- Classrooms/Technologies -

During the seminar discussions, especially those built around artefacts and photographs, I became interested in the special tools of classrooms, their presence in rooms and cupboards and the ways in which they were used by teachers and pupils. I remembered from my own teaching experience the epidiascope I had used in my first year in an innovative social studies dept, my final encounter with a Gestetner printer, the use of coloured pens, the two day closing of a wing of the school to make a film recording of a single teaching lesson, the whistle used in the corridor to change social studies topics... Then I thought of the form of the lessons in social studies, the combination of discussion, worksheets and groupwork, which took place across the age range within late Edwardian classrooms and how it emerged and was kept in place. Past accounts I had collected from teachers followed : were there stores of now unused educational film slides somewhere ? what did it mean when it took a Fifties school forty years to finally remove its original class furniture? Why did school inspectors tell teachers the right age children could use an ink pen (and where did this information come from)?, Had the design of a board duster ever changed? What happened when the designed purpose of a classroom tool is overtaken by a shift in practice? for example, desks with inkwells and storage space, windows placed high on the wall, a teacher's dais, partition walls, and most readily to hand, textbooks and readers. In the social studies dept, we regularly amalgamated classes to watch films together: ordered films that were often unconnected with current class work. Only later had I recognised the circle of meanings that the film was at the centre of, and that this was not a random act or at whim. Film , motivation, interest, new technology, 'these kind of children' and social studies were all linked together and produced its practice and reaffirmed meaning. The tools appeared to operate within networks of meaning although these networks could be obscured, deteriorate or be reinvented in new ways over time. For example, I knew no longer the pedagogic function or curriculum innovation that epidiascopes were invented to sustain or that came into being through their invention yet I used it for my purposes anyway.

This paper emerged from a recognition that I was treating the classroom as a known and yet invisible part of teaching and yet, as a pupil or teacher, I had worked in very different classrooms (a Victorian period elementary classroom, a 1950s designed primary school room etc) and should have been sensitive to setting. Concentrating on recovering the histories of teachers from administrative narratives, I had taken either the individual life or some form of collective life, in which the classroom was the place they occupied briefly or less significantly than other places. These 'places' could be the marriage bar, strikes, social associations, activist campaigns and so on. So, while the the idea of the classroom was ubiquitous I realised that I had not treated it as

significant. I think that this was partly because I had no way to develop a conception of it. Nor had I thought through my relation to it. I recognised the classroom as a place of work, I recognised that inhabiting it might mean domesticating it, and I recognised its privacy. My underdeveloped recognition of the way the physical environment (read classroom) affects me might be shared by others viz. Malcolm Seabourne, the specialist historian of school building in England, began a book by stating that teachers were much more influenced by the physical environment than they often realised - 'at any rate consciously' (Seabourne, p1).

Yet in the early Eighties, I had co written an essay , the Educational Worker, (Lawn and Ozga 1981)which had argued a version of the Braverman labour process thesis on teaching. Within this argument there was a strong emphasis on the technologies of teaching and the relationship between them and the teacher. In the Braverman thesis, technology is used to harness and control the worker and cheapen the cost of production. At the time, my questions were about computers and their ability to replace workers, speed up work and remove craft knowledge from the worker. The worker and the machine is a powerful coupling in other fields of research but this image did not easily fit the idea of the teacher in the classroom; a teacher who seemed to lack sophisticated tools and to be in charge of the pace and modality of the classroom. The failure of technical innovations, such as programmed learning and microteaching, and the teacher's fear of technology seem to give little substance to the idea of such a powerful relationship within education.

I want to use this paper to raise questions about how to define teaching tools, designed environments and teachers and the relations between them through a necessary argument about the scope of technology in the classroom. These questions are produced to enable a new perspective on classroom technologies to be developed , enabling the tool to be placed within a methodological context in which its creation and use, its relation to ideas and pedagogy, and to teachers and networks are available to historians.

Technology/ Classrooms

Technology has become synonymous with hardware and earlier, with physical objects, which have tended to be seen as quite separate from the teacher; they appear to exist within a subsidiary and minor role in the classroom, although when marketed , they may appear to be capable of replacing the teacher. But technology is more than sets of educational objects. Technology can be defined as a tool and as an approach. It is the science of the practical, the systematic application of solutions to the practical situation. The systematic solution may not result in new hardware but a redesigned sequence of events or a rearrangement of people and objects. Technology can be defined as a tool and the thinking the tool represents, it is both. In a simple way, the classroom is a technology; it is a design solution, or series of solutions, to a problem. It is at the same time, a simple machine, a process of systematic solutions and a particular way or thread of thinking

about using technology.

Bijker et al (1987), in a collection of essays in the new sociology of technology, it is possible to use the term technology in a number of ways. Technology can mean simple objects or artefacts (a reading primer, for example), a process (a production process) and the know how or tacit knowledge used in creating the tool or managing the process. In education it tends to be used mainly in the first sense and rarely in the second. Street's definition is helpful
technology refers to the way in which the parts are organized, through the application of knowledge, to realise their particular purpose (Street p8)
So technology is the tool and the social processes within which it is created, contained and used.

When Dreeben (1970) used the idea of technology to explore the nature of teaching, he used it within the sense of a systematic solution, a means by which a job gets done. While not excluding hardware, teaching technology means organizing the instructional process, motivation and control and varying classroom design and social relations. The latter included
... numerous attempts, both architecturally and socially, to vary classroom design; by unscrewing desks and chairs from the floor, by permitting pupils to move more or less freely around the room, by dividing the members into numerically smaller units to provide ability and interest groupings, by introducing more than one teacher into the classroom, by introducing inanimate teaching components (such as teaching machines and computers), and by widening the age span of pupils assigned to one teacher. (Dreeben p100)
This is a wider usage than is now common when technology is explained yet it stays within the proper meaning of the term viz the systematic application of solutions in which incipient networks of social arrangements and inanimate components are used to create teaching solutions in the classroom.

However, returning to the idea of physical objects use by human agency in the classroom as a means of educating and controlling, there is a gap in our knowledge about why these objects were constructed and consumed or how they were used within single or integrated solutions. Classroom tools are often referred to yet more needs to be known about their origin and relation to tasks and each other. Kulikowski offers a fascinating list of necessary inventions which are used in 'study and instruction'. The list is of general teaching tools, for example,' 1780 steel nib pen, Samuel Harrison, England' '1795 graphite pencil, Nicholas Conte, France' and 'c1940 overhead projectors in bowling alleys, AMC Inc, USA'. Kulikowski is interested in the the acceleration in the technical requirements demanded of teachers; in a short preface to the list, he discusses the necessary invention of chalk for the classroom. Chalk allowed the teacher to manage a larger group, display text and graphics simply and allow the pupils to sit and see from a distance. The list is of value as it draws attention to the technologies of the classroom but there are difficulties associated with it. Why is the invention of the electric light excluded ? It is not a teaching tool, according to the

list criteria, yet it is an essential element of other tools, for example, the movie projector. The exclusion of electricity renders a part of classroom history invisible. In what way was the classroom designed or organised differently because light was available in a new, accessible form?

The list raises other questions. What significance does the cost of an invention have? While the invention of the standard rule can be related to new pedagogical flexibilities, did the cheapness of its production affect its spread ? Again, is there a presumed relation between the tool and its use in the classroom ? So, the invention of the tool does not explain its adoption, use and its relational capacities in the classroom. The exclusions from the list helps to obscure the wider question of how the tools are placed in relation to each other to create a system. The tools can be observed in the classroom but often not the whole technology which relates them together, a point I would like to return to later.

In a strongly technological determinist argument, McClintock argues the case for printed texts as the single greatest invention for education which enabled the rise of modern schooling from the 16th C. Schooling was created by the technological breakthrough of the printed text; it was due to the text that the city bourgeois were able to create the prototype school which then, McClintock says, grew with developments in transport technology.
'Printing gave rise to the technical strategy employed in modern schools: to use inexpensive printed texts as effectively as possible as a foundation for educational efforts, redefining the task of education'
McClintock treats the printed text as much more than a simple tool for enabling the formation of systematic instruction. Instead, he sees it as a complex technological development which created a raft of material conditions affecting the ordering of schooling. For example, the physical nature of books 'necessarily influence the way that educators organise schools'. The centrality of the book determines the entire system for McClintock; it involved problems of physical distribution and transport, classification and division of texts, ordering sequences and shifts in groupings. The use of the text created problems that the shape and evolution of the modern school resolved. Indeed, as this is part of an argument about the power of new learning technologies, McClintock argues that the school has ossified around the book; the physical load of the book necessitated a limit per subject and the schools are now ordered by this original technical problem (load and distribution) so that self direction is thwarted by the lockstep of the class etc.

Although the final reasoning might not convince, the argument about technology and the classroom has advanced again. A tool (in this case the book) is not just invented and used, it it may determine the shape of the school. Its use involves a number of problems which have to be resolved. The interrelatedness of technologies create complex problems which affect how schooling is designed or evolves.

In his interesting book on technical learning in the 19th C and the way it shaped school practices, pedagogical thinking and tools, Stevens (1995) showed how the necessity to teach sciences in school created problems of explanation which new texts had to overcome. In addition, teachers or small manufacturers had to invent new apparatuses to explain visually the abstract natural forces. First a 'cabinet' had to be provided, to display models and other necessary materials
Everything from stones to skeletons, levers and electrical apparatus found a place (p73)
The essential equipment for needed for demonstration was listed by one lecturer in 1830 as a timepiece, maps and globes, a blackboard and an abacus or a numeral frame.(p75)

Stevens shows why certain tools were invented, how a new pedagogy of visual demonstration developed which needed these tools and how teachers and others became involved in their manufacture. A fuller version of technology is at present here so that a network of people and objects originate and manage a systematic solution to a problem: tools, processes and know-how enable the science classroom to work.

Form, Space and Function
Widening the scope in these areas, it is possible to see the classroom in a further way. As a unit within schools, it is not just the home of technological processes it is also a designed technology itself. As part of a building designed for a purpose it contains particular forms, spaces and functions, all of which express intentional usages by teachers and pupils.

For the purposes of this argument, it can be said that historians of education have privileged the actor over the wider technology so that a focus on the teacher or the curriculum (or more often on regulation and site narratives) has treated the classroom as invisible. Sometimes this is a difficulty an historian has because of the complication of classroom reconstruction, more often it may be that remaining sources are not available for this type of research. The problem of classroom reconstruction from the perspective of a sociology of technology, is that physical tools maybe left but become separated from their located meanings: for example, in their operation, their place, their interrelationship, their necessity and their value to the teacher. In this case, the difficulty is made worse by the invisibility of the classroom as a technology. It is a common occurrence in teaching narratives for the shape, awkwardness, irregularities, exits, convenience, site periphery and heat/light qualities of the classroom to be mentioned. They are significant to the teacher and can be treated as part of a discussion on work, resources or learning. Design is treated as a quality of the architecture and building yet there is a level of analysis missing, I think.
If the classroom was designed with values and purposes built in, which shape the work and behaviour of the teacher, then what were those ideas and how were they turned into machined solutions?

There is a limited but interesting field of study on schooling in the UK in which a narrative history of post war architectural developments in school building and design is created. Concentrating on the innovations in school design and construction in a period of massive educational reconstruction, this field is a formal record of the use of new technologies of aluminium on site construction, fibre panelling and shaped wood. The contemporary English primary school, usually in the city suburbs, built in the building boom of the 50s and 60s, is a creation of these material innovations. This period of school building is now finished and these schools now exist alongside the other distinctive English schools, usually in the inner city or town, which were created in the building boom of the late Victorian period (1880-1900). These schools are brick built, inner and outer, have high ceilings and poor natural light; classrooms have either part glass partition walls (looking into a shared hall) or brick walls. A primary school teacher in a large city is likely to have worked within both of these designed environments.

The post war schools are represented in the numerous photographs taken to illustrate the rebuilding of society and are symbolised by children playing/ working in sunlight in friendly, well lit classrooms. The Victorian schools are less well represented but exist in contemporary photographs of ordered classrooms and curriculum improvement. Taken together, the contrast is of light and dark. In each case, the photographs are to be read as a sign of the material improvements in schooling , at the start of state schooling and at a significant stage in its development. The field of school architecture study tends to work with biography, technique, regulation and administrative policy and reveals the solutions to problems of construction and design and the social ideas present in the design of schools. It is the latter which are fertile ground for an inquiry into the classroom as a technology.

According to Thomas Markus (1996), the material evidence an educational historian should look at, in for example studying schools,
'is in the buildings which were adapted or purpose built, the space thus created, and the material contents of this space - furniture and equipment. Above all, it is in the order imposed on the human bodies in this space, down to their tiniest gestures, including the gaze of their eyes.' (Markus p. 12)
(Markus is almost echoing here one of Seabourne's teachers who said to him 'that in his experience the building made the teaching method (Seaborne p1)).In this material evidence, there is a fixity of form and space; in the Victorian school design there is an emphasis on control of movement and visual surveillance. When Markus 'reads' the Victorian school as a text, he finds evidence of a concern for moral force in its architectural symbols and ordering of space, a cost benefit analysis of necessary institutional cost and an emphasis on hygiene and hierarchy expressed within structure. The separate classroom was sign that teachers 'suffered less supervision, were trusted to be more independent, and had greater privacy' (Markus p50). In other words, the classroom was designed and built to represent and shape a particular form of teaching

behaviour. Markus, drawing on a spatial analysis of 19thC schooling reformations (such as the Wilderspin school), argues that the simulation of the predictable order of the machine was one of the ways that social control and power relations were built into the fabric and design of schools. Such a spatial examination of schools would concentrate on how the building is designed for use (flow, observation and constraint) and the way in which the fixedness of the material technology shapes its function through order, classification, compartmentalization, segregation etc. This argument is not just about the late 19thC Board schools of England. The way a school is designed to work is a reflection of the social ideas on institutions and education it is created to further.

In David Hamilton's history of forms of schooling and the creation of the classroom (Hamilton), the social ideas expressed within the form of the classroom were mass production and social efficiency. The classroom emerged from the confluence of two forces, the social and the technological. The social philosophies , such as the social efficiency or industrial efficiency movements, emphasised this particular form of school organization , social control and differentiated courses. For Hamilton, the technological refers to school architecture, time and resources, placed together within a particular pedagogic form. He describes a system of schooling as 'batch' production to show how it resulted from the expression of industrial efficiency, social control and technology to produce a managerial and material form which is intended to reproduce a specific practice. The classroom was invented, together with a teacher, furniture, texts and aids, to produce a designed effect.

Markus and Hamilton raise questions about the operation of the classroom which focus less on the teacher controlling the space and form, and more on being controlled by it. When Cuban (1984) researched questions of constancy and change in classrooms, one of his categories was concerned with organizational structure. In one passage he tries to isolate this category, referring to it as teachers' working conditions

'about which decisions are generally made by others far removed from the classroom. Design of classroom space, how many students.., required courses of study, district tests, report cards, supervisory rules - all of which are concrete realities over which teachers are seldom consulted yet their presence penetrates classrooms daily influencing in large and small ways what teachers do.' (Cuban 1984 p 48)

In this section, Cuban is trying to explain the lack of innovation in classrooms because of these conditions yet the separation of designed space from the regulations which flow into it may be a false distinction. While space and form remain fixed, function may alter. In later passages, Cuban explains organizational structure through the continuing pressure of productivity; they need to produce order and teach a testable content in a confined space and with a large group of people. The classroom and its regulations are one; the organizational structure is material and produces a certain pedagogic form. This is no accident and to call it a choice is mischievous. He is describing teachers worked by their classroom -

Organizational structures drove teachers into adopting certain

instructional strategies that varied little over time. By structure, I refer to the way a school space is physically arranged; how content and students are organized into grade levels; how time is allocated to tasks; and how rules govern the behaviour and performance of both adults and students. (Cuban p242)
In this section of his book, Cuban explains how the organizational structure, this mix of the material and its ordering, shapes teaching. It drives routine, constructs efficient teaching practices and rations energy and space.

Markus, Hamilton and Cuban are describing teachers worked by their classroom. What they have in common is an argument, derived from social ideas expressed in material and organizational structures, about the shaping of teaching through a school/ classroom technology.

Social Technologies
In 1973, Daniel Bell used a phrase which is helpful in securing the argument about the classroom as a technology. He differentiated between machine and social technologies
The organization of a hospital or an international trade system is a social technology as the automobile or a numerically- controlled tool is a machine technology. (Bell p29)
Technology has been defined as a tool, the process which contained tools and the knowledge about the process or use of tools. In this paper, technology has been more widely defined than is customary in education so that a new perspective on the classroom enables it to be conceptualized in a new way. The classroom fits within wider material and social (organizational) structures.

Is the classroom a social technology, seen as a set of artefacts and structures, and as a set of socially constructed principles, procedures and processes, devised to function effectively and realise its purpose. It will be necessary to see to see the classroom as a hardware and a software; it is the material structure (spaces, walls, furniture, tools), working procedures and a series of ideas and knowledge systems. The classroom is the integration of artefacts and rules and teachers. Within the sociology of technology the artefact is not seen as inactive, it maybe an actor in a network it is part of. The meanings of schooling are constituted by the network of actors (computers, displays, desks, teachers, ancillaries, rules, etc) that constitute the classroom. It is a social technology in which the elements cannot be easily separated even though we have tended to think of it as a space in which the teacher operates freely.

Function, choice, actor, discretion, cultural realignments are all concepts used in architecture, sociology or history to denote the effect that people and ideas have in managing, disrupting and reordering their surroundings. Histories of education are full of the means by which teachers have been influenced by social movements, new pedagogies and new practices.This paper is not about to recreate the idea of a total institution, the classroom, which has been designed to operate in a ‘teacher proof’ way. Indeed the

way in teachers or new tools alter older networks of meaning is at the heart of this approach.

The English Primary School

As a test of the interpretation offered above, I want to look at the post war history of the primary school in England. It is an interesting test because the representations of the classroom and school in the 50s, in image and words, is one of the most powerful in English educational history. The photographs of children in well lit classrooms or in pleasant playgrounds came to stand for the optimism and resolve of the post war reconstruction of education and the political establishment of a new partnership with teachers. The images and words about teachers, particularly primary teachers, came to symbolise the new public and democratic space of education. The professional teacher, empowered by society, is helping to rebuild England, by developing the citizens of tomorrow. They are seen to be growing, inquiring and creating in new, well lit, friendly classrooms with a caring woman teacher to the fore. This whole view of the teacher and the classroom seems to be in stark contrast to a view of teaching as part of an earlier social technology network, certainly Hamilton's view of 'batch processing'. The image is so pervasive that it has taken a deliberate campaign by English politicians, beginning in the early 80s, to lever it apart from descriptions of primary education.

In 1957, the Ministry of Education, in a review of its post war school building, stated that

we see the school no longer as a mere machine for giving lessons but as a social unit concerned with the all round development of boys and girls (Min of Ed 1957 p2)

in a textual context where it is also describing the new provision for school meals, practical curriculum activities and groups in the classroom. This was a review of the response by planners , especially the Ministry's Development Group of architects and planners, to incorporate into their school designs the curriculum philosophies of the pre-war education reports (like Hadow). Buildings were designed to manage the shift to care functions, groupwork, fields of experience (topic work etc) and new forms of discipline. The Ministry and its advisors did this by seeking to *identify the leaders in educational thought, translate their ideas into architecture and then convince clients to try them out* (Saint p192) This translation of current social philosophies (Hamilton's phrase) of education into space and form occurred in several ways.

It was seen by Maclure (1984 p112) as an industrialization of building, using steel fabrication and a design reflection of Modernist concerns with democratic , mass produced buildings. The flexibility and fast construction of prefabricated buildings for primary schools, combined with new building regulations on natural daylight areas in schools, produced new kinds of primary schools. They were often single storey buildings, with glass and woodfibre panelling as key structural features; they were based on a grid system which broke down long corridors, staggered classrooms and paired them. By reducing the need for corridors (by cutting down pupil circulation

through the school), pairing classrooms and decentralising toilet and cloakroom space, they could increase the number of classrooms. They invented the idea of the teaching space (a phrase first used by one of the influential planners); it was a classroom plus a practical activity/ wet area plus care facilities. This design was intended to

offer the options of privacy and intimacy, by decentralising lavatories, or of community and integration, by staggering the corridors and opening them up to classes (Saint p71)

Planners worked with paint manufacturers to produce new colour schemes for rooms and with steel and panel manufacturers to produce structures and cladding. Manufacturers produced technical innovations in materials. A range of furniture, specially constructed for schools, incorporating new data about child ergonomics was designed to encourage the modern teaching methods of group work, activity and movement (Saint p192)

These innovations were created by partnerships of manufacturers, architects, consortia of local authorities and several Ministries. Led by architects/planners, and used extensively after a while on other forms of public buildings, they were designing schools for new functions and in a quite comprehensive way. They were integrating the material into a social system. John Newsom, a key figure in this process, saw it as a

thinking about what good primary education might be and how it could be made possible in building (Saint p62)

They used the ‘best’ or ‘imaginative’ teacher as the model for good educational practice and designed the building that this teacher could use effectively. They even saw the increase in natural light as a way to increase teacher performance; they were designing in performance which they calculated against daylight factors.

Hamilton, studying a later open plan school describes the planned flexibilities of space -

Particular attention was focussed on the relative disposition of space within a school, on the distribution of resources which could be shared, and on the utilisation of unused areas inside and around the building. In turn, there was a blurring of the architectural boundaries that had previously separated indoors from outdoors, corridors from cloakrooms, and classrooms from halls and dining rooms (Hamilton p33)

Material resources, such as books, equipment, writing and painting materials, were very important in this newly designed practice of primary schooling. The new pedagogy depended upon thes new resources. Hamilton offers an interesting insight into their new prominence in the classroom

(the) increased importance of material resources means that they must be located much closer to the child’s working milieu.. (though too costly to be in each classroom). (They) become shared rather than guaranteed (Hamilton p105)

In a distinctive way, new primary schools were designed to be operated to produce a new kind of teaching and learning. In fact, it is unclear whether they were to be operated by teachers or they performed teaching by creating and shaping responses. Pedagogy may have had to follow or rub against or be contradicted by the

designed space it occupied.

Conclusion

In this short essay, I have set the scene for new possibilities in classroom histories in which the designed tool can be broadly defined, placed in relation to others and to teachers/ designers and its meanings and usage verified at different points. In addition, the classroom may be seen as constituting a social technology. Tools and aids, furniture and walls, space and form, rules and meaning all create teaching and are inseparable from it. This view is not technologically determinist as it recognises the way networks of buildings, artefacts and rules/meaning establish the classroom.

Historically it may be possible to discriminate between a classroom as a site of simple technologies and as a complex technology. Design has got closer to the point of production and is not just concerned with the school as a machine of control and social efficiency. As in other kinds of work, it may soon be possible to recognise that teaching has been redesigned itself and the emphasis will be less on the Markus' building shaping a particular form of teaching behaviour and more on the technologies which can make teachers improve themselves.

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