicopter photographs” and talked about the diagrams she had drawn:
... there’s three cars and they’re moving in one lane; one’s a parked car and the
other two cars are moving at different speeds and you’ve got to show how the cars
move along in each second and (whether) they crash into each other or overtake …
They all overtook but most of them had to overtake the parked car as well as the
car that’s going slowly …

F was the least articulate of the group and he showed some work on symmetry.

I like shapes.

Unfortunately, the library had another class in it during this conversation and
many of F’s quietly spoken comments were drowned on the tape. He had not
written any comments on his matrix form to influence the teacher’s choice of tasks
in the next programme of work he designed for F. It was interesting that this group,
although they understood the mechanisms whereby they could negotiate their own
programmes of work, had not taken charge of their work in the way it appeared the
fourth-year pupils had. Amongst those interviewed there was a significant change
in this aspect of development between third and the fourth year.

Sometimes if a friend’s done a card which you like you can put it down and if he
agrees he will put it on your matrix. Sometimes if a card that’s really difficult or a
card that’s really easy, if you tell him why you don’t want the card he’ll sometimes
take it off your matrix.

E, who had shown a considerable depth of understanding of the speeds and
relative positions of the moving cars in the diagrams she had produced, surprisingly
expressed a certain ennui with respect to mathematics.

I don’t like the cards. I don’t like SMILE much … I think it’s the way you have
to do … the instructions on the cards are not very easy to understand.

Yet she then went on to say

Some cards are really … I enjoy some cards they’re really good … Some cards I used
to get. I used to get a lot of angles and stuff and I’m really sure of angles now. Just
kept on getting angle cards.

D had transferred from another secondary school and was pleased with the
consequent change in his mathematics programme. He found the work here harder
than in the other school where

We worked out of books.

When pressed about what was harder he said

Just the work because in my other school you were doing work what we were doing
in primary school, too easy.
Their feelings as to the appropriateness of the level of the work set came out when they were asked about comparisons between the practices in mathematics and other subjects.

E: It’s different, you have cards and worksheets. (In other lessons) you have books and you work at a different pace whereas here you’re at your own pace ... I don’t think we get pushed enough ... I get cards I can do but I don’t get many hard cards.

D: Most of the cards, 70%, I can do quite easy. Then 20% are quite hard, then the other 10% are very easy ... generally about right.

Thy appreciated the security of having programmes worked out to suit their own individual needs in a framework they understood, as is shown by D’s comments on the way of working in mathematics lessons in contrast to other subjects.

Well, this is organised. On the other ones you don’t know what you’re going to do until you get in there. Here you’ve got a subject you’ve been explained to but most of the other lessons you come in and there’s stuff waiting on your desk or you have to go and get it all out and then you’re told but in maths you come in and you’ve got your matrix all ready.

Records and the teacher’s assessments

D arrived in the school in September 1986.

D has completed 2 matrices this year, their levels being 2.8 and 3.6 He has made good progress on levels with no problem and got through a good amount of work. Dead-pan - no real spark - but careful thought.

Average or slightly above amount of work achieved. There has been considerable improvement in confidence leading to much more thorough work. He has not initiated any work himself.

E’s last 5 matrices had levels 4.0, 4.0, 4.2, 4.0, 4.3. Motivation to “get on” is high but external. Above average amount achieved 86/7 but at same time interest has declined. Now weary of the open ended, excitingly produced work she would previously have enjoyed such as “rectangle diagonal” and “watch out”.

She has produced a considerably above average amount of work, making a lot of progress and becoming more analytical/methodical. With respect to pupil initiated work, she has taken part in quite a few very good pieces of group work. All these have been credited formally in the records.

F is working at a much lower level than the other two, his last 5 matrices being at levels 1.9, 1.9, 1.3, 2.0, 2.2. Less than average amount of work completed. Level has improved quite well. Needs a change of some kind ?? from me ?
He has achieved an average amount of work, with gradual but consistent improvement in his understanding. Very constrained by his language development. He has not initiated any work himself.

**Back in the classroom**

There was a generally purposeful atmosphere in the room into which F immediately fitted unobtrusively. D returned to his work on anti-magic and magic squares. In discussion it was obvious that he had not yet seen the link between the total of totals each way. Perhaps this suggests that these particular tasks need re-editing to bring out the relationships more explicitly while not giving the game away. E continued in the classroom to display a slight ennui with respect to the whole proceedings but this seems to a certain extent to be a pose because, as seen above, she talked knowledgeably about what she was doing.
In this Interlude, we revisit the issues associated with how classrooms are observed and see the reflections from two inspectors in action. One gives a contemporaneous account of his observation of a SMILE classroom and the other looks back over a varied experience of visiting a fair number of schools.

**Inspecting classrooms**

In her autobiography Joan Bakewell mentions the changes in photography that have taken place in her lifetime. She explains that, in her childhood the family photograph was a solemn occasion, recording a single image and that image was of a formal ‘front-facing group’. But, she says, “history does not happen in front-facing groups”. The traditional classroom was built for front-facing groups where, SMILE teachers would maintain, precious little learning takes place. The reason why SMILE classrooms are so misunderstood is that they lack front-facing groups. Therefore, just as it is now agreed that the traditional photographer cannot capture the essence of the family with a single viewpoint of the group as a whole, neither is the traditional inspectorial habit of sitting apart and concentrating on the teacher’s performance valid for the assessment of such a learning environment.

Although in SMILE classrooms the teacher’s role is still the key to successful learning, a ‘performance’ is not demanded. Such a performance would rarely be appropriate because of the recognition that every student is at a different place on the mathematics map and is journeying along their own particular path. These paths frequently intersect and very often run parallel to each other but, in order to get a true record of what is going on in a SMILE classroom, a large number of ‘snapshots’ of individuals and small groups - by no means at any one time all facing the teacher - must be taken. Rather than traditional classrooms, SMILE rooms resemble more those other places designed for study – laboratories, libraries, museums or art galleries - places rich with resources where people can browse at their own pace allowing their minds to take in what they perceive as significant.

Once, when I was inspecting a teacher who had a small but particularly unruly group (not a SMILE group) of Year 11 boys, I tried to look my fiercest to support the discipline the teacher was having difficulty imposing and, to make my presence heavier, I announced to one boy that I was an inspector. “Naah!,” he said, “You’re not an inspector. Inspectors sit in the corner and wear suits.” Maybe that is why inspectors do not appreciate SMILE classrooms, because they certainly cannot be judged adequately by sitting in a corner. Whether the wearing of a suit makes any difference to the quality of the judgement I have not investigated. But certainly, even in the 21st century, in more traditional classrooms a visiting adult stands out as an intruder.

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In 2004 the TES carried an article about a comprehensive school in the Forest of Dene where observation rooms have been introduced so that lessons can be viewed without the viewers having to go into the classroom.\(^{124}\) Beside one-way vision the rooms are equipped with sound equipment so that the viewers can listen as well as look without actually stepping inside the classroom. This innovation was heralded by the journalist as an exciting step forward. However, if the teacher is not the dominant personality in the room - in control certainly and a facilitator of learning, but not the focus of attention - there is no need for such elaborate viewing equipment. In a SMILE classroom, the presence of extra adults is non-intrusive in the sense that they will be taken as more potential helpers by the students and the teacher. It is well-nigh impossible to be a passive observer in a SMILE classroom. Actually, becoming a part of the working community in the room enables deeper impressions to be formed by any observer. You are able not only to see what is happening but to ask questions about why it is happening. It offers a chance to learn for all who enter, teachers and students alike.

**An inspectorial portrait of a classroom**

The principles outlined above for inspecting SMILE classrooms are clearly illustrated here by John Hibbs (at the time of writing a member of HMI who had, before joining the Inspectorate, worked very closely with SMILE) in his description of observing Jill Bruce’s classroom:

> I got to the room before the class or the teacher. It was furnished simply with groups of tables and chairs informally arranged. A couple of grey filing cabinets stood at the back, their half-open drawers bulging with SMILE cards. The wall displayed pupils’ work. One large poster declared ‘the puzzle of the week’, while another invited pupils to contribute their own matchstick puzzles. On one side of the board was pinned a statement on cheating yourself, while on the other was a pupil composed policy on equal opportunities. Three-dimensional solids hung from the ceiling. Pupils began to arrive, first a trickle, then a rush. Some sat, others stood. A few busied themselves giving out folders. One boy cleaned the board and then wrote his name alongside number 1. Others followed, adding to the list. A girl entered, writing her name next to 15, leaving a large gap in the list. As a pupil approached to ask me whether the teacher was away and was I there to take them, in walked Jill. I had counted by this time 29 pupils - fourth years, 15 boys, 14 girls.

> ‘Sorry I am late,’ she said, ‘thanks for getting yourselves organised,’ and ‘Oh, hello,’ turning to me. Turning back to the class she continued. ‘I’ve got your books here - they have all been marked. Now remember, your first job before you do anything else is to read my comments and write at least one or two sentences by way of reply to me on what I’ve said, OK?’

\(^{124}\) Martin Whittaker, “Happy to look in the mirror”, TES, 7 May 2004 (Dene Magna School)
The books were given out. Pupils opened their exercise books and read the comments, some reading them out loud to their neighbours. By now they were all sitting in groups. After writing their replies, they all got down to work. I roamed the room to find out what they were doing. One group was designing a board game. Another group was working on graphs, taking the British Telecom charge leaflet and trying to turn it into something easier to understand. Another group seemed to be working on a textbook exercise, whilst yet another was doing some paper folding from a SMILE pack.

The rest of the class appeared to be working individually, mostly from SMILE cards. A few left their places to get cards or equipment from filing cabinet or cupboard. The room hummed with purpose. Jill joined a group and got into conversation. I followed suit.

‘Why the list of names?’ I asked, pointing to the board.

‘Oh that’s the help list,’ a boy replied, ‘You put your name down and she comes around in the order of the list. It stops queue jumping by shouting out.’

For the first time I noticed that there was no teacher’s desk, just a group of cupboards in the corner of the room, stacked with papers. ‘Why did Hannah put herself down at 15 when she could have got in at 7?’ I asked. ‘Ask her.’ So, I went to Hannah.

Hannah had her head down and was hard at work.

‘What’s that?’ I asked. ‘Sh, Sh! I’m trying to finish it off,’ she said. ‘It’s English.’ ‘Is it homework?’ I asked. ‘No, I started it last lesson and I want to finish this bit off before I forget what I want to say.’

I left to disturb others before returning to Hannah. She now appeared to be on mathematics. I asked her about the list. She explained that she knew that she needed some help with her maths project but had wanted to finish off her English first. She also wanted to have another look at her maths work before Jill got to her. I asked her about her project and whether she liked maths.

‘It’s all right,’ she told me, but she didn’t think she was very good at it. The project had been hard initially but it had got easier after she had ‘learnt up about sines, cos and tangents and things’. She got stuck a couple of times, but with the help of the teacher and one or two other pupils whom she ‘chatted up’ she had got herself sorted out. She now needed some advice on how to write up her conclusions. I helped her as much as I could. I asked if I could look at her exercise book and I read an interesting dialogue between her and Jill throughout the book. Jill was now sitting alongside another pupil and was in no hurry to move on. I asked if I could help and she told me to help the next person on the list.125

John’s understanding of the classroom, clearly evidenced, depended upon his becoming engaged with the learners.

**An inspector looks back**

John Bausor, a science inspector for the ILEA whose comments have appeared in earlier chapters, also provided a reflective overview of the project as a whole for this book. He recognised the effect SMILE could have on the attitudes of students.\(^{126}\)

As far as the pupils’ response to SMILE was concerned, there can be no doubt that for the most part it was very positive. I am sure that SMILE made a major contribution to the shift in pupil attitudes which occurred from the 1970s onward. Prior to that it was quite rare for pupils to say they liked mathematics. It is still quite typical for many adults to say that they hated the subject at school and did not understand it, no doubt reflecting the way it was taught. But now many pupils (including girls!) will say that mathematics is their favourite subject. This was not unusual in SMILE classrooms when I visited them.

There were, however, certain pupils who said that they preferred to be taught, rather than learning independently. My suspicion is that this may be a matter of temperament and personal learning style, but I do not have any evidence for this. Certainly, in recent years research has shown that people differ considerably in their preferred and most effective style of learning.

There was also a minority of pupils who took advantage of the fact that it was impossible for the teacher to be closely aware of what each of 25 pupils was doing at a given moment, and deviated from their assigned tasks, sometimes for a long time. Effective teachers devised strategies for dealing with this problem, ineffective ones did not! The interesting thing is that, even in schools in the most difficult areas, such slacking was not the norm. This fact seems to support my contention that in all forms of learning motivation is all-important (a point which appears to have been almost totally neglected in the national curriculum). There can be no doubt that SMILE made a very positive contribution in that respect.

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\(^{126}\) John Bausor, Reflections on SMILE.
Chapter 14: *con amore not con labore*

As I have attempted to make clear throughout the book, for those of us involved, *SMILE* was so much more than a set of curriculum materials. In this chapter I bring together some of the moral and emotional dimensions of the whole experience, those things which affected the whole person, be they student or teacher. I write first about trust as an introduction to the sort of learning communities we were aspiring to build. I explore the issue of student autonomy and then try to sum up all the different aspects of our teaching selves that we sought to develop.

**Trust**

An effective learning community is based on trust. Little learning can occur in and around a classroom lacking commitment and mutual, informed trust. Wherever you look today you cannot avoid mentions of management studies in all areas of life and it is assumed more and more that teachers need courses in management, usually from the commercial or industrial sector – go and see how a brewery is managed and you will know how to manage your school or your classroom. Yet it has always seemed to me that even the least effective lessons I have seen have demonstrated quite highly developed skills in people-management. Without considerable management skills you cannot even begin to keep clear of chaos, let alone teach, with a class of 30 odd children of any age from early years to teens. The good teacher knows that the core of effective management is trust: respect for people, valuing their aspirations, their intelligence, their independence and their individual autonomy.

Yet an atmosphere of trust is more and more foreign to society today. Onora O’Neill in her Reith lectures in 2002 put the question whether the revolution in accountability in this country today supports or possibly undermines trust. She points out that although central planning may have failed in the former Soviet Union, it is alive and well in Britain today. The new accountability culture aims at ever more perfect administrative control of institutional and professional life. The idea of audit, she notes, has been exported from its original financial context. Testing, according to government, is the be all and end all of the classroom. A constant emphasis on individual competitiveness has eroded valuable elements of our civic life in all its aspects.

However, teachers, no less than good organisers elsewhere, recognise that unless you have the elements of a concern for others you cannot even feign a good management style. Indeed, we get more like late-1930s Germany every day – actual lessons in behaviour are now being mooted by the politicians. Surely behaviour, like statistics, unless studied at a high academic level, is essentially an applied topic best understood in applications? A recognition of the responsibility of the
individual to the society she finds herself in is best learned through being given some responsibility for her own activities and for the shared resources of the group as a whole. This recognition has been the basis of all SMILE thinking.

**Learning communities**

Any classroom, if the teaching and learning in it is meaningful, is about learning many things beside the label the lesson is given on the timetable. The 1944 Education Act saw the duty of schools to contribute towards the spiritual and moral development of the community. In a SMILE classroom, besides mathematics, the students were learning many lessons. In citizenship, for example, in taking responsibility for:

- their own work
- the resources they share with their peers
- developing a co-operative community where the ideas of others are listened to and respected.  

So, what kind of learning community did teachers aim for in a SMILE classroom? If your view of the aims of education is restricted to the passing of tests, then a non-front-facing classroom may not seem the most effective. However, if you believe - as Dr Johnson did concerning the aim of writers for their readers - that the true aim of education is to enable the student the better to enjoy life or the better to endure it, you will understand better SMILE classrooms as places in which a child can grow up with access to a variety of adults whom they know and trust and with space (mental and physical) to mix meaningfully with their peers.

A sense of community is engendered if learning groups are organised so that the children in them are treated as individuals with their own programmes, with recognised responsibilities for their own work, respect for the resources and space they share with others and concern for the welfare of the group as a whole. The SMILE organisation nurtured these attitudes.

Classrooms certainly need to be places where the process of life-long learning can begin. And that means engendering a love of learning. The title of this chapter comes from advice given concerning a forthcoming piece of work that was being undertaken by a translator and I would suggest that it is fitting advice for any form of intellectual work undertaken by people of all ages. If the work done is seen as hard labour then it will not be well founded. Young people take to the streets because they are not satisfied with what they are getting in the classroom. At North Westminster Community School when SMILE was flourishing truants would often come in to school just to attend the mathematics lesson then 'bunk

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127 SMILE: A Guide for Parents, SMILE Centre
off” again. Perhaps it would be more realistic in the 21st century to consider fining the schools for truancy rather than the parents. Phil Barnard, head of department in Pimlico School, also found that learning the SMILE way was effective in keeping students in school:

Working in this way took courage, especially at the beginning, but it worked. Despite our misgivings the children enjoyed SMILE – we had never seen pupils so keen (some of them anyway!) to come to maths classes – or any classes for that matter! Those cynics who thought the children only wanted to check their folder hadn’t been stolen were surprised by the reluctance of the pupils to stop work at the close of the lesson. Discipline was not the ‘monster’ that was feared – the expected riots didn’t materialise.129

It did take courage to work the SMILE way – still does – as Watson, Geest and Prestage note,130 when writing about their project to achieve deep progress in mathematics for “the lowest achieving groups”; teachers needed to be “brave” to work “in ways which contradict normal practices and expectations. They also needed to be brave because the way they covered content with their students did not conform to an easily observed list of topics.”

How did SMILE teachers understand the learning communities they were building in their classrooms? The answer of course is strongly influenced by the individual teacher because, as Dylan Wiliam and Hannah Bartholomew comment, the day-to-day life of a teacher is “intimately linked to the teacher’s personality”. 131

Peter Winbourne, for example remembers:

My aim was always to open up dialogues with students. It was wonderful when you’d looked back over a period of work together and you could see the conversations you’d had reflected in the written dialogues that could be seen developing through the students’ work books and matrices. This kind of talk was absolutely central to the way we worked. It was also what helped to get students working in groups and talking amongst themselves about their work in similarly powerful ways.

Hannah Bartholomew, in her study of SMILE classrooms,132 analysed the reactions between teachers and learners and studied the crucial role of the teacher in creating the atmosphere and setting the standards of behaviour and discussion.

129 Phil Barnard Splash (Eds: unable to trace). At the time of writing Phil was the headteacher at Pimlico.


131 Dylan Wiliam & Hannah Bartholomew, It’s not which school but which set you’re in that matters: the influence of ability grouping practices on student progress in mathematics, British Educational Research Journal Vol. 30 No. 2, April 2004

Her retrospective analysis of student/teacher relationships in the SMILE classroom in which she grew up kindled her desire to understand how students came to take up their differing roles in the group, how, in particular, they sought help from the teacher and the kind of help they sought. In order to do this, she observed SMILE classrooms in two mathematics departments of comprehensive schools. She observed introductory lessons in Year 7 in each school and also lessons in year 11 and she contrasts the differing roles of the teachers and how these were related to the philosophy and practice of the departments of which they were members.

In one of these departments she notes the skill of the teacher in creating an atmosphere of calm where everyone appeared to be involved and interested in what they were doing. Nobody seemed to receive or demand excessive attention. In these lessons the students were encouraged to exercise self-control and work independently as far as possible. Their teacher gave them a background understanding of what they were going to be doing and they felt free to consult any adult around who might provide them with help. In these classrooms Hannah did not feel out of place whereas in a Year 7 lesson in the other school she felt her presence was disruptive. This is an experience common to many observers in secondary classrooms. Perhaps in general the teacher is a performer who deliberately keeps the power to himself, the students being cast in the role of audience, and the introduction of SMILE does not automatically change this hierarchy of control.

When John Barzey said he took control of his own learning he was able to do this first and foremost because of the quality of his teacher, Tony Garwood, and only secondly because of the SMILE materials he was using. So, in the school with the less ‘structured’ approach studied by Hannah, teachers made a deliberate attempt to encourage their students to exercise self-control. In the other school she found that teachers were not only regulating their students’ behaviour but also their learning.

**Furthering student autonomy**

All Smilers were committed at some level to developing responsibility and autonomy in their learning but some, for example Tony Brown, made a more far-reaching commitment than others. He wrote:\[133\]

> In some ways this method of study is like making a patchwork blanket. Each card is a new patch and the completed blanket is handed in for CSE. The blanket represents the child’s understanding of mathematics and it is hoped that related patches are in the same part of the blanket and that the connection is understood. The amount of time spent on a patch is generally quite small and involvement can only be fairly limited as a consequence. As a Holland Park pupil observed, ‘You just put the right number in the appropriate boxes.’ The card asks the questions and does nothing to provoke the child into asking theirs …

133 “SMILE rules OK”, Splash 11111, January 1981
I am sure that, if most people reading this were to start a course of study, they would attempt to identify the nature of the subject and then follow their nose thereafter. Enthusiasms would be followed up as they arose. One would realise there are many alternatives to choose from. One would not assume that teachers and the teaching system are always right. I feel that it is condescending if not wrong to assume that a child is not ready to realise such things. The SMILE structure works against such freedom of thought.

In a second-year group that I teach every child has spent long periods on projects of their own design. One girl, Melanie, did not get around to completing her first matrix until after a year in a SMILE class. Presumably that matrix was relatively boring otherwise she would not have gone off on yet another tangent. I firmly believe that most lower school groups can intelligently and significantly influence their course of study …

Melanie … spent one whole term investigating the nature of polyhedra with a group of three friends. They studied photographs of shapes and then tried to make them. As soon as one shape was completed they dismantled it to see the net. After that the problem became irrelevant and they went on to the next shape. At the end of term, they had no evidence of their achievement, apart from an embryo understanding of the geometry of polyhedra.

With the maths being presented without an overwhelming structure, the structure will not decide the nature of the study. When this group are presented with a matrix there is no assumption about how long it should take. One boy spent six weeks working on card, 743, ‘Solving by Graphs’. Another boy, Steven, spent two lessons trying to work out how many zeros there are at the end of 100! And developed a vague idea of how to do it for 1000! The answer for both boys is irrelevant. It is wrong to suppose that answers suggest an understanding, as any maths graduate will know. SMILE cards emphasis the answer far too strongly. They promote the idea of finding the most efficient algorithm to get the answer. If you do not fill the boxes you seem to have failed. This encourages a reluctance to tackle difficult questions. Empty boxes are neater than those filled with uncertainty. Steven records his results like this. He does his calculation at the back of his book and on the table. He often reaches the centre of the book from the back before he reaches it from the front.

To avoid this fear of complex problems I feel there is a tendency to set work at a relatively low level to ensure that enough boxes are filled. In this way children lose their capacity to problematise. When they lose this, they ask and answer their own questions at a much lower level. The fear of getting the wrong answer ultimately takes over from the quest to learn.
As Tony Brown has demonstrated, throughout school and beyond, although the learning programme needs to be planned, it must be flexible at all times so that it can be made to fit each child.

Formative assessment is the key to effective teaching and it must go deeper than formal testing can ever go: it is only the trained and experienced observer of the children, who has known them for some considerable time and been able to analyse them one by one, who can hope to choose the right moment. Such individual knowing is so much easier in an individualised setting like SMILE where no one is asked to conform to a pre-ordained pattern of learning and where differences are celebrated. Returning once again to Tony Brown, it is clear that he had a detailed picture of where each of his students was mathematically although they were working in what might be considered an unstructured way with little formal assessment.

Nigel Langdon, when head of mathematics at Christopher Wren, was interviewed in his third-year class in which the standard of the work varies between normal first-year and fourth-year mathematics, according to the individual’s abilities. Nigel explained the natural, calm and stress-free climate in which no one shouts, no one lays down the law. He said,

*It is largely due to the responsibility that the individualised approach to learning puts on every pupil. We are saying to them: ‘It’s no good coming here unless you are prepared to work yourselves’.*

134

Developing new roles as teachers

Returning to the title of this chapter and as we have seen above, SMILE certainly demanded *labore* from its teachers – but that labour was also for many teachers an experience also of *amore*. One element of this was the range and richness of the roles in which the teachers became accomplished. HMI defined those roles as “manager of resources, director of studies and tutor as well as teacher.” 135 So, the careful, continuous evaluation by all involved of the values and practices needed for an effective individualised approach to be guaranteed by SMILE involved not just the production of different classroom materials but the creation of a different form of learning in SMILE classrooms. Despite the narrowing influence of a legally binding national curriculum and testing imposed from the centre in recent years, steady development of good practice in SMILE mathematics classrooms persisted into this century. SMILE’s vision of the practice of the effective teacher is expressed in the parents’ guide: 136

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134 Bob Doe, “Calm not confrontation”, TES 10/6/77
135 SMILE Guide for Parents, SMILE Centre
136 HMI, “Secondary mathematics individual learning experiment (SMILE) of the ILEA 1975–6”
Chapter 14: con amore not con labore

SMILE is very demanding of the teacher in terms of both energy and organisation. A SMILE teacher will rarely stand in front of the whole class and explain some mathematics using the board. Instead a SMILE teacher will spend the lesson moving around the classroom explaining and discussing mathematics with individuals or groups. The teacher will try to enable children to answer their own questions or to find solutions by discussion with other children. The teacher will be aware of the different work being done around the classroom and will respond to an individual’s needs as they arise.\(^{137}\)

The guide highlighted the role of the teacher in considering the individual needs of the child and drew attention to the fact that SMILE teachers were actively involved in its continuing development and in ensuring that SMILE kept abreast of current initiatives, particularly those concerned with race, gender and class, in the production of new materials, in classroom practice and in thinking about how children learn. And this was accomplished with passion and with joy. The sharing of problems and the discussion of conditions for success made SMILE so effective but so did the development of an educated imagination. As Ted Wragg reminded TES readers:\(^{138}\)

> Teaching as a profession should be for people with imagination. The ability to invent and create is precious, the badge of the true professional. It must be protected like the Crown Jewels. Take away imagination and we have teacher-as-machine, programmed androids, not human beings with a heartbeat. … we must scrap detailed prescription now; today not tomorrow, before it is too late. … Imagination should be nurtured like a delicate orchid, not buried under tons of fertiliser. …

(As an aside, of course, as with any other classroom materials, it is possible to use the SMILE resources ineffectively. Many years ago a special needs advisor in Lincolnshire told me of a visit to a classroom where she had heard, to her surprise, the SMILE materials were being used. What she found was chaos – carefully organised chaos that is. Every child was set the same cards in the same order – the numerical order of production. This teacher had in no way thought through her practice, she knew nothing of the creative process behind the materials, she did not know that the number of the task merely indicated its order in the production process. - the 59th task produced might have been designed for an enthusiastic year 10 student well versed in mathematics, while the 60th could have been written with a year 7 student in mind who was still struggling with the simplest mathematical processes. This teacher clearly had no imagination and was using the resources mindlessly. In such instances a conventional text, planned to be used from cover to cover, might well have been preferable.)

\(^{137}\) SMILE: Guide for parents, SMILE Centre
And imagination was valued and nurtured in the SMILE collective, for it was essentially a community of teachers with enough vision to recognise the need for resources appropriate for their own students and to create them themselves, backed financially by a supportive education authority. It was geared to develop the creative imagination of its members and a greater sensitivity to the diverse needs and interests of their students. The tensions, noted by John Bausor, between Smilers and Non-Smilers in the ILEA were not surprising. The SMILE groups that developed were very close to ‘action learning sets’, as described by McGill and Beaty, who see such sets as providing safe, supportive yet challenging environments characterised by trust.139 This trust, they maintain, empowers ‘set members’ to take risks. In SMILE’s case the risk was a dramatic role change inside the classroom supported by a group spirit generated in the discussions outside the classroom.

Chapter 15: Conclusion

In this final chapter, I tell of the death of the ILEA which led, inexorably, to the eventual demise of SMILE as a living project. That the demise was so drawn out is a tribute to the vibrancy, energy, passion and commitment of those involved. I point to the fear of the unfamiliar experienced then which continues to dog the educational thinking of the powers that be. I return to the theme of empowerment - the aspect of our teaching lives that brought so much satisfaction and joy to our work. And I celebrate the commitment to life-long learning which we embraced both for ourselves and for our students. I outline the lessons to be learnt about how to support teacher-led projects so that they flourish.

The end of the ILEA

A summing up of many of the most valuable attributes of this project, started in 1972 and surviving throughout the rest of the life of the ILEA, is found in a letter written to the ILEA News in March 1989 when, for purely narrow party-political reasons, the ILEA was being destroyed. London children in school at that time lost out because its destruction meant the end of many successful educational projects initiated and supported by an authority which respected teachers and was large enough to finance experiments which some of its best teachers wished to carry out for the good of those growing up within its boundaries.

It was enlightening at that time to go to the London Special Needs Exhibition where publishers from all over were displaying their wares. Standing out, because of their innovative ideas and enticing presentation, were the materials from projects initiated and supported by ILEA, most now sold off to the commercial sector. Many of these had by no means reached their sell-by date yet they soon disappeared from most shelves. The letter from Dick Gmiterek was intended to ensure that the same fate did not overtake SMILE.

ILEA NEWS

March 8, 1989

Letters

Supporting maths with SMILE

Many readers will be unaware that the Authority is planning to dispose of the Learning Resources Branch and that various options are to be considered, initially on March 10 and then finally on March 22.
There are a number of “bids” from various groups for the copyright to LRB's catalogue. This causes great anxiety for those teachers and students currently involved in the SMILE (Secondary Maths Individualised Learning) curriculum project. A successful bid from commercial publishers for the SMILE materials would lead quickly to the destruction of the project, and thus render these materials commercially worthless.

The governors at this school have put the following arguments to the ILEA members.

SMILE consists of a number of interdependent elements. First, there are some 1,000 – 1,400 teachers developing and using the materials. Second, there is the SMILE Centre which co-ordinates (but does not direct) all this work. Third, there are the materials printed by an outside firm and distributed by Learning Resources Branch (LRB).

It is important to clarify that the LRB simply acts as a printing and distribution agency for SMILE which itself is essentially a teacher co-operative engaged in curriculum development. The main customers for the materials are the SMILE teachers themselves. Consequently, the bids to buy up the copyright are illogical and self-defeating.

We believe that such bids, if successful, would lead to the rapid collapse of SMILE. The project depends on an enormous amount of unpaid work put in by teachers. For example, simply production of the four examination papers last year took some 1,500 hours of work. Whilst ILEA funded some of this, most of it was done in the teachers' “free time.” No commercial body could afford to pay for this; nor would it get it for free. There are many other important initiatives being carried out by these teachers, who would be unwilling to do the work if the project were split up. Indeed, they couldn't without the SMILE Centre to co-ordinate. There would be no appropriate examination for next year's 11,000 GCSE candidates. There would be no development to bring the project into line with the National Curriculum and compulsory testing requirements.

Consequently, the collection of materials produced so far would become virtually worthless commercially. There would be no-one to buy them as SMILE departments would be forced to turn to other schemes.

The development work could not be carried out by a small team of employees. There is too much of it. It would be, in any case, more expensive than maintaining the SMILE Centre. It is only by allowing teachers, through SMILE, to keep copyright of their materials and by maintaining their control of the project that there is any viable future.

The options which are currently being put forward would rapidly produce chaos in some 200 departments, about half of them in ILEA. It would result in the loss of many of the well-qualified mathematics staff who were attracted to ILEA schools specifically in order to work within SMILE. Its collapse, coupled with the break-up of ILEA, removes the last serious reason for staying in Inner London.

We would urge that the Strategic Policy Sub-Committee accept the SMILE consortium proposals that the project should continue under teacher control co-ordinated by a SMILE Centre which would continue to be located in the Borough of Kensington and Chelsea, who have given strong assurances of their intention to support the project and its contribution to the education of all London children.

Whilst deploiring the break-up of the ILEA, we wish to salvage as many of the Authority’s initiatives as possible. SMILE has been enormously suc-
Chapter 15: Conclusion

Successful. Mathematics in our school is a very popular subject and the examination results are excellent. It has been responsible for improvements in girls’ achievement in the subject. It has a national, even international, reputation. Its ideas have been taken up on a national scale and many of the GCSE developments had been pioneered by SMILE. The proposals for assessment ... in the national curriculum look remarkably similar to the SMILE model. Its survival as an independent entity would be a reminder of what ILEA was able to achieve. We hope that the ILEA’s belief in the advantages of grass roots developments will lead to a rejection of the attempt to asset-strip our scheme.

It is important that all concerned – teachers, governors and parents – alert their ILEA members to the educational issues involved in the LRB decision.

Dick Gmiterek,
Head of Mathematics,
North Westminster Community School

Everything hinged on the materials and their ownership. The story of how those materials started to be produced and the effects this production had on those who created them and the teachers and students using them has been told in this book. Although Dick’s proposal outlined above was agreed and SMILE did not die immediately the ILEA was abolished, the abolition did cause a death blow to the project. Without the authority’s support, teachers found it increasingly difficult to meet together and to learn from each other, a process which had been at the heart of SMILE. And increasing control of both curriculum and pedagogy by central government added nails to the coffin.

But looking back at the experience from the vantage point of many years later, what are my closing thoughts about it all?

Fear of the unfamiliar

The style of learning through individualised programmes that evolved from the joint thinking of the 1970s appears to have been as mistrusted then as it is today – but not, of course, by the teachers who observed its effects on their students at first hand. At JFS, as has been noted, we tried out this way of working in one first year class in 1972-73 and ended the year with four of the eight first-year classes involved, but we found that the approach did not appeal to all teachers. In fact, I frightened off one new member of staff (who had just had her final interview with the head and agreed to come and teach part-time next term) by entertaining her in the classroom where I had thirty kids working on this scheme. About a week later she wrote saying that, having considered the teaching methods and approach used in JFS in the maths department, she had decided that it wasn’t for her!

Others also continued to have doubts. Inspectors, advisors, those engaged in initial teacher training, administrators and politicians feared it from the beginning because they could draw no parallels with their own school days. However, despite enormous changes in the education system, it proved impossible to kill it off completely. Few confessed that the failure to grasp what learning was taking
place in a SMILE classroom was a result of their own shortcomings rather than of the educational scene they are surveying. Those entering such a classroom with only their own childhood memories of school to guide them were certainly often confounded. It was not unusual for a tutor visiting a student on teaching practice in a SMILE school, to plead for some ‘proper’ teaching to be arranged for the visit. How were they to judge their students in this unconventional setting? In such an unfamiliar atmosphere what does ‘teaching’ mean? Sadly, even today, to the bulk of observers, trained or otherwise, this method of organising learning is still a mystery. Despite conflicting and inconclusive research evidence, the politicians have the unshakeable idea that children must learn best when they have been sorted according to achievement and are being lectured as a coherent group. Such lectures, they believe, are the only real lessons.

Certainly, SMILE never did “leave each student to study alone” – which is what David Miliband suggested in 2004 happens in individualised learning – whereas “personalisation”, according to Miliband and all the rest of the DfES, did not mean such isolation. What the difference is, who knows!

I would suggest that perhaps the greatest isolation in learning occurs in some types of “whole-class approach”. The worst example I remember observing many years ago was an A Level (or whatever the term was at the time I am describing) class in a college of FE. It was a “going-through-the-homework” session with the whole class. The boy next to whom I was sitting at the back of the class was completely isolated. His work was perfect. He did not need to go over anything in that homework. He was bored stiff. He had nothing to do but think his own thoughts which might have been mathematical or they might not.

However, those who have been a part of a flexible individualised scheme of learning pose questions as to how effective an education based on the lecture mode, hour in hour out, can be. How well do you listen to lectures? If the lecturer’s delivery is dreary and the content less than inspiring, it is only too easy to drift into daydream. If the delivery is exciting, with all the latest technological enhancements, and the content enthralling a gripping new idea can take over and by the time the mind has finished playing with it the lecturer has moved on and the listener is thoroughly lost. Despite the difficulties of individualisation, SMILE proved that, at least in one area of the curriculum (and why not in others?), not only is it possible but that many teachers have found it worth the doing and, through a programme tailored to their own individual needs, many pupils have become excited by mathematics. From the early 1970s, more and more teachers found in this way of organising learning the satisfaction of sharing with their colleagues – and their pupils – an enjoyment of mathematics and the excitement of watching meaningful learning take place.

Today, Ofsted, when reporting on what has been seen in classrooms, have a lot to say about breadth and balance. These are characteristics that quite rightly
belong to national curricula. If you are planning educational programmes for a nation then it is essential to achieve the greatest breadth possible and to see that the programme is balanced. The teacher must make the curriculum fit the child, not the other way round. If the child is to learn rapidly and happily, to be inspired to life-long learning, it is no good going for the off-the-peg, one-size-fits-all type of education. But patterns other than the standard package are still seldom taken seriously. The unconventional - and consequently controversial - Summerhill was condemned by Ofsted in 1999 and only saved itself by going to court, the result of which was a new inspection process for the school and a legally recognised right of its students to choose whether or not they go to lessons. Later, in 2003 Kent education authority refused to continue to fund a child with special needs, who had been placed for some time at the school and seemed to be overcoming his difficulties. Why? Because the appeals committee chose to use the original, condemned Ofsted report. Was the underlying reason for the refusal a fear of the unknown?

**Empowering front-line workers**

Today the rules of the game of education are laid down by a central hierarchy, which seldom includes teachers. What was different about SMILE was that a local group of teachers were encouraged to lay down the rules, create the curriculum and work out the pedagogy. Is this the way the game of education should be played in the 21st century?

A framework at national level can, of course, be useful in any public service, providing there is flexibility at the point of client-experience. In 1972, in the field of mathematics education, SMILE teachers set out to give children, as diverse individuals, opportunities to learn with understanding, each in their own unique manner and at their own very different levels and paces. Indeed, as we have already argued, SMILE was a group of teachers with freedom to design a part of the curriculum and to present it to each of their students as seemed to them best. This is a complex task but it seems more likely to succeed than the traditional hit-and-miss lockstep which has held sway in schools of all descriptions for as long as they have existed. It is, in a way, more a return to the far older tradition of apprenticeship which rested first and foremost not on experts 'delivering' skills and knowledge, but on apprentices observing skilled practitioners at work and doing their own thing with the most advanced tools available.

After all, universal education is a recent development. Although schools of sorts were to be found in ancient civilisations, they were only for the privileged and, within that privileged set, only for those of the male sex. Until this century most people learned what they needed to know in order to function in their allotted role in society through apprenticeships - not necessarily formal ones. From earliest times, with gender roles clearly defined, girls learnt their housekeeping roles by
being in the home with their mothers and grandmothers, helping them with their duties and gradually being allowed to do more of the tasks themselves. Likewise, boys went out with their fathers in order to learn how to be ‘men’. Both boys and girls learned by example – from role models – and they learned by doing. The ‘lecture mode’ was more or less unknown except for religious purposes. It is, after all, purely an economical – although not necessarily effective - method of instructing large numbers but is nevertheless beloved by many, including those who pass judgement on classrooms. They believe they can see what is happening because they equate instructions given with lessons learnt.

So, was that move away from lockstep to SMILE in 1972 the beginning of a better mathematical education for all children, or is universal schooling of any form only capable of awarding to the majority certificates of failure rather than success? Is the school, with its built-in selectivity in so many aspects, essentially an exclusive rather than an inclusive institution? The thesis of this book is that the SMILE approach - that is individual-centred education programmes specially devised by the teacher for each of her students - and with the teacher creating some of the learning materials – offers the best chance of learning to every child in the 21st century not only in mathematics, where it originated, but right across the school curriculum. It is interesting to note that currently it is where education is found most difficult – for those who are said to have special educational needs – that individual-centred education programmes have become mandatory. Elsewhere, such individual approaches can only be found in a handful of ‘alternative’ or ‘progressive’ schools or in home-schooling.

How was it that the mathematics teachers, many of whom had linked up in 1972, managed to continue to provide exciting mathematical environments for their pupils? The first element guaranteeing continuity was the passionate commitment of Smilers to their subject and to their students. The second was the group dynamics of solving their own problems together – they challenged and inspired each other. As we have discussed earlier in the book, SMILE courses were examples of what had come to be known in the area of business and management education as ‘action learning’.

‘Action Learning’ was pioneered by Reg Revans and Jim Mayhew clearly shared his views – although he may never have heard of the man himself. Revans believed that many of society’s problems sprang from a perception of education based on an over-obsession with facts transmitted from the educated to the ignorant, a Gradgrindian view in other words. He believed that, rather than asking experts to solve their problems for them, it was in sharing and solving their own problems together that managers in industry and commerce would learn.

Likewise, Jim Mayhew had recognised that the teachers he brought together in 1972 were all looking for a way to create more effective learning environments for the mixed-achievement groups in their classrooms. He believed that they had a clear vision of what was required and that, if given appropriate back up, they could together write the new materials they needed to solve their own problems.

He and the group of teachers who joined him believed with Revans that “there can be no learning without action and no action without learning.” With Jim, these teachers had recognised that for non-selective learning groups they had to change their role and they were convinced that, as a group, they could, themselves, create much more effective learning environments for these - to them – previously unknown groups. They stayed together because they were given the backing and the finances to do just that.

McGill and Beaty – following in Revans’s footsteps – writing about trends in higher education, say there is a basic strategy choice to be made between a system which highly controls and structures a student’s experience and “one which develops and relies on the independence of the student as a learner.” Both Mayhew and Revans were after new ideas and they believed with Popper that ‘every discovery contains ‘an irrational element’ or a ‘creative intuition’. Popper goes on to quote Einstein on ‘the search for those highly universal laws … from which a picture of the world can be obtained by pure deduction. There is no logical path’, he says, ‘leading to these laws. They can only be reached by intuition based upon something like an intellectual love of the objects of experience.’

The SMILE group, who, when offered the option, had made the decision to join together in solving their own problems, were given the necessary freedom to follow their ‘creative intuition’ and exercise their own ‘intellectual love’ of mathematics that was required to construct their own solutions to the problems they faced. Turning the pages of those early issues of Splash it is possible to see the cut and thrust of argument about mathematics, education and pedagogy that resulted and to recognise how the writers were changing as they wrote. From the beginning SMILE teachers felt their worst problems were on the way to being solved: Laurie Buxton noted, when ILEA staff inspector for mathematics in 1975, that he visited SMILE schools “with the certainty of finding classes organised and children working”. The group was producing the pupil-friendly resources many of them had dreamt of for years, assignments written in such a way that pupils could work on them at their own level of understanding, with support - but without too much intrusion - from adults. Indeed, these teachers wished to give to their students something of the freedom to learn that they themselves were experiencing.


Life-long learning

As noted above, in general, mixed-achievement groups and individual-centred learning has always been considered dubious. Superficially, the complex organisation of a SMILE classroom could look as if there is no organisation. It has therefore been one of the ‘good ideas’ that are forever being phased out by the ever-increasing restrictions of bureaucracy heaped on schools by successive Secretaries of State of both colours. The centralising bureaucrats – always out for the short-term result – forget that it takes a long time in the world of education to prove the worth of an idea. If your priority is to instil a life-long passion for learning you cannot finally judge to what extent you have succeeded until members of the group with whom you are working are coming towards the end of their lives.

Are non-selective groups more effective in initiating life-long learning than groups carefully selected according to levels of achievement? No one, so far as I know, has investigated this. Why not stick to the short-term goals? They are so much easier to measure! And, after all, to the politicians and the funders it is measurableness that matters. I would suggest that it is the easy measurableness of many short-term goals in mathematics education that has tended to produce such poor teaching in the discipline over the decades. It is easy, for example to ask whether or not someone knows the result of multiplying eight by seven. H. G. Wells wrote that Mr Polly did not know whether it was eight sevens or nine eights that was sixty-three. But, Wells continued, what was more important was that he did not know how to find out. In that simple picture one begins to see the difference between blind rote-learning aiming at short-term goals and some appreciation of pattern, which may not give instant recall of a single fact but guarantees, with a little more thought, an ability to produce a multiplicity of multiplication facts. SMILE teachers did not dismiss all learning by rote but from the beginning the tasks they designed for their pupils were geared to producing a thoughtful response.

But, in spite of all the cold water of bureaucracy and the virtual impossibility of retaining SMILE practice in current secondary schools, SMILE, having erupted so vigorously, has a legacy which so far has proved unquenchable. Why? Since that time when co-operation was relatively easy, the education system has been gradually – deliberately – fragmented, putting school against school through league tables, isolating schools through LMS (the Lonely Management of Schools) and taking schools out of local authority control. The local education authorities provided a wider organisation which could have an overall plan for education in a locality, encouraging and organising ways of sharing not just fiscal assets but those more vital intellectual resources of

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143 See, for example, https://www.stem.org.uk/ and https://smilemaths.wordpress.com/.
teaching expertise and dedication across schools. Such sharing has become so much more difficult.

Fortunately, none of this so-say empowering legislation had been enacted when SMILE happened or the ‘pack of cards’ would not have grown into the rich and flexible resource bank of material, capable of producing a fit for the needs of the whole achievement range in mathematics at secondary level, which it is today. SMILE would never have been capable of standing on its own for teachers who were non-mathematicians dragooned into taking over and guiding mathematics classes unless the original Smilers had been given opportunities for further learning themselves, calling in whatever expertise they felt necessary to help them in their task and so growing themselves along with the resource bank.

**Necessary and sufficient support**

The sort of support required for teachers to progress along new paths and to produce the innovative materials they needed could only be supplied by a large local organisation which was sensitive to the potential it had within it and was willing to put finances into backing that initiative. The preamble written in 1985 to a document explaining the duties of the director and deputy director of SMILE states:

> Schools moving over to SMILE look for and need long term support from the Centre, not least because of the major change of role teachers undergo when moving to effective mixed ability teaching.

Throughout all these SMILE / ILEA years the continuing existence of SMILE centre staff might have said to be fragile. Their contracts from the beginning were temporary. As each academic year drew to a close the staff, including the director, were often waiting to hear whether their contracts had been renewed for the next year. In 1985 memos were exchanged between the Staff Inspector for mathematics and the Senior Staff Inspector, Staff Development concerning this uncertainty of tenure for the Centre staff. Although wardens and deputy wardens of teachers’ centres had had permanent posts since these institutions were set up, the SMILE staff, including director and deputy director, were classified as advisory teachers.

Advisory teachers’ posts in the ILEA were temporary as a matter of policy. They were often appointed to support projects which ran for a very few years and, for professional development reasons, it was considered that they should after a short period return to school with enhanced skills and experience. One of the ways in which SMILE proved unusual was that it went on and on and on – indeed more than forty-five years on it is still offering remarkably appealing and challenging materials for the classroom, although it has lost most of its other
attributes. Legislation has made it increasingly difficult to get groups of teachers from a large number of schools together to generate new ideas for use back in their own schools. By the mid-eighties, when these discussions about the status of advisory teachers were taking place, there were already difficulties in getting teachers released from school in order to edit materials, write exam papers and so on. The editing meeting planned for 3 January 1986, for example, had to be cancelled because it seemed “very unlikely that any classroom teachers will attend”.\textsuperscript{144}

Support was also provided by extra advisory teachers and the job description written for such a post in 1987 gives extra insight into the culture of the SMILE classroom:

Centre staff are involved in working with teachers in schools throughout the authority. The individualised nature of SMILE means a change in role for most teachers accepting the project. The role of tutor counsellor allows for an atmosphere in the classroom in which the adult is viewed by the pupil as someone to turn to for help and guidance. It is possible for a SMILE adviser to visit a classroom without interfering with, or imposing upon, the authority of the teacher. In fact, the visitor simply becomes an extra resource in the room. Given this atmosphere, one can participate in whole lessons, at the same time obtaining detailed information about the teacher, the classroom and the mathematics department. Discussion based upon a visit to a SMILE classroom can therefore be extremely fruitful whether with the individual teacher or with a department. Because the adviser will have taken part in the lesson the teacher is not only able to view the adviser as a colleague but is aware that she/he has experienced the particular problems of that classroom. Where teachers have themselves chosen to adopt SMILE they have, in one sense, joined a group. They are therefore receptive to comment and criticism.

As the 1985 SMILE document defining the roles of the SMILE director, deputy director and designer goes on to explain:

\begin{quote}
In the sphere of mathematics education, SMILE has a world-wide reputation. Its materials are used as far afield as Australia, Canada, West Africa and India.

The success of SMILE’s development has been to a large extent due to committed teachers and staff who have been responsible for its evolution. It has also come about because of the Authority’s flexible and imaginative response to grassroots initiatives. The young scale 1 teacher originally seconded to coordinate the developing project was, over the years, gradually up-graded to become the Director of SMILE as the project grew.
\end{quote}

\textsuperscript{144} Letter from Hilary Povey to SMILE departments 10 December 1985
Final words

As education is organised at the beginning of the 21st century, with very little mediation between the national policy and the individual school, it would be well-nigh impossible for such an initiative to be considered, let alone brought into being. But this book is intended as a testament to what is possible when there is the political will available. Hilary Povey writes:

*The materials survive and remain some of the best available for supporting mathematical thinking for young people working at all levels of attainment in our secondary schools. This is a valuable legacy. An even more important one, however, is the example of a very different educational world from the current one. Telling the history of SMILE and thus keeping alive the knowledge that other ways of working, knowing and being are possible is a vital bequest. I was shocked recently when I had a conversation with an intelligent young woman who was working on an assessment project with me and another old Smiler. She had completed a PGCE with distinction at a prestigious university and had taught mathematics for three years in a secondary school, gaining promotion even in that short space of time. She had now left the profession because she was already bored. It was well-nigh impossible for her to imagine a mathematics lesson that didn’t have three parts – what on earth could we be talking about? – or to see herself as independently crafting a mathematical learning experience for students where her insights and understandings were of the first importance, rather than, largely, following a script. I am happy to say that after a day when the three of us worked together, each of us putting forward and arguing about quite passionately held beliefs connected to mathematics teaching and learning, she was able to say ‘I see. Hmm, perhaps it would be interesting to go back to teaching mathematics after all’.*

*I remember at a meeting about SMILE for non-Smilers about twenty years ago a mathematics education colleague asking ‘If you were starting again, would you create SMILE just the same all over again?’ I thought this was a very interesting question and, I guess for me, the answer is ‘No, not quite’. I would probably emphasise more whole class activities than I had envisaged being possible in 1972, more opportunities for more extended work than I achieved in my SMILE classroom, more frequent use of structured group work than I employed. But this is as it should be. A major strength of SMILE was its ability to adapt and adopt new insights generated both within the project and outside it. However, I return often to the materials for use in my mathematics teaching at the university; I cannot forget the excitement of young people working together co-operatively and independently in SMILE classrooms and feel enormously privileged to know that this can happen; and I, and hundreds of other mathematics teachers, have been indelibly touched by a vision and a range of possibilities that are needed more now than ever. A vision of co-operation, mathematical excitement, mutuality and real learning.*
So, this book stands as a reminder that:

*It is teachers who have learned to modify curricula, develop new teaching and assessment strategies and deal with the myriad of social problems society has dumped on our schools. Teachers have made these adjustments out of their desire to serve pupils not because of bureaucratic mandates. Pupils are not standardised and teaching is not routine. Good teachers are necessarily autonomous in professional judgement … They do not need to be told what to do.*\(^{145}\)

Stenhouse (1984)\(^{146}\) captured this idea well:

*Good teachers are necessarily autonomous in professional judgement. They do not need to be told what to do. …it is the task of all educationalists outside the classroom to serve teachers; for only teachers are in a position to create good teaching.*

Teachers have made these adjustments out of their desire to serve pupils not because of bureaucratic mandates. Pupils are not standardised and teaching is not routine. Teachers need knowledge of child development, multiple teaching strategies, a variety of assessment approaches, as well as insight into children’s ways of learning. Historically teachers have been treated like semi-skilled tradespeople. The sooner teachers are seen as knowledge workers, professional educators and leaders, the sooner schools will improve. I hope this book shows one way this might be accomplished.


\(^{146}\) Eds: we have been unable to trace this reference.
Thanks go to the executors of Ray’s estate for helping to ensure that her work on SMILE is acknowledged and that her record of SMILE’s development and practice is available for readers now and in the future.

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This story, told by Ray Gibbons and others, is one of teacher and pupil power, supported and encouraged by a trusting local education authority. It details the growth of a teacher-led mathematics curriculum project - SMILE - from its beginnings in Chelsea School for boys in London through to its gradual demise once the Inner London Education Authority was abolished. The project fostered independence and creativity in both teachers and pupils, tackled head-on issues of inequity and prejudice and produced classroom resources still regarded as amongst the best to be found.

In the current policy context, with its emphasis on ability thinking and teacher-led whole-class work, the book contains much food for thought for practitioners grappling with providing good mathematical experiences for all learners of all dispositions. It is a story that can connect present day teachers with important currents in the history of mathematics education in English secondary schools, reframing the possible and challenging “common sense”. There are key messages for any educationalists looking for a fresh approach to teaching and learning mathematics in our schools today.