

building learning futures...

a research project at Ultralab

within the CABE / RIBA "Building Futures" programme

Stephen Heppell

Carole Chapman

Richard Millwood

Mark Constable

Jonathan Furness

and others in the Ultralab team

executive summary

Fundamentally, the UK is not building a broad enough, or brave enough, variety of schools. It needs to.

Many of the schools that are being built are unsuited to the changing future pedagogy, curriculum and learner expectations that we can already anticipate. They also lack the agility to cope with further anticipated changes that we cannot yet know in detail.

This exploration requires a substantially increase research effort, but this research will not put the learners involved at risk. There is a confidence that, through engaging learners in the research design process, it will universally enrich their learning and in doing so will progress school standards.

Some simple pragmatic changes could make a substantial difference to the effectiveness of the existing stock too.

The increasing pace of change means that this is already a problem; this research project confirms that it will rapidly become a crisis tomorrow without immediate action in line with the project's recommendations. The recommendations do not provide a menu for choice; each is interdependent and necessary.

Globally there is much good, but isolated work exploring the future shape and design of schools. A better dialogue is needed with and between these research explorations.

School buildings do not exist in a vacuum. The way that teachers are developed professionally, the school curriculum, assessment and testing systems, parental engagement, expectations and entitlements all intermesh with the design of schools.

No one ever said that designing exceptional learning environments was going to be easy and indeed a primary finding from the research is that building appropriate, engaging, challenging, seductive, ambitious, effective, world class schools is highly complex. That complexity is neither well understood nor well documented; it is thus not well implemented either.

Importantly, there is sufficient political commitment and creative imagination in place; that provides grounds for optimism.

Introduction: a changing world

As a nation we are currently building a substantial number of schools, more than one every four days in England and even more in the immediate future. This is welcome news if we are building the right schools, but an accelerating crisis if we are not.

We are doing so at a time of considerable changes in learning, teaching, assessment; new technologies have provided both a catalyst for change and a means of changing. The pace of that change is rapidly accelerating. We therefore need to look critically at the schools we are building:

- are they the able to deliver the highest achievable high standards effectively now and into the future?
- do they anticipate the inevitable general change we know is coming and the specific changes that we can already anticipate?
- do they exhibit the agility that is needed to deal with the unspecified changes that we can't anticipate?
- are we doing the best we can architecturally to improve standards of performance, creativity, teaching and learning?
- are we sufficiently aware of what others are trying elsewhere in the world?
- are we exploring enough new ideas ourselves?
- are we committing enough resources to research and development relative to total expenditure on new buildings?
- are we achieving best value from this welcome capital commitment?

Inevitably, the answers are not straightforward and hence this research project. This research report is the result of a complex year of eclectic work, but it is only a fragment of what needs to be done. Like the Classrooms of Tomorrow DfES research work it is a useful contribution but much, much more is needed.

The world that schools are being designed for is changing, propelled by some powerful drivers. Throughout this research project a clear sense of change emerged at every level. From futurologists to headteachers, and always when we were speaking with children of school age, a powerful sense emerged of exciting change and of an entitlement to respond to it. Globally, new pedagogies are emerging. ICT has been both a catalyst for change and a key tool to bring about that change in learning as indeed it has been in the social and economic infrastructure too.

But this does not mean designing for an unknown future. There is certainty, but it is the certainty of uncertainty (if that is not too trite). Designing for that uncertain future is a tough challenge, but not one that is necessarily out of reach. The pace of change however does signal an urgent need for a clear acceleration in the way that we iteratively design and use our schools. We need to learn fast, in every sense. As we come to discover more and more about multiple learning styles and intelligences, about the importance and variety of the group dynamic in learning, about the interrelationship between community, culture and learning, about the richness of multiple media, or about the many different routes that children can follow in pursuit of excellence, and indeed about the impact of the many drivers of change, so we begin to see how complex and diverse learning can be and will

increasingly become.

That complexity and diversity is rapidly increasing and a very broad range of possibilities for our future schools are emerging from work around the world. At the "safe" conservative centre of that range lie the schools we currently have and the schools we are building. In both those groups some clear changes need to be implemented and tested now if they are to exhibit the agility needed to survive as assets and to pursue the highest standards.

However, on either side of that "safe" centre lie a much broader portfolio of possibilities: a breadth of exciting, plausible, effective school configurations which need substantial further exploration. Much more research and development is needed to explore these possible new future school designs. This work is so overdue that we even lack a vocabulary to use with radical design alternatives. During presentations from the finalists of the useful DfES Exemplar Schools initiative (itself a useful step towards the type of exploration that is needed) this lack of vocabulary became apparent as the design teams variously described their "rigs", "testbed", "pods", modules", "pavillions", "clusters", 'elements" and more. Investing in the renewal of a "safe" school building stock without investing far more substantially than at present in research exploring radical alternatives is not justified. We cannot easily evaluate alternatives because we haven't built any, or at least not many. It is very hard to see how we might optimise learning without a considerable diversity of solutions and we do not yet have that diversity in our portfolio of possibilities. This is no reason to halt the valuable capital programme, of course.

None of this is helped by a complete lack of agreement about what learning is. Dialogue with architects revealed that whilst they can design with some precision to minimise heat loss from a building, the target of minimising a loss of potential learning through good design is considerably more elusive. Different schools, different children, different cultures, different contexts at different times will embrace different definitions of that potential learning and these need to be given voice, challenged and defended.

We can be certain that there is much still to learn about what makes effective learning and that new pedagogic knowledge must be capable of being incorporated into our schools. The "Designs for change and the drivers of change" section below deals with the changes we might expect and with the velocity and direction of that change. There is much to be done to respond to these changes with innovative design.

However, it is also clear that school design is only one of the limits on the ability of a learning organisation to respond to the future changes. Although when we spoke to teachers about bad learning experiences they very often discussed design, when we spoke to children the key barriers were more often organisation, meaningless rules, unfairness:

*"I sat down and then found I had to stay in that seat all year", or
"he was way better than me at history but he wasn't allowed in the exam room because of what happened in Maths".*

There are many barriers to be surmounted and although a new building is almost always a transformational experience for those within it, the limits on

that transformation may be set by other factors: the micro details of the organisation of the school day, of the administrative structure of the school, the formality of external assessment modes and the tyranny of expectations built on the past behaviours; all these impact on education and conspire to limit its ambition for the learners within it. A few radical schools world-wide are exploring all these factors; not enough of this work is being done, or monitored, in the UK.

The work reported on here is focussed directly onto the evolution of pedagogy in the school sector and its implications for design, although schools lie on the greater continuum of lifelong learning. It is worth reflecting that the research team saw little evidence that other sectors and learning organisations had made even the small progress that schools have made. Clearly with so many organisations now espousing the rhetoric of being learning organisations the design of learning spaces outside of the school sector represents a even greater challenge for policy and design. Schools have at least begun their progress, others have not.

This research report contains details drawn from the most eclectic of sources over a full year; it offers some solid recommendations which need to be acted on and it offers some lightly drawn scenarios to provide a provocation for the many creative people involved in this whole debate. The saving grace of this work, for all the urgency of the need for change, is the research team's solid confidence that everyone involved in the building of new schools, from civil servants to civil engineers, from architects to headteachers, from children to politicians, bring to this area a wealth of creativity, of genuine involvement and of a passion to make UK schools the best in the world. Knocking down the barriers that allow them to do so is a relatively simple task compared to the struggle that would be faced if they were less creative, less talented or less committed.

Methodology

Unhelpfully, tomorrow's pedagogy is typically a theme explored through speculation, clouded by doubt, guided by prejudice and spun by marketing.

To be confident of this research project's emergent certainties and conclusions, the project team developed a highly eclectic and iterative methodology. There were a substantial number of school visits and return visits exploring schools around the world, there were informal and formal interviews with planners, pupils, futurologists, teachers, headteachers, architects, designers and more. New technology was harnessed for new discourse, from digital video to SMS annotations. The result was wide reaching and revealing, lays down a methodological framework for further work, and gave the research team absolute confidence in this document, its recommendations and reflections. The methodology bears some detailed description:

At the outset, multiple visions of future learning were sought from within fiction literature to provide an initial provocation; from Aldous Huxley to William Gibson via Action Comics was quite a journey and in the final analysis, rather depressing. Utilising this and other provocations, a broad range of witnesses were assembled and their reflections were engaged through various devices: headteachers were interrogated in a number of ways, the most effective of which used the on-line community for all 21,000 England and Wales' headteachers, Talking Heads. Using the discourse methodology developed for that community of practice a head's recent reflections on the process of specifying, then occupying, a brand new radical school was posted as a series of video clips. These clips engendered a managed debate with the head herself "in the hotseat" and this pragmatic debate laid down a number of key directions for the research to explore.

Those in broadcast, in new media or in technology hardware were interviewed about corporate visions of learning futures and some were kind enough to contribute powerful video material to the web archive that had been previously authored to narrate those corporate visions. It was a difficult time in the technology cycle and three quarters of the "corporate visionaries" we interviewed were out of post before the research project was concluded. Following the lead from SchoolWorks, joinedupdesignforschools and the research team's own past research the authentic voice of the learners themselves were sought in a number of ways, including an innovative SMS-to-web based question and response that the project team designed for use with non-school based groups (like Scouts). They also collected children's sketches and drawn thoughts, seeking to keep away from purely textual notation and this considerable archive was effective and revealing. too

A range of education policy documents from Singapore to Sweden, were explored to help establish the vectors and velocities of policy change. Seeing the very considerable impact of the development of virtual learning spaces, a day conference was commissioned to put the architects of these virtual spaces in dialogue with architects of physical learning spaces. And the project team took advantage of every opportunity to visit innovative schools and to talk to their teachers and learners, around the world. The project team tried always to return at least once so that a dynamic was observed,

rather than a single static view. There were also a very considerable number of innovative projects emanating from within Ultralab, where the project team are based. In the nearly 12 months of research they were able to maintain an interrogation throughout all these projects exploring their impact on future technologies and the built environment that might house them.

There were some areas where new work wasn't needed: for example the project team already had access to a recently completed and detailed "technology watch" report for a substantial European m-learning project, which was a valuable starting point. Past work also proved valuable: the team also had full access to the unique resource of children's contributions to the millennium Tesco Schoolnet 2000 project. This huge body of children's work had not, until this point, been analysed as a research resource, but exploring the enormous numbers of children's visions of future schooling was informative and established a methodology for others to follow.

Throughout the research work was shared with a broad and interested "project community" as fragments and details were posted to the project's evolving website, which rapidly started to take a substantial number of "hits" and began to generate feedback too; all this feedback maintained a pace of iteration. Some areas emerged as needing more research, others presented themselves as unique opportunities. For example, although not in the initial project planning the project team sought to harness the views of over 100 lecturers in teacher education with an ICT remit; this group who regularly engage in professional, formal, observation of teaching in ICT equipped learning spaces had some powerful insights to offer into the effective design of those spaces. A seminar, workshop and SMS debate with them were added to the project; their insights were particularly well observed and they comprised a powerful addition. Other areas were less revealing than hoped: a revisit to a 1989 set of future school scenarios ("School 2015") did not offer much insight into the pace of change although the work confirmed some clear directions.

What became clear throughout the research was on the one hand a clear and rapid velocity of change in some areas: technology, children's capabilities, the economic context. But against that a very slow development in some key "gating" areas: assessment and examinations, the professional development of teachers, individual's internalised models of what a school might be like. These different velocities and vectors of change emerged from every element of the research but a final challenge for the project's methodology was the extent to which the project team were drawn into key policy and design decisions after only partial completion of the research work, so that in a recursive way a research conclusion might inform the adoption of a decision, which in turn would partially diminish the research findings by making change happen. This made the research even more complex, but does encouragingly suggest a system ready, willing and rapidly able to respond to the research in this report, now that it is concluded.

In this world of rapid development, international competition and vast investments the project's methodology might best be described perhaps as proactive ethnography. Above all else this eclectic and organic approach left the project team robustly confident in their research's emerging certainties and recommendations, below.

Designs for change and the drivers of change

This chapter explores macro influences on change and the key drivers of that change. There are also many micro influences, more pragmatic in many ways: the impact of eye line on the ability of a class to collaborate; the design contrast between individual task orientated learning and more open ended collaborative learning (for example furniture layout in assessment scenarios); the impact of the timetable on what is achievable (work with cBBC confirmed that that producing good quality, media rich work with children typically requires whole day-long blocks of time); the impact of repellent toilets on fluid consumption and thus on consequent concentration levels; the inflexibility of laboratory furniture (for example the inability to harness drama based activity to reinforce science concepts) and more. These micro influences are embedded elsewhere in the report, below.

This chapter primarily explores the vectors of change, but a meta level reflection here should be that the velocity of change is significantly accelerating. This pace of change, above all else, provides the primary driver, and need, for change in the design of learning spaces.

Social drivers

Just as mobility changes diminished the power of the extended family, so information and communication changes are regenerating distributed social relationships in companies, families and in learning. Current educational political trends as documented by DfES¹ and NCSL² are towards "networked learning communities" of schools and "federations" of school organisations which recognise the need for schools to move from a philosophy of competition towards one of collaboration with resultant economies of scale. Although some of this is still realised through geographical proximity, ICT links do support (as with families) this social cohesion across considerable distances.

But a much clearer and more powerful social driver is the family. According to the 2001 census³ one in four (22.9 per cent or 2,672,000 dependent children) live in lone-parent families - 91.2 per cent of which are headed by the mother and this is an upward trend that impacts on schools' role and function. A survey carried out by the Institute of Child Health⁴ of 800 single parent families shows, for example, that when money is tight more than half (53 per cent) still have to skip meals to save money, with more than one-quarter doing so often (28 per cent). Asked what were the hardest things about being on a low budget when money is tight, one fifth said not being able to afford school-related or social activities for their children. It is clear that the school's role in society is thus becoming more important. For an increasing number of children who live in split households school may provide the main framework of stability.

Paul Kenny, from the GMB Union, said: *"These figures demonstrate the absolute necessity of employers adopting family-friendly policies to enable these lone parents to participate fully in the workforce. After-school clubs and other supports for child care are also essential"*.⁵ Added to the inexorable trend towards a longer learning day and greater community access it is clear that tomorrow's schools will be much more 24/7 institutions than today's

are, with profound implications for the design of facilities within them.

The needs of the child have become a significant policy lever, every child matters, literally: for example many critiques of SATs are based on the damage done to the child rather than arguments about pedagogy. The media has increased concerns of "stranger danger", with the perception that children are less safe on the streets despite the fact that children are in more danger in their own home⁶. This has resulted in children playing outside in mixed social age groups less. With smaller families the opportunity to "learn" from elder peers increasingly comes largely therefore within the school context. Yet increasingly fears of bullying and social pressures result in schools "locking" pupils into age ghettos with different playtimes, lunch breaks or curriculum time.

"I think the tension between community and security is a real one and it is not surprising that parents in particular feel anxious. I suppose there may be two lines of thought - put all reasonable measures in place and develop a crises action plan or develop schools that are so enclosed that they become fortresses and send out corresponding signals." Head teacher in on-line consultation

The rise of fashionable concepts like emotional intelligence, now included in most educational leadership courses, result in pressure to protect the individual child rather than the child in its communities. The development of minority religious schools further increases social and cultural isolation. In this context school can be seen as a protection, as a "fortress" (see "scenarios").

Against this is a trend to distrust institutional provision. Currently over 100,000 children are "lost" from UK schools⁷ with home schooling, particularly in the USA, growing prodigiously, fed by a new technological capability to provide viable learning communities without building learning institutions. On a population of around 53 million 5 - 16 year olds home learners totalled 703,926 in 1996, rising to 1.72 million by 2000, an annual growth of around 36%⁸. In the UK home schooling comprises just over 1% of the school age population, 150,000 children⁹ but is also growing. This opposite pole from the "Fortress School"¹⁰ leads us towards a de-schooled alternative (see scenarios). Effectively these social trends are broadening the portfolio of possibilities that education might, indeed must, embrace.

Finally, one interesting social trend to observe,(www.policymatter.com), is the move towards a more litigious society. If we take school toilet design as an example, it is clear from much good research that children try to avoid using toilets during the school day.

".. if I was an infant boy in my school I would not want to go into the toilets!!" Head teacher from on-line consultation

This translates into a loss of concentration during the afternoon as a result of dehydration and an increase in urinary tract infections. Given that this is known and documented, why wouldn't parents sue for the impact of this loss in attention thresholds, or damaged health. Sooner or later they will, with a further loss of confidence in today's provision.

Technological drivers

"Future school is paper free

A laptop for you a laptop for me

Australia, Pluto where shall we go?

Holograms so real we love it so!"

Child reflection on future schooling from Tesco SchoolNet 2000

The history of learning technology encompasses a number of clear cycles. Ultralab's Law¹¹ from the early 90s suggests that "With new technologies, between denial and adoption is the space for innovation and that is where radical progress is made" and this can be observed with every emergent learning technology from ball-point pens to smart phones. It is clear that we are in that space in 2003; the research team have indeed observed some radical progress in a number of schools globally, for example The Australian School of Maths and Science, Unlimited, or Chafford Hundred, largely predicated on technological change; this should be a fertile time for school design.

Technology is evolving rapidly. Gordon Moore observed his "Moore's Law"¹² in 1965, just four years after the first planar integrated circuit was discovered. In his original paper, Moore observed an exponential growth in the number of transistors per integrated circuit and predicted that this trend would continue. It has so far. This has profound implications for schools as today's phones, for example, have the processing power of about a ten year previous desktop microcomputer and might be expected to progress as Moore's Law predicts. We are already seeing, in many UK schools, the profound effect of this as the "computer suite" with its fixed rows of CRT monitors and fan cooled, noisy, CPUs begins to look like an inflexible dinosaurs alongside the freedom and flexibility that schools are finding with portable and wireless technology. The research team are confident that these computer suites should not still be being built. An observable trend sees small and personal equipment, like smart phones and PDAs, becoming steadily more commonplace, affordable and powerful. Schools attempt first to ban and then to inspire their use before governments intervene to promote and then mandate adoption. Schools are currently encouraging personal computer ownership at home, or standardising provision at school, whilst most contacted for this research are not yet encouraging "bring any personal computer to school" and are discouraging the use of mobile phones in the learning environment. Rapidly, they will welcome both; history confirms this predictable cycle of deny then adopt, then welcome, for example with ball-point pens and later with calculators in previous decades.

In each country progress is reported as rapid, often more rapid than expected. In Scotland the 2001 School Census¹³ showed that the target ratio of 1 modern computer for every 5 pupils had been achieved a year early. Significant progress was also reported by BECTa¹⁴ in primary schools, who reported 1 computer for every 11 pupils compared to 1 for every 18 in 2000, whilst primary Internet access had risen from 64% of schools to 84% in 2003.

There is an inexorable trend with learning technology away from the "central, controlled and provided" towards the "personal, diverse and individually

empowering". This is not a simple, linear change, but a frenetic tug-of-war with an observable trend line on a cyclical and unstable baseline underpinned by a concern over equity. With calculators we moved from "they won't matter, ban them" to " we should buy some class sets" to "don't forget to bring your calculator to the maths exam" in three decades. The speed of technological change indicates that it will be faster with computers and substantially faster yet with phones.

This is immediately translated in design terms into a tension between providing and enabling. A school's dedicated computer suite vs a wireless network supporting mobile and personal ownership? institutionally provided whiteboards vs ubiquitous projectors for teachers' and children's own laptops, or a tension between places to watch others' broadcasts or participative spaces to make and stream your own video. The trend away from computer suites, whiteboards and content provision technology has been clearly observed by the research team in visits to UK, Australia, Scandinavia, Singapore and New Zealand schools who were early technology adopters. Early adopters report that the more complex ICT enabled tasks and the greater levels of concentration and engagement that accompany them, lead to much less movement with profound implications for the network of corridors and landings design to facilitate the efficient passage hourly of the whole school population. Children will move a lot less.

A significant design implication of this change driver is that these new communication technologies open a door to a world of learning outside of school

"The school of the future will be a community resource, it will be open for 52 weeks a year, 7 days a week from 7.30 am (with breakfast clubs, computer clubs, gym facilities etc.), and will stay open until 10.00 pm (with after school clubs, homework clubs, sports facilities, cyber cafes etc. etc.) It's pupils will be aged 0 to 100 - why not, learning is for life isn't it? "

"the four walls of a classroom/school will be replaced with Online classrooms/schools/homes, ensuring access to technology and information. Without doubt, the National Curriculum would have to change to allow for changes in schools which can only enhance the ownership of the learning process by the children" Teachers' comments in the research project's on-line consultation

International inter-school projects thrive: "Virtual School provides online learning resources, tips and activities in curriculum subjects. The European Schoolnet Community Environment[®] enables anyone to create online communities via a rich set of tools including chat, bulletin boards, file-sharing and web-publishing" and thus the locus of control moves from the individual school to open up possibilities of learning institution, distributed, virtual, unconventional. At the same time the current paranoia about on-line paedophile chat leads schools to close down and limit children to an intra-net which even parents can't access. In this way technology can be seen to polarise learning on either side of the current model of provision.

Phones, interestingly, may have evolved too rapidly to ever become institutionalised, they are never "centralised", rarely "provided", and may pass straight to the acceptable personal ownership stage. As a learning technology they are potentially the most powerful of all; they are always "symmetrical" in nature (as soon as telephone technology let you see video you could also contribute it) and Ultralab's research into m-learning

devices¹⁶ makes it clear that they are as, if not more, important to learning than computers. Personal equipment requires shared collaborative space and whether it is the media rich wall spaces of the Australian School for Maths and Science, the valued projection screens of many current new schools or the ubiquitous plasma screens of corporate Britain, design attention needs to be given to the need to share with medium and large groups the work on small screens.

To date, technology has done a disappointingly poor job of eliminating the most wasteful and tedious administrative functions from schools, but there is a real sense of rapid change beginning to occur; for example registration is currently handled poorly with tutorial groups and all the room, timetable and movement implications that go with it. But with schools like Blackpool Sixth Form College who have 14 years of school smart card experience, a lot is known already about how introducing smart cards can have pupils logged in and out of the premises, saving valuable time, reducing the design need (in organisation and architecture) for dedicated registration space and offering a myriad other savings too¹⁷. We are confident that administrative technologies will continue radically to impact on schools organisation design needs.

Children's expectation and entitlement drivers

Different visions of a future learning world were offered to us by different populations of "witnesses", but it was abundantly clear, as others have found before, that children have some particularly robust views about the learning environments that dominate their lives.

"loos really smell, the corridors are always busy, the walls are boring colours and the seats are hard and really uncomfortable"

SMS consultation with children

The research also suggested a generation who felt themselves moving forwards rapidly, fuelled by technological advance, and who are perhaps less tolerant of an education system that fails to keep up.

A predominant impression confirmed by the children in this research, and from their work, was that they did indeed reflect on their learning at a meta-level. As many have found before¹⁸ they are actively involved in reflection on the learning environment that so dominates their lives and have much that is useful to contribute. Our children witnesses, whether texting or drawing their responses, saw a future for learning with far more large spaces for "doing things" with others. They were unequivocal about that.

"need more outdoor play space"

"..freedom to learn where and when"

" more big spaces"

"More doing places"

"bright light and space"

SMS consultation with children

Indeed in schools like New Zealand's "Unlimited" in Christchurch, where the children's input had been a significant factor in the design process, these large open social "doing" spaces are already very evident.

In this research project, children also championed a less rigid timetable, with greater flexibility and more time spent in the same place rather than moving around, all of which again has considerable design implications. A few schools where the children moved around less were busy "designing out" the corridors, offering the prospect of a cheaper build cost with greater effective learning space and, of course, no "trouble on the corridors". Children were also very clear in their vision that they would often be engaged in learning "away" from school.

"They will stay at home and talk to their teacher on the internet.

They would be able to see their teacher and the teacher will be able to see them"

"We will just come to school when we have PE and a school football match"

"We will have computers so that we can learn from people around the world"

Research consultation with children visiting Ultralab

Working with children in that "away from school" context it becomes clear that, when the task is demanding, they engage in the task for really substantial periods of time. A conclusion from the BBC's "Input cBBC" project that saw children across Sheffield and Humberside making their own television through digital media was that the timetabled time for really creative work to occur needed to be increased substantially⁹. Really large blocks of time were needed and a clear conclusion is that in tomorrow's classroom children will move around less.

However, there is a really large contrast here with current practice. Children were consistent in envisaging a world where doing, and doing with others, characterised their learning, yet where their own individual sense of progress, their ipsative referencing of their own progress against their previous attainment, was highly motivating. Yet schools typically (though not exclusively) sought children working individually, often not "doing" in the sense the children meant it at all, with their individual progress and attainment judged in the context of a ranking within a cohort. The children seek to actively learn together, whilst sensing progress individually:

"round tables for small groups ... at least 7 people"

"places 4 working together.."

Research consultation with children visiting Ultralab

By contrast schools often deliver a model of working alone yet sensing progress indexed to a cohort. The design implications of this mismatch are considerable particularly because of the need to "design for community" which the children's evidence confirms as desirable.

The children's vision of learning elsewhere also emerged strongly from research with others. A number of innovative schools were already timetabling significant parts of the week away from the physical location of the school and the research team met a general acceptance that learning would spill out of the school and into other places, but those other places might include the home, universities, the community, local industry and even other schools.

"Schools will be places where kids are based for much of their time. But they will have separate, carefully planned experiences unrelated to that of school. Schools will work collegially. Pupils can plug into courses, even if they are educated at home"

Tim Brighouse²⁰

Economic drivers

Put simply, education is in part driven by an economy's needs; what the economy needs varies over time.

Developed economies are currently at a time of considerable economic variation and thus of change. Inevitably education is cautious, conservative even, in nature and needs to see economic trends confirmed before the curriculum and pedagogy move so meet them. History informs us that in the agrarian age learning, like production, was small scale, one on one. It was located in existing institutions: the family, the local community, farms, craft teams. As the economy moved on into an industrial age, learning became based on what became a familiar input output model, seeking institutional economies of scale through much larger learning organisations, with a product rather than process focus; the vocabulary of inspectors, standards, performance tables and costs was very much the language of mid-twentieth century Britain. In this economic phase communities were marginally relevant and the alienation, anomie and disengagement that characterised Britain's factories in the 1950s and 60s characterised some schools too. Clearly towards the end of the last century the economy began to be characterised by what some suggest is an information age, but is clearly beyond the agrarian and industrial ages. Whatever the correct term, the economy began to find words like downsizing, agility, collaboration, disaggregation, empowerment, creativity and process more beguiling than the mechanistic vocabulary of productivity. Quality assurance began to supersede the rigidity of quality control. Inevitably this trend is less clearly seen in structurally declining industries and more clearly seen in newer high value industries.

The language of 20 years ago was of capability and quantifiable standards; to accompany this the design of schools spoke largely of efficiency in

moving pupils or in heating and lighting, whilst decor was judged by its impact on concentration levels and behaviours (no orange!). There is now a clear economic imperative driving the needs for agility, creativity, ingenuity and collaboration and this is being reflected in educational policy around the world; for example China²¹ and Singapore²² have both embraced "creativity" in their guiding plans for education. Designing a business environment for creativity is very different from designing for productivity. This can be observed in the design of many commercial buildings for the creative industries. Given that education tends to lag behind economic needs conservatively, it is starkly clear that there is some mismatch between what schools think they should be producing, what the curriculum and assessment systems value and what the future economy will need them to produce. This report signals a real concern that this may lead to significantly inappropriate building stock. For example creative organisations often work in an organic way with teams assembling as they work on overlapping projects; a key skill is the ability to negotiate these collaborations and manage the complexity of multiple working relationships. The traditional "egg box" school design, both organisationally and physicality compartmentalised, with its emphasis on individual endeavour and single task groups in small dedicated spaces, specifically locks children out of the opportunity to evolve and hone these important economic skills. The creative industries and the new economy have not spawned single solutions to their workplace needs; as befitting creative minds they have evolved many solutions. It is likely that schools, responding in part to economic drivers, will reveal a far greater diversity too. That very considerable diversity is not currently present in school design.

Environmental drivers

"I was exhausted; you have to fight every inch to get what you want and all I wanted was to make this a wonderful place for children to learn in and teachers to work in. Somewhere the community would be proud of. We weren't even trying anything radical but it was still so very hard!" Headteacher in consultation at Ultralab

The environment drives school designs in several ways. It is noticeable that architects are often selected for the energy efficiency and environmental sympathy of their designs. Conversely, our discussions with head teachers have indicated that when cash gets tight these features would be the first to be dropped, if the school had sufficient autonomy to do so. This is not because head teachers disagree with environmental aims, but because capital judgements of the school build are not weighed in any way against the revenue judgements of operating the school. To some extent the simplistic view that "if we build a stunning new school we will attract more children" always outweighs the "if we build an energy efficient new school we will save an indeterminate amount of money in the future". Curiously, it is very rare to hear of architects selected because of the radical impact their designs have had on pedagogy, learning, staff retention, examination grades, although there are some good attempts to minimise bullying. Inevitably there is often a mismatch between the design intentions of the school community and the architects.

Whilst impact on the local environment is examined in planning terms, including traffic flows, the cultural and learning impact is considered rarely. Where schools have been designed to bridge the gap between learning and other community activity (rather than simply by the designation of "community

school"; a concept first established by Henry Morris in 1920's²³ they have had an often electrifying effect on the local population. Seeing Discovery1 in Christchurch, New Zealand, designed intentionally in a shopping mall to bring community and learning closer together, and observing the impact it has²⁴, has raises some serious concerns about the extent to which this key aspect is neglected elsewhere. Too often issues of "identity" and "security" end up producing "fortress schools" with a minimal interface with the local community. A litmus test is an exercise we carried out with 30 head teachers: "draw the rough outline of your school on a sheet of graph paper, walk around the school and mark with a cross all those places where the work of your children is shared or celebrated with the local community". Almost without exception the headteachers returned with a blank sheet of paper; very little imagination has been directed to showcasing children's work to the community the school serves. Children recognised this too,

"hall of fame with pictures of kids who've achieved good things"

SMS consultation on desirable features of a learning environment, with children

This exercise has engendered a vigorous debate; time and effort needs to be invested in engaging the community around a school in the processes and pedagogies of learning in the 21st century. But similarly, building a much clearer understanding of what learning is, how it can be progressed and nurtured or stultified and lost is an essential task for the architecture profession and a necessary quid pro quo for the massive investment by governments in their building design work.

Perhaps as a result of this lack of communication of current education's exceptional outcomes, schools also report that planning for more radical school designs often face local opposition as local communities want a "traditional" school. The research uncovered one example where local planners had insisted on a clock tower, because it matched their expectation of what schools needed! Again, this lack of understanding of current and future learning needs acts as a brake on design and an absolute barrier to innovation; it is hard to imagine a community wanting, or insisting, on a "traditional" dentist for example. Communities in general have been much more radical in their ability to absorb changes in their retail and shopping lives than in their schools.

In all the schools visited only one was observed where the whole environmental management was transparently open to the children in it. The complex data collected by the environmental management equipment was consciously displayed for children and indeed was used by them in project work. In this way a very real understanding was developing between the children's behaviour (for example opening windows in winter) and the impact on the environment (for example through carbon emissions).

This simple leap of imagination by school and designers was achieved at minimal cost (the monitoring equipment was already a part of the school's environmental control system - it only required a glass door and a data interface to be added). With environmental concerns being such a significant driver in what is, and isn't, possible in school design, building a clearer understanding of those environmental issues and engaging children in an understanding of them is an opportunity that should not be missed.

Scale drivers

Large schools or small? High volume or low volume buildings within those schools? Large groups of children or small? Scale raises a lot of options for school design. Simple mathematics suggests that in designing containing surfaces large volume is cheaper than small volume. Thus we have large oil tankers and warehouses. But schools have so many specific space requirements (science labs, libraries, dining areas, corridors) that the relationship between scale and cost is often broken. Providing that specialist space in an agile way leads to more expensive construction methods, for example replacing a solid wall structure with the flexibility of a steel frame building.

The uncertainty of size also applies to the teaching and learning rooms within the school. Schools need increasingly to vary teaching and learning group sizes too. Looking around the world and indeed the UK, it is clear that large lectures to a hundred plus and tiny seminar or tutorial groups to less than ten are all being used, and used increasingly. There is no basic unit of learning scale.

Open plan schools seem to offer a cost effective solution, both to cost and to agility. Open plan carries quite a hand baggage of history with it. It was back in the 60s that open plan schools achieved both widespread adoption and then notoriety. The widespread adoption may have been simply a reaction to the dramatic increase in the school population brought about by the post war baby boom, or it may have been an attempt, by counting some spaces twice, to circumvent government building requirements. What was clear however was the speed with which open-plan was vilified and the large spaces were rapidly "enclosed":

"Partitions have since been added to all of the original open plan schools so that there is some visual privacy, but rarely acoustic privacy, between classrooms. Due to recent class size reduction mandates in California, these open plan schools have often been subdivided into even smaller classroom areas than originally anticipated, creating a maze-like atmosphere"

"Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance", 20th August 1999, Hescong Mahone Group, California²⁵

Some of teachers' early dislike of open plan concerned the way that a loss of privacy threatened the autonomy of their classrooms and noise too was a continuing problem. Latterly however, learning in a 21st century world find it exists with multiple media and a more complex sensory environments. A wide variety of adults are now to be found passing through and working within the classroom: classroom assistants, literacy and numeracy advisers, teaching students, inspectors, governors, colleagues. The result is that some primary objections to open-plan have diminished, as a number of radical school designs are finding. The Australian School of Maths and Science (ASMS) in Adelaide was built in 2003 on open plan principles²⁶. Crucially other part

of the learning environment were "opened" too: subject groups and year cohorts were dropped for example. During this project research some of the team from Ultralab watched as some 600 teachers explored the radical ASMS environment for their own teaching and learning. It took three days for them to fully understand, and exploit, key enablers like noise and group management or movement between learning groups and to enjoy the holistic view that evolved of everyone else's learning processes too. In three days the teachers became very solid, reflective, converts. Using radical school implementations to generate design feedback and also using them too raise questions in teachers' minds about the management of learning in other than the "egg box" learning environment is wonderfully effective. This research is needed in the UK.

Given the beginning of a trend back towards mixed age teaching, there is little work to suggest other than that very small schools offer viable, appropriate and delightful learning environments. The principle reason for high marginal costs in small schools is not architectural but administration and it is clear that this is a problem technology can solve with ease. Indeed the UK government is keen on federal schools and network learning communities (where sharing administration exists) but this does not seem to have generated the effective tiny schools that clearly are viable. All this points, again, to a need for considerable research if the poles of possibility are to be explored. The distributed, wired school has not been built in the UK, the enormous school hasn't either, yet both would be viable in the right cultural context and constitute necessary research and development.

Political drivers

Education is not currently a "political football" in the way that it has occasionally been historically. There is a cross-party consensus that improvement is necessary, that pedagogy is changing, that school buildings and ICT capability are vital and that provision is needed in capital and revenue terms to resource that change.

"A workforce with technological skills for the 21st Century is vital to Britain's success" Charles Clarke, speech, 25th June 2003²⁷

"The Government are supporting £657 million of investment in schools' information and communications technology (ICT) provision up to 2002 as part of the National Grid for Learning Initiative. This funding may be used to install new equipment and software and to replace or upgrade older infrastructure." Michael Wills, 26th June 2002²⁸

"the time is right to approach capital investment in a new way to build schools of the future....

...we must ensure we have a standard of school that our young people deserve, inspirational well-designed schools to motivate teaching and learning, and up-to-date facilities to enable us to compete as a world-class economy in the 21st Century"

David Milliband, 26th June 2003²⁹

...and indeed modernising schools rather than modernising teaching or rejuvenating the curriculum has always been something of a vote winner and a popular manifesto commitment:

"Already, up and down the country, hundreds of new modern schools are showing the shape of things to come. Our programme will open up the opportunities that they provide for further education and better careers to every boy and girl; and by 1965 we expect that at least 40 per cent will be staying on after fifteen" Conservative party manifesto, 1959³⁰

In practice obviously the current political commitment is hugely welcome, but it does carry its own problems. Tangible investments like new schools, modern schools, up-to-date facilities, schools of the future, are all easily understood by the electorate, more so than curriculum reform, or more targeted CPD, or new forms of assessment. Unfortunately, a central tenet emerging from this research project has been the clear understanding that moving the design of schools forward cannot happen in a vacuum any more than pedagogy or assessment can be changed on their own. The creation of a new school might be electorally desirable, but without the radical changes that are needed to accompany it there is a political risk of building "yesterday's schools" rather than tomorrow's.

In short political commitment is needed to progress a programme of new school building, but political bravery is needed to progress the necessary accompanying changes too and that is harder for politicians to offer, with some honourable exceptions.

It is, bluntly, as hard for politicians to justify high levels of expenditure on schools without clear evidence of substantial gains in learning outcomes as it is for architects to design better schools without the feedback of better data on the learning that results from their designs. The danger is that this skews school design to delivering on a small set of outcomes (eg GCSE A-Cs) effectively trapping design in the past. Again it is clear that a better idea of what learning gains might result from a programme new school building; this research project leaves no doubt that new schools are transformative and valuable. That value needs to be given better expression and this will help the necessary political braveness mentioned above.

Pedagogic drivers

"For me the classroom of the future (and the school of the future) must promote and encourage the kind of learner we will need for the next century - ie. problem solvers, imaginative thinkers, independent workers, confident social human beings willing to try new ideas. This is a life long commitment." Headteacher in an on-line consultation

Arguably, the post war baby boom defined a generation of school organisation and design as systems and structures struggled to cope with a huge growth in numbers. The "egg box" model of schools emerged with standard learners in standard class sizes, housed in standard rooms, fed on a

standardised curriculum. Inevitably, after a long period of stability in educational organisation and pedagogy some dramatic new directions are emerging. The boldest schools are questioning all assumptions about organisation and management; some electrifying new approaches to learning are emerging as a result. The single age class, often a forced necessity in some primary schools due to numbers, is being challenged by some and innovative all-through mixed-age teaching environments are resulting. The artificial subject boundaries are being pushed by cross curriculum study, the relationship between learning within school and out is being challenged, as children spend increasing parts of their day learning in the community , via the world wide web and Curriculum Online or, in one case, in the "host" university.

The number of adults in the classroom is changing: classroom assistants, adults other than teachers, student teachers, older children (perhaps from another education phase), parent helpers, inspectors, advisers. Classrooms are no longer one-teacher, one-group spaces and yet designing for this (for example with multiple foci) is not well understood. Much of the professions rejection of open plan schools in the last century was triggered by the threat to a teacher's "privacy" in "their" classroom and by noise issues, but although that privacy has long since been breached by team teaching, inspection, initial teacher education, assistants and even parents, and the noise level in a multimedia classroom is already higher, open plan has not been properly placed back into a portfolio of design opportunities for UK schools and yet new designs in other countries had large, flexible, open spaces. Our survey of children's preferences for school designs indicated that children wanted more open "doing" spaces for learning rather than being restricted to an assembly hall or gym.

Pedagogic trends do tend to come and go; currently whole class teaching is firmly back as desirable component in a variety of teaching techniques, but in some areas of many schools, particularly ICT rich rooms, whole class teaching is simply precluded by previous design decisions. We visited one school where a brand new science block had no network connections in most rooms, but where a cramped ICT suite had no focal point, no display or board area and where, in both cases, current pedagogic trends could simply not be countenanced having been excluded by very recent design decisions. We need to build for agility and flexibility to allow for changing trends.

"Flexibility is key for a school of the future. Spaces that can be just that, spaces... These 'spaces' could then be filled with moveable storage, chairs and tables where required. A variety of different shaped and sized 'spaces' would create interest and allow groups of different sizes to use them." Teacher in an on-line consultation

The length of the school day is changing with a mixture of curriculum need, curriculum crowding, parent employment, single parent families and much else moving schools toward pre-school and after school formal activity. This kind of 'longer day school' has very different design needs to a traditional 9 to 3 school (for example a need for better washroom facilities and café facilities with lower marginal costs of use). But these changes are highly complex and frighteningly interdependent: one school we visited where the subject structure had been abandoned found it hard to recruit junior staff (without a subject structure applicants couldn't see career path leading them towards "head of department"); another school produced a learning environment so exciting that it became a target of local union militants fearing for radical changes to the conditions of service.

One of the issues that arose in both our face to face and online discussions with head teachers time and again was the reported conservatism of the teaching profession as a whole. This is almost certainly not innate; teachers are imaginative and creative professionals and the research confirmed this. But the standards against which teachers are judged may be more conservative than the teachers; a nightmare scenario is that the profession starts to move forward, but finds that the new stock designed by the "old" profession becomes its major impediment. Government needs strategies to avoid this disaster.

Many head teachers commented that newly qualified teachers had gone through a system of tests and national curriculum, and learnt to teach using a framework of testing and monitoring. In this climate, they suggested, it was sometimes difficult for those head teachers who wished to innovate with the organisation of learning in their institution to effect change. Teachers are, arguably, not well prepared as action researchers, to evaluate an evolving pedagogy. Without this preparation the feedback needed to iteratively improve design will be absent.

To explore the design of schools today for a pedagogy tomorrow schools must be able, where justified by the research gains, to work outside some of the current constraints on their teaching. We will not learn enough about the schools we need in the future unless some schools now can explore significantly different hours, timetabling, subject organisation, pastoral structures, assessments, testing and much more besides. An important debate needs to be opened with OFSTED to see how the quality assurance needed for this more iterative work can be substituted for the quality controls of current inspection regimes, without risk to children's learning opportunities. A conclusion from this research is that failure to do this will threaten future children's learning opportunities.

Community drivers

"Community needs are also likely to change considerably in the not too distant future. I wonder what different demands they might make on our schools." Teacher in on-line consultation

One really strong emergent design theme, and a local driver of change too, recurred throughout this research. It was Community. Some of the oldest schools, for example convent schools in the UK, were designed around a motif of community and great care was taken to consider not ONLY the efficient flow of children around the premises but ways in which that flow could support meeting, greeting and an awareness of the institutional identity. Designing for community is not just about building cohesion and identity within the new school.

The strength of community designed into a school really does matter. Ultralab's own research over 15 years has confirmed the importance of community in learning. One certainty that permeates everything the lab does is that "deep learning requires deep community". This holds as true with on-line communities of practice, as with alternate schools, traditional schools, large or tiny schools and indeed everywhere. A sense of community isn't

enough; for really deep learning to occur a real depth of community is required and this is a significant design challenge.

This is not limited to community within the school; community also embraces the local context in which a school is located. That context may be cultural, may carry some powerful history, and is inevitably an influence on the school's design. Exploring schools for the research, from Finland to Maori NZ it was clear just how powerful local community can be, and indeed must be, if the school is to achieve the highest standards. This may include everything from a build largely utilising local materials to one with the symbolic architectural cues and clues of an ethnic culture. The Druk White Lotus School in Ladakh, high in the Himalayas, is newly built with entirely traditional materials, but state of the art engineering³¹. Local materials, from willow to the dung that fuels the heating, are harnessed and give the school a real bond to its community whilst Ove Arup's modern engineering gives it seismic resistance³². If education is to embrace local community skills and wisdoms and if the school is to be powerfully connected to local community then this locally bespoke approach is effective. The alternative of an "alien" steel and concrete building immediately sends out messages of rejecting local culture and weakens the important learning links that community can strengthen. This is no less true in a dockside location than it is in the Himalayas and again points to the importance of a considerable diversity in the interpretation of local learning needs. With schools like Hellerup School in Copenhagen utilising considerable local resources it again emphasises the diversity of school solutions needed³³.

"But the biggest impact on the children has been the opportunity to understand diversity, she says. Not only does the school serve a community where more than 30 languages are spoken, it has a special needs unit which attracts children from across south London... Although it is too early to tell if the children's academic performance has lifted - the school has only been open a year - Mr Donnelly says it acts as a signal of hope to a community blighted by unemployment and deprivation".
BBC News Online report on 2003 RIBA Award winner Jubilee school³⁴

A key point to remember here is that in many urban settings community is not static but evolves and reflects population changes and movements, pointing once again to a need for an agile, evolving school. This makes it particularly hard to design generic solutions for multiple contexts and cultures. For example a much needed gain of greater community involvement may be replaced by a necessary gain of better security (by excluding the community) elsewhere, the gain of a more effectively extended school day may be contrasted by a substantial reduction in the administrative within that school day elsewhere. In different communities different gains are more, or less, valued. For example in an area of teacher shortage better staff retention may have the most profound impact on standards. This really does suggest strongly that a much more complex mix of possible school designs will be needed to maximise the opportunity presented by this substantial capital investment.

Design life drivers

Almost without exception school design assumes a residual building value measured in scores of years, with an enduring build quality to match. This

creates the tough challenge of designing a school that will deliver appropriate teaching and learning for, say 2050 or beyond and a clear driver is the assumption of longevity; it permeates the allocation of capital rather than revenue to school design, it makes planners overcautious about what will be acceptable to future generations and it profoundly limits experimentation. Any of our witnesses who had been involved in a new school build reported that the reflection and debate surrounding the experience was indeed transformative, even where it went less well than hoped.

"We have a chance to rethink the total process of learning within a school...This does not mean that everything we do will be different from what has been done before, but it should mean that we do not automatically repeat an established practice without considering why"

"we have been earmarked for a classroom of the future, as they call it. In our case it will mean a new build, its very exciting...never had this opportunity to think about classrooms in this way before"

"You can imagine my excitement when I was told we had a classroom of the future project .. It has been an interesting challenge considering how we can enable children to have access to a variety of learning experiences."

Teachers in consultation at Ultralab

Even with a school replacement programme approaching one new school opening each day (as they did in the 1970s) this transformative experience will be limited to once, at most, in a professional lifetime.

In retail and manufacture and elsewhere premises are designed with a much greater variation of design life. The research team visited an interesting experiment in New Zealand where a school is "assembled" briefly for a very few years (two or three) using design values, and shop fitters, of retail space with a philosophy of constant renewal and repurposing of space, moving from leasehold to leasehold and, by adding value to the overall site through this community focussed occupancy, getting favourable leasehold conditions. Again, this stresses the real need for much more research exploration within UK school building programme. With this unusually short building design life every child and teacher had been engaged in the design of the building they occupied and gained from the meta reflection about learning that the design experience generated. In Singapore we found very large scale primary schools, but groups of around half a dozen schools would share in a cycle of replacement and renewal so that at any time one of the group would be seeing their school replaced. In some instances the "new" school community would be learning within another school as they waited for their own school to be finished. These high volumes allowed relatively cheap building costs with a cycle of constant renewal and consequently a very agile school building stock. When the government decided to add life science laboratories to all primary schools (because of a burgeoning biotech global industry) this could be achieved within less than a decade.

However there is a further compelling reason to explore building some schools with much shorter design lives and that is the need for research and development. An overwhelming conclusion from this research project is that we need to explore a far greater diversity of possible school design types

to help inform overall design decisions. Shortening the design life of buildings in some instances allows us to explore possible school designs without being committed to the consequences for many years. Short design life is thus one essential key to unlock the unexplored potential of a wider portfolio of design possibilities. Without this shorter term exploration the usable life and assumed residual value of many current and future schools will be seriously jeopardised.

Interestingly, the project research suggests that even small design changes within a school can engage staff and children in considerable meta-reflection of the learning process.

The "blank sheet of paper" that a new design suggested in its earliest stages proved to be a catalyst in terms of generating real reflection and a depth of debate about learning that was valued by all concerned even when only a classroom was being considered. In the case of the valuable "Classrooms of Tomorrow" DfES project one LEA concluded that this debate was so catalytic in professional development terms that began to explore recreating the impact through a series of LEA small scale innovations.

Research and Development needed urgently

Much more R&D is needed. This is a fundamental conclusion from this research project: with so many possible directions that innovative school design might follow, a major question is thrown up about the magnitude of the research and development budget for new schools. The budget for new schools is substantial and universally welcomed, but the budget for R&D is not adequate.

There is some good research and development already. The DfES has been powerfully imaginative in several ways, for example the Classrooms of Tomorrow³⁵ and the Exemplar School³⁶ design programmes. But these projects between them amount to relatively little research and development spend when measured alongside the magnitude of the school replacement and refurbishment budget. Measures of "R&D Intensity" usually suggest cross sector average rates of around 3.7% (Europe, 2003), although for industries that are being radically transformed by new technologies, as education is, the ratios can be far higher. In aeroplane design the figures is nearer to 6% for example. On a new school budget of £2.4 billion rising to some £5 billion this would suggest an annual R&D budget of £88.8 million (3.7% of £2.4 billion) rising to an annual £185 million and these figures are very substantially below current annual expenditure. Clearly this research and development can occur in three ways:

- (i) treat more of the capital projects as full R&D projects with additional resources to gain evaluative feedback, including some funding to allow for quite substantial iterative change in original plans where the research indicated a "less than effective" direction;
- (ii) tender for substantially more "blue sky" projects like the "Classrooms of Tomorrow" or "Exemplar Schools" initiatives (and the civil servants who

managed those projects are exceptionally capable as a team to expand this work much farther)

- (iii) finally, dedicate considerably more resources to a detailed exploration of some of the more radical departures in school design world-wide. The global pool of innovative schools spanned a far greater breadth of innovative possibility than the domestic portfolio did. This R&D needs to be in real depth, with researchers attached to those schools for at least a full term and working there researching on a daily basis in a way that the host schools regard as useful too.

In practice the research team considered that all three of these R&D possibilities should be funded, within the budget of no less than 3.7% of the capital budget.

There is a second and further research and development gain to be sought and that is the collection of action research experiences of all schools passing through a new school design and build. Simple pragmatic changes here can make a substantial difference. For example the DfES have explored a contributory database of "design mistakes" and an accompanying one of "good ideas"; this should happen. See also (4) immediately below.

Pragmatic changes needed urgently

This research report suggests very clearly that the portfolio of possible school designs being currently explored in the UK is too narrow; we have built and are building schools that are too concentrated around the centre of those possibilities. Furthermore, even at this centre, the current stock and the newer designs replacing it need greater agility to be able to cope with the uncertainty of future pedagogies. There are some simple, pragmatic changes highlighted by his research that will immediately make a difference. These are piecemeal, but emerged from the research championed by many, and in some cases, all our research witnesses. These offer a prospect of substantial improvement in the design and implementation of the schools we have built and are building today.

They are an important outcome from the research. Effectively the research is saying loud and clear "whatever happens in the design of future schools, stop doing this now please":

- (1) Almost without exception heads and teachers who had experienced a new school build were confident that a single cardinal error was that ICT was "bolted on" to the design after the details had been completed. Whereas lighting was integrated in the building plans and designs (and was very much viewed as a key architectural design function, with an understanding of lighting making up an element of an architect's training), ICT was typically treated, like curtains and coffee machines, as something that was added later by contractors. Sometimes this was because of a provision contract that excluded the design team from including ICT details in the drawings, but the research "witnesses" reported with a forceful emphasis that this was a really substantial problem. At the "appearance" level it left rooms with plastic conduit, loudspeaker brackets, projector gantries and ethernet points tacked

onto walls in a way that was ugly and vulnerable. But at worst it left rooms unable to deliver the ICT rich curriculum of the 21st century. And there were real horror stories of network points over sinks, mains plugs unreachable from laptops on desks and light levels that either precluded whole class, or whole school presentations. ICT must be designed in at the outset.

- (2) Another clear thread jumping out of the research concerned the restrictive nature of the DfES Building Bulletins. It is clear that historically these have offered considerable support to architects and to schools in helping to define appropriate interpretations of a school's learning needs, expressed architecturally. Just as the Literacy and Numeracy curriculum have prevented some of the worst excesses of poor practice, so too the Building Bulletins had prescribed appropriate interpretations of the school design task. But is abundantly clear, as we begin to look for iterative change in our schools, that the definitions in these Building Bulletins are too restrictive. Time and time again headteachers, architects, almost everyone involved in the experience of a new build reported that creative interpretations of learners' needs, agreed by schools and by design teams, were thrown back as "not being allowed" under a particular Building Bulletin. This very solid finding was not the view of a few maverick dilettante designers or avant garde staff losing their pet schemes, they were the views of sensible headteachers and their staff, who after considerable debate with experienced and creative school design teams had arrive at clear, shared, professional conclusions only to see them rejected. Their hurt and sense of lost opportunity was apparent throughout the research. Although initially useful, it is clear that the Building Bulletins have become a brake on innovation and this has prevented the kind of exploration and iteration that is needed if action research is to better inform the future and present design of schools.

These Building Bulletins need a complete, bottom up rewrite; this is already broadly understood and indeed welcomed. They have served a purpose, but it time to move on. However, a Building Bulletins' rewrite requires some other details to be in place, with some urgency, first: the Building Bulletins need a "litmus test" definition of the future pedagogies and processes that will characterise schools (hopefully this report will go some way towards beginning that definition); they will need an interpretation of those new pedagogies in terms of the requirement for particular learning processes, but the Building Bulletins need to stop at that point and allow the creative interpretation of those needs by architects and teachers. An example requirement might be that children need to be able to assemble in a whole school group at irregular times. The current Building Bulletins specify in some detail the definition and limits of that assembly space but it is clear looking around the world that interpretations of that "need to assemble" can be creative and better suited to the immediate context and culture of a particular school community.

However, without the concrete, prescriptive guidance of the Building Bulletins, schools and their designers might be left with too little exemplification and it is clear that alongside these new "process" Building Bulletins will need to be a contributory compendium of different interpretations.

- (3) In new schools everyone, from heads to children, reported that they didn't have enough time with architects; probably they never will have, but there were some glaringly extreme cases of this and at least one simple remedy: a surprising number of heads were appointed to brand new, completed, schools so that they had almost no say in their school's design at all. The research didn't clarify whether the stress of a new build had driven many heads to early retirement (!) or whether new schools were, in most cases, exactly that so that there was no head appointed until the school was part built to

save money (the head's key role being seen presumably as appointing key staff, putting systems in place, etc.). Common sense and the research findings make it abundantly clear that a new school head should be centrally involved in the design process from specification through detailing to completion and this means appointing heads well before planning starts, even if they don't take up their posts until later. Visiting a school in Hong Kong the research team found a head who had been in post from the very beginning of the design process; long enough indeed to know and understand the community the school served before the design process properly began. This is exemplary.

- (4) Another obvious, but rectifiable, error that emerged with some clarity is that the new school capital funding model assumes a school design will be "right" from day one. In any domain there are very few design instances where the design is perfect straight out of the box and it clear that schools, with all their complexities, are no exceptions to this, but the assumption of "right" results in no funding being available for the necessary "fine tuning"; a substantial part of the capital investment is wasted through these residual, emergent but unresolvable, problems.

Enlighteningly, in the seminar research sessions unpacking insights from current innovative learning projects, it emerged that in building virtual learning communities there is a very clear "three iterations" rule: the first iteration is often quite a major readjustment, the second and third are fine tuning. But it is also clear that because of the expectation of these iterative changes a habit of formal reflection, action research and reporting evolves which in turn powerfully informs future design elsewhere. It was abundantly clear from the research for this report that holding back a capital sum to fund that first iterative readjustment would realise far more potential from the building programme, but would also established a (required?) habit of action research and reporting to inform that iterative readjustment which would in turn engender a steady flow of practitioners' experience to inform future school designs; a win win solution. A 5% fund for iteration would almost certainly yield a 10% more effective building and a much better flow of information to inform future practice.

- (5) There are two key areas where the flow of information and the evolution of understanding is not now adequate to keep pace with the rapid evolution of learners' and learning institutions' needs: architecture degrees do not explore learning adequately or indeed at all, with the parallel failure that teacher education doesn't explore architecture adequately or indeed at all either. They both should.

Looking around architecture schools throughout the UK it was apparent that through either the degree or diploma curriculum most architects emerged from training with a clear understanding of energy efficiency and environmental aspects. This may be found everywhere from history of architecture courses to the technical dissertations, everywhere. However, it was clear that none, or certainly very few, emerged with any detailed understanding of pedagogy and the impact of design on it, despite a considerable body of literature. Thus architects are often able to specify a "green" school and be confident about heat and energy losses, yet are not able to specify in any detail the learning gains and losses resulting from poor pedagogic design. This is broader than education; with almost every organisation espousing the rhetoric of a "learning organisation" this divorce of architecture from learning must end.

Similarly the teacher education curriculum offers few insights into the detailed methodology needed for teachers to be able to observe and relate the impact of physical design, micro and macro, to learning standards and outcomes. Thus teachers often make poor clients" in the design process although all report that "second time around" they would have a much clearer understanding, both of what they knew, and of what they didn't know but needed to discover.

A bonus of these changes to the teaching of architecture and of teacher education would be the accompanying research focus that higher education would contribute, driven by the needs of Quality Assurance and the RAE (Research Assessment Exercise). It is not the place of this report to define the precise curriculum for either architecture or teacher education but both these omissions are glaring and damaging and need to be addressed.

- (6) ICT is itself transformative within the new build programme. The siting and organisation of that ICT, inevitably, was a substantial focus within this research project. Two major factors emerged. Firstly, and bluntly, computer suites are, or should be, effectively extinct. Designers must stop specifying them. So many schools reported the effectiveness of portable devices within a wireless environment with its ability to turn any room into a dedicated suite, or to pervade substantial numbers of learning spaces instead. Practitioners and technologists alike were clear that these agile new solutions sound the death knell of the computer suite although open access, large volume learning centres still seem to thrive with a range of permanently installed desktop computers.

However, the second major factor with ICT in school design was furniture. So many of our witnesses commented on poor furniture and the difficulty in locating affordable, appropriate, moveable, robust furniture that it is clearly a universal problem. Even where specialist furniture was available it was many years behind the design of the computers it supported, and expensive too. Bizarrely, some of the most imaginative surroundings had been engineered by shop fitters who would, without prejudice, simply build what was requested, affordably and robustly. But it was also clear that not enough detail was known about the micro design of furniture and seating arrangements around computers and shared screens, especially when a variety of devices was added to the mix; what layout engendered collaboration, or what engendered individual endeavour?, how much space did creativity need? what seating was gender flat? how could such a wide range of child size and height be catered for? This is an area for really significant research investment. There has been a useful design competition initiated by the Design Council to explore new designs³⁷ but this is a tiny component of the work that needs to be done. Again, a ratio of expenditure to research should indicate a continuing 3.7% furniture research and development investment.

- (7) One final small detail, but rather harder to rectify, that was raised time and time again in the research concerns the way that schools are skewed towards large scale; for example headteachers' salary scales depend on size above all else. This is a more relevant component in a head's remuneration than school performance for example. It is financially more rewarding to lead a large failing school than a successful small one. In a world where the iterative investigation of diversity is looking to be an essential tool in progressing standards nationwide this design distortion is surely not helpful. Although alternatives are beyond the scope of this document it is not too difficult to devise incentive schemes that place something other than scale at their heart, especially since there is little persuasive evidence that scale is equated to standards in any way.

This all amounts to a lot of small detail, but the passion with which these small details were conveyed to the research team make it clear that in this short list of detail changes alone lies the potential to move teaching and learning forward significantly. Since these small details were effectively universals, the message sent out by not responding to these concerns would be as damaging as responding to them would be constructive.

Recommendations: summary

Broad recommendations:

- 1 Much better research and development is needed: some much more radical school designs need to be explored as part of this R & D, with a recommended 3.7% of capital funding available for research and development annually. More radical designs should push towards the poles of what is possible. With a school stock of over 20,000 schools there should be more and better exploration of the range of possibilities.
- 2 There should be a requirement to design for agility. New school designs must show that they are capable of responding to changing pedagogy, context and expectation. The certainty is of uncertainty; designs need to reflect and defend their ability to address that challenge creatively.
- 3 Better research and development includes building a long term relationship, and exchange of practice, with some of the more radical / experimental schools around the world. To gain the value of this substantial research opportunity we need to contribute substantial UK explorations too. The DfES "Classrooms of Tomorrow" initiative was a good start but much, much more is needed, and needed annually.
- 4 Better research and development includes a much better system to collect the insights and wisdoms of teachers, architects and others involved in the new school process. This should cover everything from short term contributions ("This didn't work...", "This was excellent...") to longer term reflections after living with, and reflecting on, a design for more substantial periods.
- 5 There is a really urgent need for a broad debate, including the architectural and educational professions, to reach a measure of understanding about the breadth of outcomes, in different contexts, that would suggest whether a new school design had been successful. There is currently a mismatch between what schools think they should be producing, what the curriculum and assessment systems value and what the future economy will need. This constitutes an impossible design brief. In general, given the magnitude of expenditure, there need to be much better and enduring relationships between the architectural and educational professions, at every level.
- 6 Some schools must be able to explore and research their teaching and learning processes outside of OFSTED's current formal requirements and expectations; but with the partnership of OFSTED; informing their own understanding this should be hand in hand with explorations of new approaches to the physical design of schools.
- 7 A summary of the detailed conclusions of this report's "Designs for change and the drivers of change" should be made widely available for those currently engaged in the design of school buildings.

Pragmatic recommendations:

There were many simple pragmatic suggestions from the research witnesses, but the 7 items below achieved a very high level of consensus. These recommendations, promptly acted on, would allow the value of current investment to be more effectively realised and would allow more usefully progressive schools to be built. Recommendations (1) - (6) are straightforward, (7) doubtless is much more complex to implement:

- 1 ICT must not be "bolted on" to a design but the design must start with ICT objectives and provision should be designed in at the outset. Plastic conduit attached to new walls and ceilings is a clear sign of failure.
- 2 The Building Bulletin's were useful, but now need to be completely rewritten and are "beyond their sell-by date". The new Bulletins must define and prescribe a learning need to be designed for, rather than imposing a prescribed solution through a defined specification.
- 3 With a new school build, headteachers must be appointed early enough to be fully engaged in the entire design and build process; this is a requirement.
- 4 Capital funding should be either found or held back sufficiently to allow some iterative revision of a design implementation. Too many new schools were "very nearly right" but lacked any capital resources to make themselves "just right". In exchange, new schools should formally research the effectiveness of the new features of their school's design.
- 5 In this Learning Age, architecture degrees should explore learning adequately; currently they don't. Similarly teacher education doesn't explore architecture adequately. It should. Building a much clearer understanding of how design can progress learning is an essential task for both professions to share. A dialogue would help.
- 6 Computer suites are, or should be, effectively extinct. They should stop being built immediately. Technology rich learning spaces need much better, affordable, furniture. Almost none exists, despite some useful initiatives.
- 7 Salary and other incentives should no longer skew schools so substantially towards large size.

Scenarios

As a final outcome from this research four scenarios have been drawn from the vectors and velocities of change revealed by the research. Their intention is to provoke debate between architects, policy makers, teachers, parents, students and other stakeholders in new schools and to serve as a resource for that debate.

This research report suggest that many, if not all, of the schools we are currently building lie within a narrow band of "safe" design: conservative, cautious, rooted in past practice, over prescribed. But it also suggests that far greater exploration of the possible design and function of schools is required as a research task if the conservative "safe" designs are to be transcended. The research team are confident that this research task is not damaging to the children who will attend these research schools, but that leaves an important debate about what direction this research should face. These scenarios explore some extreme poles of a possible continuum, from formal to informal, and posits two interpretations: Firstly there is a contrast between the disestablishment of no physical school at all and the isolationism of the "fortress school" with it's tiers of protection from "stranger danger". Secondly a contrasting pair, equally polarised and again drawn between formality and informality, but with a very different interpretation of those poles: this pair ranges from the dissolved school, disaggregated out into the community and embedded there ubiquitous but unobtrusive, to the smothering totality of the extended schools enclosing all major community functions within its grounds so that it comes to embody the community.

These scenarios are not idle speculation, their genesis can be observed in some current provision: the Illichian vision of de-schooling has already some successful instances, for example the DfES Notschool project, or the Correspondence School in New Zealand, both virtual school for those unable to attend school because of exclusion or distance. At the opposite pole the considerable investment in security cameras, unscalable fences and visitor security systems that characterise many current schools are clear indicative of an accelerating trend at the end of which lies the Fortress School[®].

Similarly the "dissolved school" mirrors in many ways the development of the distributed university, embedded in and around its host town rather than centred on a campus. This "dissolved school" is indicated by the observed trend towards substantially longer learning periods with this research report's conclusion that "children will move less often" and will engage in tasks for longer periods of time. The DfES Exemplar School Designs (ibid.) offered some clear indications of a trend towards the contrasting pole of the "extended school". However, these four scenarios remain simply provocations for the extended debate about the range of possible school types that this research project is clear should begin.

With each scenario there is a short narrative, an illustrative sketch (of a social context deliberately to leave the design interpretations open to debate) and finally, five questions. The questions are designed to expand the conception of the different scenarios for the designer rather than policy maker. The questions are: what are the resources and infrastructure? what does learning look like here? what do teachers do? what do children do? what are the implications for design? It is the debate about this last design question that the scenarios are designed to provoke, rather than to complete.

Scenario 1: no physical school at all

The first scenario is of complete "Deschooling". Ivan Illich in "Deschooling Society" (1973) examined the corrupting impact of formal learning institutions. Illich felt that when children are removed from traditional schools they need to undergo the process of "deschooling", a detoxification period that enables children to unlearn the negative ideas associated with school: classes, grades, terms, school days, tests, performance.

Nowadays, and in the context of this scenario, the concept of "deschooling" is more often used as a term to cover all schemes which offer an alternative to traditional institutional education and it is this sense that it offered here. Much current "deschooling" falls into the "home schooling" movement; parents taking control of their children's education which is carried out in the home. What has changed since Illich wrote is the way that information and communication technologies can bridge between the individually "deschooled" learners and connect them to experts and other learning resources. A "wired" but deschooled future can offer a powerful sense of community without the inflexible capital intensive buildings of a formal institution. The DfES sponsored Notschool.net project, is a fully "virtual" school for those excluded long term from school, has evidenced remarkable success; the children ("researchers" in Notschool vocabulary) are connected at home to a broadband network, with a powerful multimedia home computer and a network of experts and peers to support their learning. The sense of community is very strong, yet there is no capital expenditure at all other than technology: no premises, no campus, no school.



This first scenario envisages many children learning in a de schooled environment. Architecturally the challenge here is to augment community and public service facilities in a way that allows the stamp of community to pervade them, without coming to dominate them. In a world of overlapping

school communities but no physical school buildings beyond some administrative centres, how can the depth of community be emphasised on the occasions that children do meet and commune together in places like theatres, museums or sports arenas? And as the massive capital resources saved by building no schools are released how can community wide learning facilities be augmented to offer the depth of support that virtual and deschooled learners will need?

"Dipti had always enjoyed science and as she sat at her keyboard she thought how lucky she was to be learning entirely on-line with friends all round the country and in many cases the world. She particularly like to have direct access to her friends at the Science Museum. Although she was only 13 she was digging deeply into Material Science in a way that astonished her mentors, but somehow she still needed a lot of support and encouragement with her language work and creativity. She already had something of an idea about her future path into and beyond university, after all, she was already familiar with a lot of the research staff at her chosen college and would be beginning study there a couple of years before finishing at the Institute.

As the long day stretched into late afternoon Dipti paused from contributing to an on-line seminar that had been running all week. She had a whole lot of details to organise before the weekend: she was mentoring three groups of younger learners and needed to set up their conferences, then there was the local Institute team playing in a (real!) badminton tournament, a field trip for her ecology project and the mid term ball for the UK students (with no less than three Institute bands playing). Dipti needed to arrange where she and her on-line friend Lucy would stay for the ball or their parents certainly wouldn't let them go. "It will be nice to see Lucy properly again" she thought. As she pulled her blue sweatshirt on over her head she looked down at the Institute's name and badge with some pride.

"Cool place this Institute" she thought, and then smiled at herself because of course the Institute wasn't any place at all".

What are the resources and infrastructure?: without any bricks and mortar other than an administrative suite the infrastructure lies in the network of experts that support the children, including experts in learning; less bricks means more people. There is also a substantial technology infrastructure in dedicated bandwidth and home computer access. Without the cost, fixed and variable, of a substantial campus the Institute is sumptuously supported by its experts and the ratios of adult to child are very favourable indeed, but the learners also mentor each other in a very supportive on-line community.

What does learning look like here?: Learning is peer to peer, expert to learner, learner to expert; it is a full community of practice and the practice is Learning. Thus a learner may tap into very high levels of expertise, or contribute their own, but then rely on a teacher for help with the process of learning itself. With the whole community on-line and so much interaction on-line it is important that learners compile their own learning plan and journal. There is no cap: children can learn as fast and in as much depth as they wish and as slowly too in areas where they show less predisposition.

What do teachers do?: on line they work hard to support the children with their learning, helping to build a sense of real personal progress, ensuring that

learning progresses and that children are stretched and challenged. There are many others on-line too, experts with a deep knowledge and understanding of their subject area, which is almost certainly their profession, but without the detailed knowledge of learning that the teachers bring. Many external organisations like Museums also have a role in this learning community too.

What do children do?: they work entirely on-line, there is no school. They are not 'downloading content' or doing screen based tests but using the on-line environment as their working world: contributing, annotating, debating, questioning, discovering. Each child follows a bespoke and unique learning path, building a digital portfolio of their work as they go in a way pioneered so successfully by Notschool.net.

What are the implications for design?: A really serious design challenge here is to develop a sense of "belonging" and of the deep community that is essential for deep learning. This is substantially more than just a school colour, sweatshirt or badge. Vocabulary, ethos, philosophy, a sense of cohort and cohesion all add up to a powerful community design...

A further implication is the direct threat that this de-schooled model poses for the existing stock of school buildings. The "virtual school" will not replace the traditional school completely, but it will replace some of it. The key question is to know what proportion that "some of it" might be. That is the amount by which the current building stock will be over-provided.

Scenario 2: the "Dissolved Secondary School"

A second "informal" scenario sees the school once again with no central campus or single location. Instead it dissolves into the local community in a way that is familiar in many university towns. Faculty centres are clustered near to local specialist functions. Each of these centres are bases for the specialist staff who teach the specialism that they house: engineering, performance, sport, health, media, science. In many cases the local resource becomes shared as a school resource too so that perhaps the local radio station shares the facilities of the school's media faculty, or the public library becomes a place of work for school students. In other cases the school facility is adjacent to the centre of excellence and the gain comes from proximity. The school still has buildings and working spaces but these are scattered away from each other and embedded in many places within the community. The school has literally dissolved into the community. The school has no real heart of any substance at its core.

All this is possible because of a radical restructuring of timetabling. Children learn in far longer blocks of time, often spread over days. Their subject teachers are based at each of these specialist function locations and it is into these locations that the school's capital investment is concentrated.

This offers the considerable advantage that vocational and work based learning can actually happen where the vocation and the work are located. The shared facilities gain from this additional funding too. A substantial number of schools explored in this research project were already placing children's learning away from the formal heart of the school campus and into the community and indeed feedback from many children anticipated this trend but we found no schools that really had yet fully "dissolved" into their communities. They will. As with deschooling, the new capabilities of ICT make this model viable because the communication between learners depends less now on geographical proximity. Historically, many experienced teachers



shy away from split site teaching, having shared some traumatic experiences with timetabling and hurried forced route marches between sites, but a clear steer from the research witnesses was towards much longer learning periods, often more than day-long, which removes this constraint.

"Another good day. Sami was hurrying home having somewhat lost his sense of time; it had been a long day too. The group he was working with had been relishing this block of time for some days and had been preparing for it. Although they'd all been learning in the town for some years, they didn't often get along to the live broadcast media faculty so often and it was a rare chance to work with the school's teachers who were based there. There was always such a buzz around the centre, with local radio and television programmes recording live and a number of community groups enjoying the facilities. This was the beginning of a six day block of creative, collaborative, media time and yet that morning as they walked the unfamiliar paths they all wondered if they had been too ambitious in their plans.

By that night, Sami knew they hadn't been. There was great support in the faculty building and they knew they could do it, but they were going to see a lot of the faculty this week and they'd planned an early start tomorrow; the building ran 24/7 anyway and no one had minded when they'd said what time they'd be in. Somewhere in this week Sami also needed to visit the AdminCentre to sort out some face to face advice about university; he hadn't ever been to the AdminCentre before.

Sami's oldest friend was due to leave at the end of term and they walked home together deep in thought. "I can't really imagine learning in another town" Sadie reflected, rather sadly, "I've been learning here for ever"

What are the resources and infrastructure?: shared resources are not simply scattered around the town, they are of the town. A complication here would be multiple schools using single instances of the town's resource. The town library, the sports complex, the local museum, halls and even cyber cafés all gain from the shared funding that the school capital budget brings them. The greater community use, especially outside of conventional working hours ensures that facilities are available 24/7, affordably.

What does learning look like here?: The children learn in much bigger blocks of time. They meet the school's specialist staff in these specialist facilities, where they are based. A day or perhaps half day would be a minimum unit of study but pedagogy is relatively conventional, and evolving rapidly too of course as elsewhere.

What do teachers do?: They teach in a conventional way, but are more likely to be based at one faculty block with other scientists, or PE staff. School staff almost never get together, but new technology allows the efficient running of the dissolved school without this day to day, face to face contact.

What do children do?: They learn in much more substantial blocks of time, often with other adults experts too, and are not constantly having to move

from faculty block to faculty block, across town. They stay put for a day, or days, at a time. It is likely however that adult learners may be sanctioned to join their classes too.

What are the implications for design?: A particularly tough problem is if the town or urban area have multiple schools sharing multiple resources. In the scenario narrative Sami see the town as synonymous with his school. If you asked him where he went to school he'd say "Wilmington", his town's name. It may be that the dissolved secondary school is particularly suited to some social contexts and not others, part of a diversity of provision that this research report predicts and recommends. Non campus universities similarly struggle with a designed identity and students often identify with their faculty rather than their university. This is a substantial design challenge for schools.

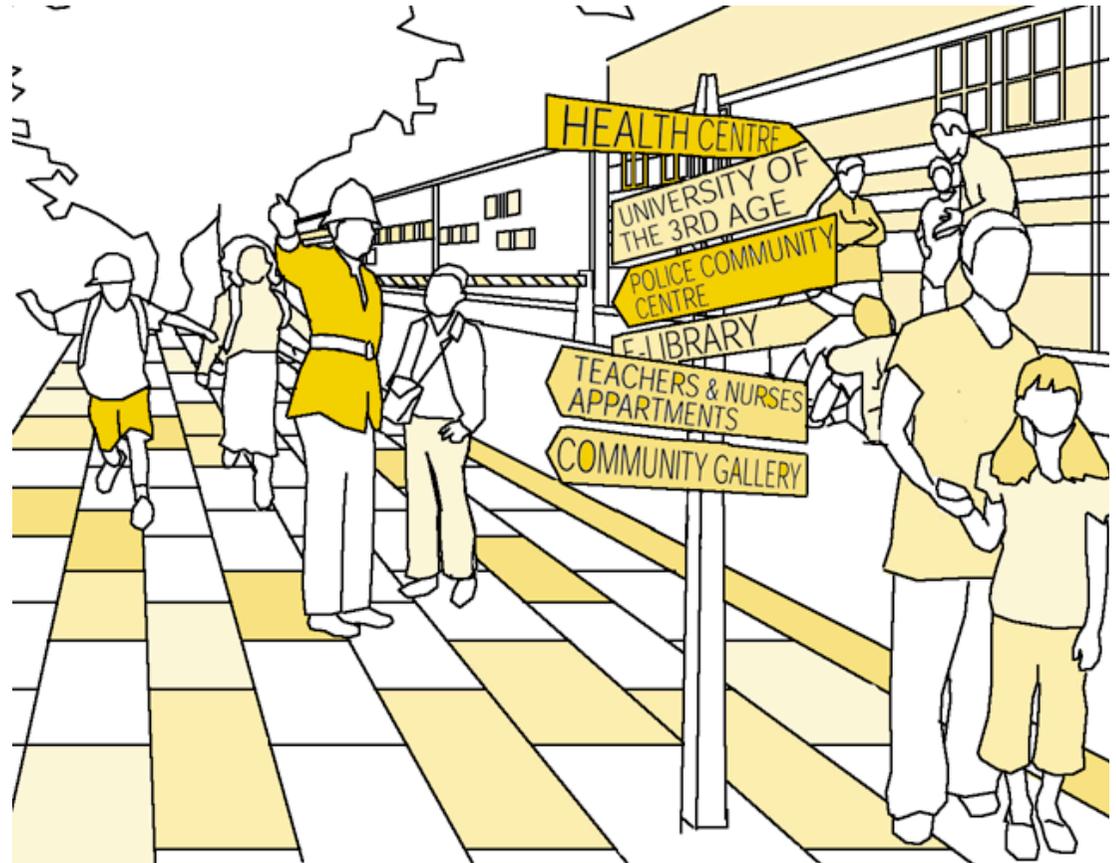
In a lifelong learning context there are some unique design opportunities offered by this "dissolved school" because the cross over between location and neighbouring functions is considerable. Placing components of the school within the shopping mall brings shoppers potentially into contact with learning in unexpected places, whilst also anchoring learning in a commercial or community context, for example. This raises the prospect of a designed learning component being a part of other design briefs rather than comprising a bespoke learning design.

The tough design challenge though is to build the necessary strength of community. This research project has established that community is significant in future pedagogy, but in the context of the "dissolved school" is the community that is being emphasised in the design process the town, the school, or both. How is it signified and reinforced?

Scenario 3: the "Extended School"

The Extended School is currently a highly fashionable concept. It reaches out to embrace and include most of the major functions of the community, drawing them in to its campus along with the people who use those functions. The Extended School is quite often an aspirational school design concept and it was raised frequently in the research. At the heart is a vision that key features of the community might be embraced within the school "campus". This extended school campus would also house other public service functions, like police, health or libraries, in addition it would offer small scale start-up enterprise support and even subsidised housing for teachers, nurses and other public service workers. It certainly makes for a straightforward design brief.

The Extended School is a vision of a very large campus indeed, with its own "street life" and an all embracing view of learning that reaches out right to enfold the local community and is very much the central heart of that community. The Extended School facilities are community facilities with a consequent dramatic investment in the shared library, sports and technology facilities. It is hard to see the extended school as being developed on many of our existing school sites because of the sheer scale of an extended school's footprint. With the children learning about citizenship and the citizens rediscovering learning the extended school comes to define and redefine the community it serves. A huge concern with this vision of the extended school is what happens to the parts of the community "outside" of the campus and at the interface between these two groups?



"It was nice to see her Mum from time to time Maylene thought as she carried both their selections back to the librarian. "Must dash" and she hurried back towards the snack shop queue. The school was really buzzing tonight with half the neighbourhood out on the wide strip that

separated the big public service block from the seminar and lecture rooms. There was something about the evening concerts that seemed to bring everyone out although Maylene didn't really know why, the band were awful and she'd heard them practising in the gig room over the health information centre.

As Maylene looked out of the window she saw a group of police cars rushing out of the school gates. Trouble outside again and she looked to see if they were heading toward her home area, just in case. They weren't, and she let her focus wander back to the concert tonight.

Four hours later, Maylene was revising both her opinion of the band and her French pronunciation as she walked towards the huge school gates listening to her French homework tapes. She felt a slight shiver; she never really liked going back outside; it was darker and although she knew many in her community because she saw them everyday there were others that never set foot on campus. As she left the campus she removed her earphones so that she could remain attentive to the world around, just in case. Taking out those earphones seemed symbolic somehow, a moment when the learning stopped. In truth, most of what she loved doing was right here in the Logan Academy, but she needed to go home, if only to tease her Mum about that strange artefact she'd been choosing from the library."

What are the resources and infrastructure?: a very substantial campus, with all the community facilities drawn onto that campus too: public library, police station, health centre. This really is a pivotal hub around which and on which the community functions. There is a constant flow of adults through the campus enjoying those community functions. To a significant extent though, the extended school sucks in resources from the surrounding community, leaving less infrastructure outside the school.

What does learning look like here?: this is a relatively conventional learning environment, in as much as anything can be at a time of rapid change. But for real life experience of enterprise, for health support and so on the school can rely on the adjacent facilities rather than erecting a surrogate.

What do teachers do?: Teachers will also have a community role and adult learners may well be either in the classrooms or sharing learning and community facilities with the children. Some key community figures (for example the campus police officer) will also have some mentor and leadership role with the children. The teachers are there as learning professionals and have to manage the inputs, and the learning, of these other adults in the learning environment.

What do children do?: they learn in a complex way partly because the community learners and experts cannot fit well into the rigidity of the traditional school timetable. Their community life is also lived very largely on campus, with many adults and others from within the community. There is a constant flow of expertise into the campus and because this does not easily follow a conventional timetable nor does the school.

What are the implications for design?: For many the Extended School offers a heart for the community and a focus for ambition. Design needs to

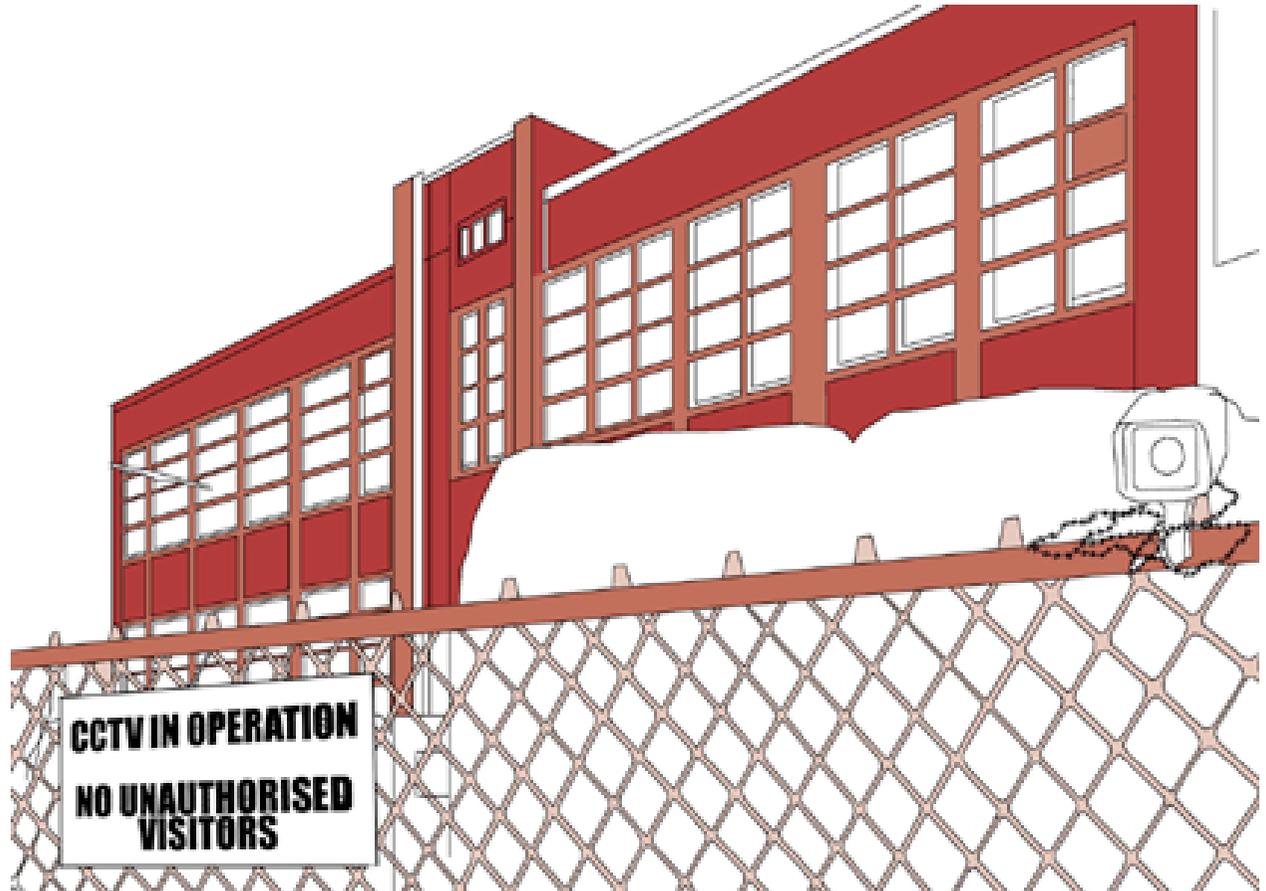
emphasise this, but also needs to be embracing of the local community, some of whom may have had a less than satisfactory schooling themselves. This means that details like the welcome offered at "reception" and the informality found there will be crucial in giving the community a sense of ownership and engagement.

A tough challenge for design is to signify the integrity of the community of learners without signalling an exclusion of those within the community who do not wish to engage overtly in learning. If visiting the library or the health centre means entering the schools "campus" area, then how can design ensure that the campus does not alienate some of the community and thus effectively exclude them from the community resources that they need?

The real design challenge though is to construct something that doesn't leave both an included and an excluded sector in the local community, those within and those outwith the community campus. If all the key community resources are loosely grouped within the "extended" campus then those outside of that campus will begin to look like an excluded "underclass".

Scenario 4: the "Fortress School"

The roots of the "Fortress School" are easily observed in current practice; schools with razor wire topping their fences, with tiny reception security windows, with foyers emphatically isolated from the school, with security cameras surveying corridors and with an extending school day. All this can be found to some degree in some current schools, let alone future ones. But the "Fortress School" of this scenario is more than just the trappings of a security culture paranoid about "stranger danger". It embraces the school as the single validator of learning for the community with an almost monastic view of the school's role and function. The reification, deification even, of "legitimate" learning would also lend itself philosophically to mechanistic individualised learning "cells" and "delivery" based learning systems, to a lack of debate or choice about what is to be learned and to a decline in learning those domains judged to be less "legitimate" like sport. Architecturally the "Fortress School" may sound quite seductive because the integrity of the school campus is a straightforward design task, but is the artificiality of the environment thus created too sterile to prepare learners for the real world beyond school? and what of the community that is left isolated "beyond the gates" in a way more familiar to science fiction than to today's teachers and learners?



There are many hints of a progression outwards from the "Fortress" model as schools attempt to fill more and more of young learners lives outside of

school with "appropriate" work and parents reinforce that sense of "remaining at school even when at home" with comments like "you wouldn't do that at school now, would you?" if children deflect from their homework. Indeed even the vocabulary changes as "homework" becomes "school assignment" and the school "colonises" parts of the home. Parents from home view children's targets and performance at school via a dedicated Intranet that extends out into the home.

Architecturally it is possible to see our current school stock, in many cases, evolving into the "Fortress School". The design challenge is to build an institution that on the one hand encompasses its students in a secure way, but on the other hand doesn't isolate them from the community that the school serves. Inevitably this leads to a zone of interface where the "inside" and "outside" meet and the success in learning terms of the "Fortress School" will depend on this interface zone. Conversely in a really tough area this level of protection and isolation may arguably be necessary and may offer an "oasis of tranquility" that lifts community morale by offering the most secure place for learning.

"It had been an early start. Jonny had met his class early for a working breakfast as they read through their parts for the drama assessment, now only three weeks away. The school canteen was bustling at that time and although the whole school population wasn't in at 7.30 it seemed to him that a lot of them were. Jonny had registered just by walking into the school canteen, but he needed to see his tutor and was glad for the ten minute morning briefing session before getting down to trying to hit this morning's targets in maths, science and citizenship. Three tests, three chances to compare his ranking with others around the country. The hours seem to flash by, with a rapid change of subject at each hour and Jonny's head was spinning by the time he got to lunch although e was very conscious of how many things he had managed to cover that morning.

Lunch was a bit of a sprint because he had a lunchtime session to fit in on the driving simulator - it was only a couple of years year until he'd be driving properly on the test track and he was already confident and secure in his capabilities; he enjoyed the physical side of driving although he'd never driven a real car on a real road outside school, obviously. But it made a good break from study. Afternoon saw a long session on the integrated learning systems before an end of school dash across to the seminar rooms for the board meeting of his mini-company. Jonny was sales manager, but the company rotated posts every month and he was delighted to find that he would be moving on to marketing next month. It was dark as he found his younger brother Jaf from the study clubhouse and they both started for home munching the snacks he'd bought for tea in the school canteen and he thought back with pride at how much he'd covered today.

Looking back at the school gates he could see the big sign that glowed out into the night with the school's learning performance indicators on it. The gate noted the identity card in his pocket and flashed his own scores up too, with rankings. "Great scores" he thought "and it's only Tuesday!" The gate also noted Jaf and his scores were a lot less impressive. "

Mum will be home soon from work" Jonny reminded his brother, "With those scores you'd better be head down and working before she logs on to review our day".

What are the resources and infrastructure?: it's a single campus school with rigid security protocols and a clear barrier between school and community. Community facilities are neither included within the school nor welcome there.

What does learning look like here?: characterised in the literature as "monastic" the dislocation from community can lead to a productivity based regime of targets and performance indicators that are focussed entirely on the work within school, rather on a broader mix of learning. In a simplistic version teachers teach, children learn, adults stay outside, but in practice there may be merit in the peace and tranquility produced within the "fortress school" and the impact that this has on learners ability to focus and engage.

What do teachers do?: teach, monitor, assess, lead. The rigidity of the design may sit well with a rigid curriculum, with stratification and structures that are closely defined, but teachers will struggle to find the necessary agility to offer a learning experience that is rich and that changes rapidly. Thus the "fortress school" may be, for teachers, a bastion of past practice and an impediment to change as a result of its rigidity.

What do children do?: learn, perform, attain, follow. The hardest thing for them to do is to "anchor" their learning in the real life experiences, beyond the school gates, from which they are effectively isolated.

What are the implications for design?: Arguably, for many tough communities the fortress school offers a focus for ambition and even a beacon of hope. It is easy to dismiss the fortress school out of hand philosophically, but the design challenge is to recognise the safety and security need and respond in a more agile way that leads down a pathway likely to be more congruent with future pedagogy. Stranger danger can feel very real, whether perceived or actual and designing for security without exclusion and isolation is complex.

Design needs to emphasise the needed security in this instance, but also needs to be embracing of the local culture if not the local community itself. Getting the design right so that it offers on the one hand "sanctuary" and on the other hand an open hearted welcome is not trivial. Many parents and visitors may have had a less than satisfactory schooling themselves. This means that details like softening the welcome offered at "reception", but without compromising tough security protocols, will be crucial in giving the community a sense of ownership and engagement and considerable design imagination needs to be concentrated at the interface between the "fortress school" and its surrounding community.

Appendix 1:

thanks

The project team would like to thank the many, many people worldwide who contributed advice, ideas, experience, insights and material to this research project, very often with considerable passion and commitment. We would also like to thank our ever patient and long suffering CABE research advisor Sarah Carmona and the **project steering committee** who were particularly helpful in our shaping of this final document:

Richard Feilden,	Senior Partner, Feilden Clegg Bradley Architects,
Eileen Adams,	Freelance educational consultant,
Mark Harrison,	Director Centre for Social Action De Montfort University,
Dr. Victoria Nash,	Research Fellow, Oxford Internet Institute,
Charlotte Rendle-Short,	Deputy Chief Executive, The Church Schools Company,
Andrew Thompson,	Department for Education and Skills,
Jennie Winhall,	Design Council,
Gillian Wolfe,	Dulwich Picture Gallery,
Caroline Fraser,	Enabling Advisor, CABE.

who are Ultralab?:

"an enviable global reputation for creativity, innovation and common sense" EuroCall

"one of the most respected research centres in e-learning in the world" Financial Times

"Ultralab is Europe's leading research institute pioneering leading edge applications in support of proven educational precepts." Oracle Corporation

Ultralab have been actively exploring "future schools" since the late 1980s. Milestones have ranged from a major national conference in 1993 "The Classroom of Tomorrow and how to get there" to the national "Learning Spaces Virtual Places conference a decade later. The lab is also engaged in or collaborating in a number of practical building projects, from three Classrooms of Tomorrow in Richmond upon Thames to a Learning Prison. Ultralab developed and run the substantial virtual school Notschool.net for those many children that conventional schools do not fit. A number of radical schools around the world have a working relationship with the lab and researchers in the lab advise a number of governments around the world on school design and policy.

This report collected a substantial amount of material. Much of it can be visited from the project website depository at: <http://rubble.ultralab.net/cabe>

references: general

Beare, H " Creating the Future School: Coming, Ready or Not (Student Outcomes & the Reform of Education S.) " RoutledgeFalmer, 2000

DesignShare : http://www.designshare.com/Services/Innovative_Schools.htm

Ford, H "20th Century Design: Post-modernism and the Future" Heinemann, 1999

Howe, A "Primary Design and Technology for the Future: Creativity, Culture and Citizenship" Fulton, 2001

Innovative Design:<http://www.innovativedesign.net/awards.htm>

Kent, A & Mortimore, P (Ed) " School Subject Teaching: The History and Future of the Curriculum" RoutledgeFalmer, 2000

OECD "Schools for Today and Tomorrow: An International Compendium of Exemplary Organization", published OECD; 1996

School Buildings Information centre:

<http://www.teachernet.gov.uk/management/resourcesfinanceandbuilding/schoolbuildings/?section=681&CFID=5200149&CFTOKEN=e02d2f-7c8b87fd-acb1-457d-8364-b4af9308a784>

School Design Parameters in Hong Kong for 21st Century: <http://www.cuhk.edu.hk/proj/innovative-school/home.htm>

Secker, S, "For the Sake of the Child", FNF Publications 2001

references: footnotes

- ¹ The Standards Site: www.standards.dfes.gov.uk/federations, accessed on 12/03/03
- ² National College of School Leadership: <http://www.ncsl.org.uk/index.cfm?pageID=nlc-index>, accessed on 18/04/03
- ³ National Statistics: <http://www.statistics.gov.uk/census2001/>, accessed on 18/05/03
- ⁴ One Parent Families (Scotland): <http://www.opfs.org.uk/factfile/survey.html>, accessed on 12/03/03
- ⁵ More children live with lone parents: <http://news.bbc.co.uk/1/hi/england/2835493.stm>, 10th March 2003, accessed on 11/03/03
- ⁶ NSPCC, Report on Child Deaths, 29th January 2001, Key Achievements at a Glance 200/2003: <http://www.nspcc.org.uk/html/home/aboutus/keyachievements.htm>, accessed on 12/03/03
- ⁷ NACRO, "A failure of justice: reducing child imprisonment", November 2003. See also The NotSchool Report 2002: <http://www.notschool.net>, accessed on 10/09/03
- ⁸ National Center for Educational Studies: <http://nces.ed.gov/pubs2001/HomeSchool/>, accessed on 12/03/03
- ⁹ Rothermel, P. "Home-Education: Rationales, Practices and Outcomes", University of Durham, 2002: <http://www.dur.ac.uk/p.j.rothermel/Research/Researchpaper/BERAworkingpaper.htm>, accessed on 11/03/03
- ¹⁰ the term fortress school occurs frequently in the literature. There is no clear agreement concerning who originated the phrase. The following URLs give an indication of its wide use: <http://www.jlifford.com/articles/fortress-head.html>, <http://www.ptoday.com/0903tim.html>, <http://www.ptoday.com/0903tim.html>. All accessed on 18/05/03
- ¹¹ Heppell, S. "Creative Learning", Times Educational Supplement 4th March 1999.
- ¹² Moore, G (1965) "Moore's Law, Fairchild Camera and Instrument group", available at <ftp://download.intel.com/research/silicon/moorespaper.pdf>. accessed on 11/03/03
- ¹³ Scottish executive, "School computer access ahead of target " news 20/06/2002: <http://www.scotland.gov.uk/pages/news/2002/06/SEed039.aspx> , accessed on 12/03/03
- ¹⁴ Becta National Statistics: <http://www.becta.org.uk/leaders/display.cfm?section=20&id=2133>, accessed on 06/02/04
- ¹⁵ The European SchoolNet: The gateway to education in Europe: <http://www.eun.org>, accessed on 12/03/03
- ¹⁶ m-learning : learning in the palm of your hand": <http://www.m-learning.org/>, accessed on 18/05/03
- ¹⁷ Blackpool sixth form college, report on the use of technology: <http://application.blackpoolsixth.ac.uk:591/appindex04.htm>, accessed on 12/03/03 with private login
- ¹⁸ joinedupdesignforschools: <http://www.joinedupdesignforschools.com/> and Schoolworks: <http://www.roeschoolworks.k12.il.us/index.htm>, accessed on 12/03/03. For detail see a reflective design paper reporting on a number of case studies: http://www.demos.co.uk/designforlearning_pdf_media_public.aspx, accessed on 18/05/03
- ¹⁹ CBBC Project. A research collaboration between CBBC and Ultralab: <http://www.ultralab.tv/cbbc/>, accessed on 12/03/03
- ²⁰ "London Schools", quoted from article in Times Educational Supplement 21/11/03
- ²¹ "Second International Forum on Creativity and Invention": May 23 2002: http://www.wipo.org/innovation/en/meetings/2002/bei/pdf/wipo_inv_bei_02_13.pdf, accessed on 12/03/0
- ²² "7th International Conference on Thinking", speech by Prime Minister Goh Chok Tong ,2 June 1997: <http://www.moe.edu.sg/abt/moe/pa/contact/vol10/pers.htm>, accessed on 12/03/03
- ²³ The Encyclopaedia of Informal Education: Henry Morris article on "His vision of the village college": <http://www.infed.org/thinkers/et-morr.htm>, accessed on 18/05/03
- ²⁴ Discovery 1 Christchurch: <http://www.discovery1.school.nz/home.swf> and for detail on the impact of the school, Education Gazette: http://www.edgazette.govt.nz/articles/show_articles.cgi?id=6142, accessed on 12/07/03
- ²⁵ Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance Condensed Report: http://www.pge.com/003_save_energy/003c_edu_train/pec/daylight/di_pubs/SchoolsCondensed820.PDF, accessed on 18/05/03
- ²⁶ ASMS in Adelaide: <http://www.schoolsnetwork.org.uk/article.asp?article=1181> and Specialist Schools Trust (Adelaide): <http://www.schoolsnetwork.org.uk/article.asp?article=1181>, accessed on 18/05/03
- ²⁷ Charles Clarke welcomes new partnership with Oracle to sponsor specialist schools", 23rd June 2003: http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn_id=2003_0119, accessed on 09/09/03
- ²⁸ "Michael Wills announces £657 million of investment for schools", Education questions, Hansard, 25th June 2002: <http://www.becta.org.uk/news/mwsspeech.html>, accessed on 09/09/03

- ²⁹ Consultation go-ahead to build schools of the future", 26th June 2003: http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn_id=2003_0126, accessed on 15/09/03
- ³⁰ Conservative Party Manifesto 1959: <http://www.conservativemanifesto.com/1959/>, accessed on 09/09/03
- ³¹ Druk white lotus school Home Page: <http://www.arupassociates.com/DrukWhiteLotusSchool/Home.htm>, accessed on 12/10/03
- ³² Ove Arup: <http://www.arup.com/project.cfm?pageid=209>, accessed on 12/10/03
- ³³ Hellerup school: Copenhagen award information: http://www.carlbro.com/projects_to_receive_prizes.php, accessed on 12/10/03
- ³⁴ BBC News Online report on 2003 RIBA Award winner Jubilee School, 12th November, 2003: <http://news.bbc.co.uk/1/hi/magazine/3250961.stm>, accessed on 13/11/03
- ³⁵ DfES Classrooms of Tomorrow programme: <http://www.teachernet.gov.uk/management/resourcesfinanceandbuilding/schoolbuildings/sbschoolsforthefuture/futureclassrooms/designdrivers/>, accessed on 18/04/03
- ³⁶ DfES Exemplar Designs project: <http://www.teachernet.gov.uk/management/resourcesfinanceandbuilding/funding/bsf/exemplars/>, accessed on 18/04/03
- ³⁷ Teaching and Learning Resources - competition: http://www.designcouncil.info/webdav/servlet/XRM?Page/@id=6003&Session/@id=D_F1oKuwr3NyKRUGBahD7b&Document/@id=3341, accessed on 18/04/03
- ³⁸ "School Security Concerns": April 2003, Richard Lloyd and Charlene Ching, DfES Research Report RR419, ISBN 1 84185 972 9