

Expanding the Capacity to Learn: A new end for education?

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‘The test of successful education is not the amount of knowledge that pupils take away from school, but their appetite to know and their *capacity to learn*.’ Sir Richard Livingstone, 1941

‘All skills will become obsolete except one, the skill of being able to make the right response to situations that are outside the scope of what you were taught in school. We need to produce people who *know how to act when they are faced with situations for which they were not specifically prepared*.’ Seymour Papert, 1998

‘One of the core functions of twenty-first century education is *learning to learn in preparation for a lifetime of change*.’ David Miliband, 2003

‘Pedagogy should at its best be about what teachers do that not only helps students to learn but actively strengthens their *capacity to learn*.’ David Hargreaves, *Learning for Life*, 2004

‘Effective teaching ... should aim to help individuals and groups to develop the *intellectual, personal and social resources that will enable them to ... flourish ... in a diverse and changing world*.’ *ESRC TLRP Evidence-informed principles for teaching and learning: No 1*, March 2006

Introduction

As the quotations show, the idea that ‘expanding the capacity to learn’ might be a goal of education has been around for some time. Being an effective learner, they have argued, is not just a means — enabling students to learn more knowledge more efficiently — but a valuable end. In the last few years, the idea has gathered more momentum. A variety of labels have been

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used — learning skills, learning to learn, developing positive learning dispositions. Some of these only go as far as developing hints and tips that will help students organise, retain and retrieve examinable information. But for many, the ambition is greater. There is a widespread belief that being an effective, powerful real-life learner is a useful thing to be; and that twenty-first century education should be aiming to help young people develop this generic capacity to learn.

Compared to the rhetoric and the good intentions, however, practical progress has so far been frankly disappointing. There is barely a school or a Local Authority whose Mission Statement does not include a nod in the direction of preparing their students for ‘a lifetime of change’. But on the ground, it has proved very hard to prevent these fine words slipping back into a concern with improving examination performance. Until very recently, we have had no clear conceptual framework for talking about what the capacity to learn involves. We have had no coherent approach to pedagogy, or to school development, that is directly targeted at expanding the capacity to learn. And we have had no reliable way of telling if this aim has been achieved.

In this presentation I want first to argue that expanding young people’s capacity to learn is indeed a valid and timely goal for education, and that finding ways of converting the good intentions into effective change is a matter of urgency and importance. And secondly, I want to discuss what seem to me to be some of the most promising developments. We are beginning to be able to unpack the notion of ‘learning capacity’, and thus to understand in more detail what it is we are trying to expand. We are beginning to go beyond the ‘hints and tips’ approach to discover what type of culture change, in both individual classrooms, and schools as a whole, is necessary to genuinely expand learning capacity. The jumble of mind maps, brain gym, learning styles and multiple intelligences of a few years back was a start — but I think we are now on the track of an approach that is more infused into the fabric of a school, and more intellectually coherent and well-grounded. And we have made a start — but nothing more than that — on developing ways of tracking and recording students’ expanding learning capacity.

Why consider the question?

So let me start with the question of what motivates the idea that ‘expanding the capacity to learn’ is a valid end for twenty-first century education. Some of the initial interest in ‘learning to learn’ reflected national government’s anxieties about economic competitiveness. At first, this drove a rather narrow focus on ‘lifelong learning’ as the continual updating of vocational knowledge and skills. The quotations, however, reflect a concern that is wider and deeper than that. It is that too many young people are not coping well with the general challenges of twenty-first century living. They seem to lack the necessary personal resources to cope.

There is a widespread feeling that twenty-first century life presents everyone, as they grow up, with high levels of challenge, complexity and individual responsibility. It is commonly said that we are in a century of choice, problem-solving and learning. And if young people are lacking the personal resources to thrive in such a context, then it is the job of education to strengthen their ability to be *good* choosers, *skilful* problem-solvers and *powerful* learners. ICT skills have increasingly short shelf-lives: some of them are out of date within six months. But the generic ability to learn has no use-by date at all.

The evidence of many young people’s struggles, in the face of this awesome mix of opportunities and responsibilities, is hard to ignore. Almost every week brings a new report on young people’s drinking and drug-taking; their recklessness and escapism; the rising statistics of adolescent depression and anxiety, and of self-harm and suicidal thoughts. Teenage drinking has almost doubled in the last four years alone. More than a third of 15-year-old girls describe themselves as regular drinkers, and it is middle-class girls from traditional, so-called stable homes, who are drinking the most. Over half of all 16-year-olds have tried illegal drugs.¹

An article ‘Time trends in adolescent mental health’, published in the *Journal of Child Psychology and Psychiatry* in November last year, documented a marked decline in teenagers’ mental health in the last 25 years, a trend that was not attributable to the rise in divorce and single parenthood. John Coleman, director of the Trust for the Study of Adolescence, commenting on the report, suggests that high levels of complexity and responsibility are one of the main causes. ‘Faced with all these choices, [many young people] say they have to “make it up as they go along”’, and that can be hugely stressful. I could go on, but you read the newspapers, and you probably know personally, as I do, some youngsters who are floundering, or even, as we say, ‘going off the rails’.²

Stress, according to both psychologists and biologists, occurs when the Demands on a system significantly and persistently exceed the Resources which the system has to respond. If the Resources that people have at their disposal do not increase to meet an increase in the Demands they are experiencing, their attempts to cope may become increasingly desperate and dysfunctional. That’s what stress is. Drinking, fighting or obsession with appearance can all be seen as misguided attempts to deal with unmanageable situations; reactions that make the overall situation worse, not better. Even if we allow for the usual degree of media hype and hysteria, this seems, in part, to be what we are witnessing *en masse* in today’s young people, in their signs of escapism, recklessness, fatalism and distress.

There are a number of ways to try to get a handle on young people’s confusion, and to give them help. Social and political analysts examine the nature of the Demands, and seek ways they might be reduced or managed. Melanie Phillips wants stricter parenting, and Daily Mail readers want more ASBOs, to screw the lid more tightly on the pressure cooker. The medical establishment offer ways of mopping up the distress with drugs or therapy. The LSE’s Lord Richard Layard wants 10,000 more therapists. But young people’s stress is no longer a series of ‘private troubles’, as C Wright Mills put it. It is a public issue. Mopping up distress with chemicals or counselling doesn’t get to the heart of the matter.

But where is education in all this? The fundamental purpose of education is precisely to increase young people’s level of Resources to cope with life. That’s what my quotations are saying. Education is the response to increased Demand that focuses on reducing stress by expanding capability. If we go right back to basics, back to the ground floor — not getting out at the usual mezzanine of SATs scores and GCSE results — education is about giving all young people whatever-it-is we think they will need in order to thrive. And that means: thrive in the face of the challenges and opportunities we anticipate they are going to meet — exactly the kinds of complexity, uncertainty, choice and responsibility I have been talking about.

Though it draws heavily on the accumulations of culture, education is fundamentally a preparation for the future, not a veneration of the past. Trying to perfect an education system that is fundamentally designed to give young people things they no longer need is not a responsible pursuit. In the judgement of history, arguing about trust schools and 14–19 diplomas may come to make rearranging the deck-chairs on the Titanic look like a well-considered strategic plan. The Demands of the twenty-first century are different from those of the nineteenth.

And so the very aims of education have to change. There is no such thing as ‘best practice’ — or even ‘next practice’ — in abstract. You cannot say what is good teaching, good school organisation, good leadership, until you have specified what it is that you want youngsters to gain, in the light of the particular world they are being readied for. By all means personalise learning — but please tell us first what the point and the purpose, what the intended outcomes, are. Only if you tell me what your end is can I tell if your means are good or bad. And if it turns out that your intention to ‘raise standards’ is merely to improve examination results, in a system that still necessarily requires a substantial proportion of relative failures, then I shall call your ‘next practice’ anachronistic and irresponsible.

In a recent survey of young people's views of the future, and of their schooling, by *The Work Foundation*, an 18-year-old Muslim man spoke for thousands when he said: 'There's a gap. In school everything works like clockwork, you know, you go to your lessons, you do your work, you do your exams ... real life is not like that.' So did this 19-year-old woman, who suggested; 'At school, and this is a really important point I think, they teach you knowledge, but they never teach you how to learn.' It is education's most basic job to expand all young people's emotional and intellectual resources to cope with life; and few youngsters leave school satisfied that that has happened — however many GCSEs or A levels they have notched up. If their core experience of school is one of massive disappointment, it is hardly surprising that many of them eventually withdraw their psychological, and in increasing numbers their physical, presence.³

Young people are floundering — and schools continue to offer them quadratic equations and the Tudors. If there is a logic that links understanding acids and bases to the development of real-life learning capacity, the lack of which they feel so keenly, it is not obvious to them. And nor is it to me. If there is evidence that traditional Good Teaching, leading to a satisfactory clutch of GCSEs, helps youngsters face life's challenges calmly, confidently and capably, then I have missed it. On the contrary, Jo Boaler's research shows that good, traditional mathematics teaching, effective at getting those vital C's at GCSE, leaves in students' minds no discernible residue of transferable, real-world utility.⁴ Carol Dweck has shown that it is academically successful girls who are most likely to go to pieces when confronted by something they do not know how to do. They will get good school results, but their learning resilience can, at the same time, be wafer thin.⁵ And no-one, to my knowledge, has yet rebutted David Perkins's large-scale study which showed, in the words of his paper's title, that 'Post-primary education has little impact on informal reasoning.' Doing well at school does not make you a better thinker. Not necessarily, and not usually.⁶ You can get good results, in the arcane world of 'educational standards', and still lack resilience, resourcefulness, and the ability to organise and evaluate your own learning. If we are serious about making education into an effective preparation for complex living, there are still some fudges and fond hopes we have to face up to.

Another issue to be faced is that learning capacity is as much a matter of character as it is of skill. Being able to stay calm, focused and engaged when you don't know what to do is not merely a matter of technical training. It requires a self-concept that has not been infected by the pernicious idea that 'Being confused and making mistakes means you are stupid.' And gaining and losing such attitudes and beliefs takes time and consistency. Of course learning capacity is partly a matter of skill. But we also need a richer vocabulary that includes words like attitudes, dispositions, qualities, values, emotional tolerances, habits of mind.

In the old nineteenth and early twentieth century worlds of grammar and public schools, they talked happily of developing qualities such as team spirit, fair play, judgement, responsibility and reason. Though educators were sometimes more reticent about the qualities they sought to develop in the less fortunate, the valued traits were clear none the less: obedience, punctuality, precision, honesty, as well as basic literacy and numeracy. Nowadays, quite rightly, we no longer want to be associated with a school system that sorted children into potential 'leaders' and 'followers', and trained their characters differentially, and so we have become nervous about talking about character formation at all. Or rather, we pay lip-service to the idea, on the opening pages of our prospectuses and strategic plans, and then, largely, ignore them.

But the problem was not in daring to talk about character *per se*. It was only the *particular* sets of valued characteristics that needed challenging and updating. I think we must reclaim the language of character, and not be afraid of the value judgements that go along with it. Or, if 'character' sounds a little too old fashioned for you, I can offer you two brand new phrases that say the same thing. They are 'epistemic mentality' and 'epistemic identity'. By 'epistemic' I mean 'to do with thinking, knowing and learning'. So one's 'epistemic mentality' is the sum total of the cognitive habits of mind that go to make up one's capacity to learn. And 'epistemic

identity' refers to the sum total of the emotional and personal attitudes, beliefs and tolerances that expand or contract one's capacity to learn.

Before we move on to talk about the capacity to learn itself, let me summarise my conclusions so far. 'Expanding young people's capacity to learn', as a goal of education, is an interesting and far-reaching idea. It could potentially help to give young people the confidence and capability they often lack in dealing with a host of real-life complexities, uncertainties and demands. But we are very far from realising this potential. Some of the early attempts to respond to this ideal have been little more than techniques bolted on to 'business as usual' to boost exam performance. They supplemented the means but did not change the ends. To make the reality of students' school experience match the rhetoric more closely, we have to dig deeper, and not be afraid of talking about the character traits and habits of mind that it is our intention to help young people cultivate.

What makes up the capacity to learn?

So now let me move on to a discussion of what the 'capacity to learn' actually comprises. If the traits that all young people need to flourish, at this point in our cultural history, are the qualities of the powerful learner — the Explorer, the Investigator, the Skeptic, the Finder-Outer — what are they?

One place to start is simply to ask people in education what they think those qualities are. I have spent most of my professional life over the last eight years or so working and talking directly with teachers and students in around 300 local authorities from Jersey to Falkirk, from Westminster to County Tyrone, from Devon to Doncaster. I've been involved in long-term projects with Cardiff and Oxfordshire that have so far generated around 250 action research reports on how to expand students' capacity to learn. Local Authority-wide projects in Stafford, Kent, Wiltshire, Milton Keynes, Harrow and Bristol, amongst others, are ongoing. And ideas are germinating in a hundred more schools where ingenious teachers are trying things out. None of this constitutes Research with a capital R. But a good deal has been learned, and the territory is beginning to be mapped in a very practical way. We may be ready to go large with an ESRC project in a couple of years.⁷

The following table shows the kinds of things that people regularly associate with being a capable learner — which, remember, is not the same thing at all as being a successful student. Have a look and see what you think. Are there any that you find surprising, or that you don't think belong there? (If we were doing a workshop, I'd get you to critique the list and suggest additions and alterations.) Several other researchers, such as Art Costa in California, and David Perkins' group at Harvard, have devised similar lists. There are differences, but they overlap a good deal, and seem to be converging.⁸

While people's intuitions are not a bad place to start, we might expect that more scholarly research might also suggest additions and modifications. Cognitive neuroscience, experimental psychology and sociocultural studies can all make a contribution. There is only time here to give you a couple of illustrations. All three of these disciplines, for example, suggest there is good reason for including the quality I have called '*imitative*' — though it is not one that appears so frequently on practitioners' lists. Cognitive neuroscientists now believe that our brains have evolved to make us disposed to learn by imitation. So-called 'mirror neurons' in the cortex automatically prime us to mimic what we see others doing around us, and that disposition towards imitation is one of the main ways in which cultural habits of thinking and learning transmit themselves from generation to generation. Just as children moderate their emotional responses by watching how those around them react, so they pick up learning dispositions such as 'persisting in the face of difficulty', 'relishing a challenge', 'pausing to reflect' and 'honest self-appraisal'. (Or, of course, their reverse). As Vygotsky said, habits of mind are contagious.

So it will be important to see if there are ways in which we can help young people become more permeable to the valuable learning habits of those around them.⁹

Positive Learning Dispositions

Resilient	Resourceful	Reflective	Reciprocal
Curious (proactive)	Questioning ("How come?")	Clear-thinking (logical)	Collaborative (team member)
Adventurous (up for a challenge)	Open-minded (‘negative capability’)	Thoughtful (Where else could I use this?)	Independent (can work alone)
Determined (persistent)	Playful ("Let’s try ...")	Self-knowing (own habits)	Open to feedback
Flexible (trying other ways)	Imaginative (could be ...)	Methodical (strategic)	Attentive (to others)
Observant (details / patterns)	Integrating (making links)	Opportunistic (serendipity)	Empathic (other people’s shoes)
Focused (distractions)	Intuitive (reverie)	Self-evaluative ("How’s it going?")	Imitative (contagious)

Likewise, the flurry of recent work in psychology on the ‘cognitive unconscious’, to which I have contributed, makes it clear that tolerance for hazy or non-articulate ways of knowing is also essential to learning. People who are more receptive to their own faint hunches and inklings are better problem-solvers, for example, than those who must have everything clear-cut. Learning rarely proceeds in neat logical steps. More often it weaves in and out of the fog. And those who have no tolerance for fogginess — who have been trained to think that confusion is a sign of stupidity, for instance — have therefore reduced their capacity to learn.¹⁰ So we can ask: How can an acquired intolerance for confusion be reversed? And what kind of school ethos would inculcate the healthy belief that hesitant and unclear knowing is a vital aspect of intelligence?

As we try to bring ideas together from both academic and practitioner perspectives, it is important not to allow the apparent objectivity of the former to swamp the delicate differences inherent in the latter. What constitutes ‘learning’, and what kinds of learning, in what situations, are judged to be ‘a good thing’, are cultural judgements. Some communities, I have found, want to argue with some of the dispositions on my list, and, in a multicultural school, such conversations are to be welcomed. For example, you will see that qualities like ‘respect’ and ‘retentiveness’ have not made it on to my list, though they are central to some cultural models of learning.

Nor should we make the mistake of assuming that the opposites of these qualities are *not* to be valued. At a slightly deeper level of sophistication, we would want to see ‘dogged perseverance’, say, as one end of a continuum that runs to ‘judicious giving up’ at the other end. I hope you would agree that an effective learner knows when it is smart to abandon a project and move on, just as much as when and how to persist. Not every difficult book repays the earnest effort to finish it — as I have learned, far too late in my life. Or, to take another example, the research shows that in creative work, it is important to be able to slide between

concentrated and diffused kinds of awareness, and between sociable and solitary thinking. As we get deeper into the exploration of what the capacity to learn involves, so we rapidly have to start overlaying the terrain of my grid with meta-level qualities like ‘balance’ and ‘fluidity’.

What does expanded capacity to learn look like?

The next question is: what does it *mean* to expand these component learning capacities? What exactly is it that is being ‘expanded’? To answer this, we need to delve a little more into the distinction between *learning skills* and *developing dispositions* — character traits — that I introduced earlier. Put crudely, when you have learned a skill, you are able to do something you couldn’t do before. But you may not spontaneously make use of that ability when it is relevant in the future, if you do not realise its relevance; or if you still need a degree of support or encouragement that is not available. In common parlance, it is not much use being *able* if you are not also *ready* and *willing*. When it comes to thinking, for example, Perkins has shown that most of us don’t think as well as we can. We are not disposed — that is ready and willing — to make use of the ability we possess.¹¹

To become more disposed — to develop the disposition — involves two kinds of learning in addition to mastering the skill. First, we can broaden and refine our sense of when it is appropriate to use this particular ability (to become more ready). And secondly, we can strengthen our inclination to make use of the ability regardless of whether other people are encouraging us (to become more willing). So when we talk of dispositions, we are not talking about a new kind of psychological entity that need to be distinguished from skills. Trying to decide whether ‘resilience’ is a skill or a disposition is a bothersome activity that is not really necessary. A disposition is merely an ability that you are actually disposed to make use of. Resilience is a disposition to the extent that you are ready and willing to persist in the face of difficulty, as well as knowing how to.¹²

Or take the disposition to be ‘questioning’. Asking questions is partly a matter of skill, for sure. One has to know how to formulate good questions, and how to tell a scientific question from a religious one. But ‘being questioning’ is also a matter of inclination, of self-confidence, of a sense of occasion, and of entitlement. It is not much use being *able* to ask good questions if in practice you are very easily deflected from doing so. Asking questions makes you vulnerable: it might be a stupid question, or one that everyone else knows the answer to. The capacity to learn depends, in part, on being willing to run that risk, and to do so you need a sense of entitlement: the belief that you have a *right* to be curious, to ask questions, to discuss, to imagine how things could be different. Some students don’t feel that they do have that right. Some schools encourage students to develop a feeling of being disenfranchised from the process of making and critiquing knowledge.

So expanding the capacity to learn means creating a climate in which that feeling of enfranchisement and entitlement is systematically broadened and strengthened — not weakened, undermined or simply ignored. In such a climate, students’ questions are welcomed, discussed and refined, so the disposition to question becomes more and more robust; more and more evident across different domains; and more and more sophisticated. If you used only to ask questions with a teacher you liked, or only in English, but now you ask questions with more teachers in more subjects — and also when you are watching the television or talking with friends — you have expanded your capacity to learn. If schools are serious about helping young people get ready for a learning life, they have to think not only about what the skills of learning are, but about how, deliberately and methodically, to help them become stronger, broader and richer.

When people think only in terms of teaching skills or competencies, and neglect the need to cultivate dispositions, then they are probably doomed to disappointing results. They may be able to coach someone to display ‘communication skills’, or ‘the ability to collaborate’ under some

conditions, but without the extra attention to coaxing the development of 'ready' and 'willing', they will probably find that any apparent gains fail to last, spread or deepen. And that is indeed what many attempts to 'train thinking skills' and the like have found. Explicit teaching of thinking skills is often well-received by students, not least because it offers some welcome relief from content-dominated lessons. But the bulk of the evidence shows that such gains fade over time, and they do not generalise to other situations and topics. Even some of the most highly regarded 'teaching thinking' programmes have had mixed success. Carol McGuinness's ESRC TLRP project on 'Activating Children's Thinking Skills' showed only modest gains in thinking for high-ability children who had been exposed to her programme for three years. Lower-ability students showed no gains. Neither did bright students who had had less than three years' exposure.¹³ (The 'Cognitive Acceleration' in science and maths programmes devised by Philip Adey and Michael Shayer have consistently produced evidence of spontaneous transfer to other subjects, but again, only after the kind of extended interventions that might be expected to develop dispositions as well as skills.)¹⁴

To put it baldly: the idea that you can teach students a bit of calculus, and then expect them to magically make use of it in next week's physics lesson, is naïve. And the idea that you can tick a list of boxes labelled 'Can work well with others' or 'Understands the consequences of her actions' is naïve in the extreme. The mind is not built like that. Relevance and robustness have to be learned. And it is therefore the job of education not to assume that learning will take place, but to do everything possible deliberately to help it to do so.

So how might we do it?

All of this brings us to the question of teaching methods. If 'Impressive Wish-lists', stand-alone 'Teaching Thinking Skills' and 'Tricks of the Trade' don't do it, how *can* schools expand the capacity to learn? Recently, attention has turned to the development of what are called 'infusion' or, to use my fancy word again, 'epistemic culture change' programmes. These infusion approaches are exploring ways in which the school as a whole, and its classrooms in particular, can become settings in which the various constituent elements of learning capacity are acknowledged, discussed, understood and systematically strengthened. Their guiding question is: what would it mean to organise your classroom and your pedagogy in such a way that every day, little by little, in the midst of the Literacy Hour, the Romans, or an experiment on magnets, your students were learning to learn more robustly, more broadly, and more flexibly and skilfully?

Not surprisingly, we don't yet have a complete answer to this question. But we have made considerable progress over the last ten years or so. Through the 250 or so action research projects I have been involved in, as well as through the work of others such as Chris Watkins and his group at the Institute of Education, the PEEL group in Melbourne, and the Harvard group which I have already mentioned, some pointers are emerging.¹⁵

It looks likely that an epistemic culture will need to attend to the following areas of its operation. The *language* will need to change, to support a shift of attention to the process of learning, and the ways in which people's learning dispositions are growing and changing. *Activities* will need to be selected, designed and framed so that they deliberately focus on stretching each aspect of learning capacity, and this goal is not eclipsed by a more familiar focus on the acquisition of knowledge and the completion of tasks. This may be supported by what my group has come to call '*split screen thinking*' on the teachers' part, maintaining a dual focus on the content of the lesson and the learning dispositions that are in play. One implication of this is that there will need to be a good representation of what David Perkins calls '*wild topics*' that genuinely engage and challenge students. We suspect that epistemic classrooms will make the intention to expand their learning capacity absolutely *transparent* to students, and more than that, they will be actively *involved* in thinking about how to make the culture even more effective at doing that. There will be continual *transfer thinking*, in which students will be

encouraged to look for out-of-school applications and modifications of the learning dispositions they are discussing and developing in school. There will need to be a sense of *progression*, so that dispositions continue to get stronger, broader and richer. And we think that *modelling* of the learning dispositions will turn out to be an important ingredient in an epistemic culture. Let me look at each of these in a little more detail.

Aspects of an Epistemic Culture

Language — we all speak ‘learnish’

Activities — a potentiating milieu

Split-screen thinking — the warp and weft

Wild topics — rich, real, responsible

Transparency & involvement — students as epistemic co-workers

Transfer thinking — looking for wider relevance

Progression — stronger, broader, deeper ...

Modelling — walking the learning talk

Language. The classroom should be a place where talk about the process of learning, the nature of oneself as a learner, and one’s improvements and intentions for oneself as a learner, is continual and natural. The focus of discussion is on the ‘how’ of learning, more than the ‘what’ or the ‘how much’. The teacher challenges students to think and talk about their own learning process with questions such as:

- How did you do that?
- How else could you have done that?
- Who did that a different way?
- What was hard about doing that?
- What could you do when you are stuck on that?
- How could you help someone else do that?
- What would have made that easier for you?
- How could I have taught that better?
- How could you make that harder for yourself?

Plenary discussions, small group discussions and reflective writing in learning diaries can all help this kind of conversation to become second nature.

Some workers in this area such as Chris Watkins think that these kinds of generic prompts will be sufficient.¹⁶ They do not want to plant their own theories in students’ minds. My view is that, provided it is presented as a tool for discussion and development, it is useful to offer students a vocabulary, such as the one in my grid, that illustrates the kinds of things that ‘the capacity to learn’ might comprise. Getting students talking and arguing about the concepts behind such words as ‘intuition’ or ‘risk-taking’, and coming up with their own preferred terms and definitions, serves, we have found, to deepen their understanding, interest and ownership.

One secondary school I am working with, Walthamstow Girls High School in north-east London, for example, introduces just one of the ‘learning muscles’ every fortnight and gets the whole of Year 7 thinking and talking about it in every lesson during that period. As the students move from Maths to English, so they know that their teachers will be asking them to deepen their understanding of the target term. Students are continually encouraged to become critical

and creative thinkers and collaborators in the construction of their own practical knowledge and lexicon for talking about the process of learning.

There are two language changes that are particularly important. If these are not made, there seems to be a strong linguistic undertow that keeps dragging you back towards more familiar ways of thinking and working. The first is the word ‘learning’ itself. When people talk about ‘improving students’ learning’, it is all too easy to slide back into treating this as another way of saying ‘raising achievement’, and if you allow that to happen, the focus on expanding learning capacity can easily be lost. So, though it feels cumbersome at first, we have found that the effort always to say ‘learning capacity’ or ‘learning power’, when that is what you mean, is well worthwhile.

There is a subtler trap with the word ‘learning’. Teachers may think that ‘helping to improve students’ learning’ means *supporting* their learning, rather than *expanding their learning capacity* — and they are not the same thing at all. Helping them learn better is not the same as helping them become better learners. Effective support can easily create dependency, unless the teacher is continually looking for opportunities to dismantle the scaffolding, and build students’ disposition to do their own supporting. And that intention always to look for a way to do less, to hand the control back to the students, may be unfamiliar, and easily overridden by teacherly habits that are older and stronger. Again, getting used to thinking and talking about ‘expanding learning capacity’, rather than just ‘improving learning’, can help to counteract these tendencies to backslide.^{17†}

† Even Assessment for Learning, and some of the ESRC projects on ‘learning how to learn’ based on AfL, seem to vacillate between supporting and expanding learning. For example, I found the quotations from Seymour Papert and Sir Richard Livingstone, on my opening slide, on a PowerPoint presentation on the TLRP ‘Learning how to learn’ website. The project clearly shares my interest in expanding young people’s capacity for lifelong learning. And some AfL activities are indeed designed to develop students’ ability to reflect on their own learning, and to give and take feedback in a useful way. Both of these expand the capacity to learn.

But when it comes down to it, the undertow drags teachers back toward supporting, not expanding, learning. AfL, it says, helps teachers ‘to decide where learners are in their learning, where they need to go, and how best to get there.’ In practice, two of the key AfL strategies involve teachers in giving clearer feedback to students about how to ‘close the gap’; and in asking better diagnostic questions to help them give more effective guidance. The AfL researchers have found that if teachers make some simple changes to their practice, like giving comments without marks or grades, or waiting longer for answers to questions, examination results go up. What they haven’t shown is whether these practices help students to become more inquisitive, reflective, persistent learners in their own right. Remember: a teacher asking more open-ended questions is very different from Julie Green’s approach, in which her nine-year-olds were learning to ask more sophisticated questions for themselves (see below, ‘Split-screen thinking’). The former by no means necessarily leads to the latter.¹⁸

It is surprising, in the reports of the ‘Learning how to learn’ project that I have read, that there is very little discussion of the richness and diversity of what ‘real-life learning capacity’ actually involves. The learning-to-learn vocabulary is disappointingly thin. And this may help to explain why even the AfL pilot teachers found it hard to break the habit of attending predominantly to the ‘content’ screen, and thus, in practice, neglecting the ‘learning capacity’ screen. Whatever the reasons, Mary James, director of one of the TLRP projects, has concluded:

We found that implementing the spirit, the underlying principles, of AfL was hard to achieve. Most teachers adopted the letter of AfL ... but few did so in a way which enabled the pupils to become more independent as learners, which is a defining characteristic of AfL.¹⁹

In several places, reports of the project quote Sir Alan Steer, one of the headteachers with whom they worked. ‘The project has enhanced the learning of us all,’ he said. ‘I have no doubt that our children are now better taught than ever before.’ But whether they have an expanded capacity to learn, we still don’t know.

The second problematic group of words are those that draw teachers' attention to what is fixed about students' minds, rather than what is malleable — capable of expansion. Words like 'bright', 'able', 'average' or 'weak', if used without qualification, can lead you to assume that students' current performance — and particularly where they struggle — is symptomatic of some kind of structural limitation in their minds, rather than of the current state of their expandable learning capacity. And this can make you less perceptive — or committed — about opportunities and activities to stretch capacity, rather than adjust expectations to fit an apparently fixed capacity. Intelligence researchers such as Lauren Resnick now routinely define 'ability' merely as 'the sum total of one's habits of mind'. It is useful to have this definition in big letters in the school foyer and every classroom, to remind everyone that learning capacity is a matter of habits — and habits are things that can change.²⁰

Potentiating activities. One of the things we have come to realise is that 'activity' is not necessarily 'exercise'. Expanding one's learning capacity requires being stretched, and being willing 'to boldly go' where learning itself is difficult. Fun activities that engage students without stretching them are not, in these terms, worthwhile. So-called 'bright', 'able' or 'gifted' students who coast through school are wasting their time — just as an athlete would be if they set up a training session in which they never broke sweat or got out of breath. To help clarify this, Margaret Carr of the University of Waikato, one of the architects of *Te Whaariki*, the much-copied New Zealand early years curriculum, and I distinguished four kinds of epistemic milieu. *Prohibitive* milieux make it difficult or dangerous to express a range of independent learning attitudes and behaviours. Many traditionally 'effective' classrooms are prohibitive environments for any but a very narrow set of learning dispositions. *Affording* environments allow students to express learning behaviours, but do not make it particularly salient or attractive to do so. Merely making it possible for students to learn somewhat independently is not enough. *Inviting* environments make it attractive to be a learner, but do not necessarily challenge or stretch students' capacity to learn. Happy, active children who do standard things easily, but avoid difficulty, are wasting their time. Only the fourth, *potentiating* milieux, make the exercise of learning muscles both appealing and challenging. In a potentiating environment, there are plenty of hard, interesting things to do, and it is accepted as normal that everyone regularly gets confused, frustrated and stuck.²¹

Epistemic Milieux

Prohibitive — close down and restrict learning-to-learn

Affording — allow learning-to-learn without encouraging it

Inviting — make being a learner attractive

Potentiating — make learning both attractive and challenging

Split-screen thinking. To help with creating potentiating milieux, many of the teachers with whom we have worked have come to use what they call 'split-screen thinking' in planning and conducting their lessons. This helps them make sure they do not forget to construct activities and environments that stretch some specific aspect of students' learning capacity. On one 'screen' inside their heads teachers are thinking about how to help students grasp the content. On the other, at the same time, they are thinking about how to help students develop their learning capacity.

For example, about a year ago I watched a Year 5 lesson in which the teacher, Julie Green, was simultaneously teaching both Magnets and Questioning. She had laid out a circus of experiments with magnets for the children to do. But in the preliminary plenary discussion, she explained that she wanted them to see what happened, and then think about the kinds of questions that a scientist would be prompted to ask by the observations that they had made. In

the final plenary, they shared their questions, and Julie led them into a spirited discussion about what makes a good scientific question, and how scientists' questions might differ from — or relate to — the kinds of questions that a historian, or a film-maker might ask.

One lesson to take from this example is that split-screen teaching doesn't sacrifice the content. There is no need to do less 'science' in order to find a slot in the timetable to 'do thinking'. In the infusion approach, attention to the subject-matter and to the process of learning are woven together as warp and weft. The desire to develop young people's power as learners, and their feel for the learning process, is not at odds — either in principle or in practice — with the need for coverage.²²

Wild topics. The intention to expand students' learning capacity does not exclude content, but it does influence the kinds of topics that are selected. They have to be engaging enough for students to want to put in the effort to pursue them. There are suggestions from many sources that the following features of a project or activity increase the likelihood that students will want to take it seriously:

- Rich: there is much to be explored
- Challenging: the topic contains real difficulty
- Extended: there is time and opportunity to go into it in depth
- Relevant: the topic connects with students' own interests and concerns
- Responsibility: students have some genuine control over what, why, how and when they organise their learning
- Real: solving the problem or making progress genuinely matters to someone
- Unknown: the teacher does not already know the 'answer'
- Collaborative: most students enjoy the opportunity to work together with others on such tasks.

It is not, of course, possible to transform a school into a matrix of wild topics. But many schools have found they can free up time for such activities if they really want to, and a commitment to increasing this time, year by year, would help to show students that you mean business.

Transparency and involvement. The goal of expanding students' learning capacity seems more likely to take root in a school culture if students understand what is going on, and are given some significant role in helping to design and bring about the desired culture change. In some of the early learning-to-learn programmes, ideas and strategies were delivered to students cut and dried, as if all the hard thinking had gone on elsewhere, and all they had to do was accept and implement the good advice. But we are only just beginning to understand what an optimal epistemic culture looks like, and it is both useful to a school, and more engaging for students, if they are involved in a knowledge-creating, and not just a knowledge-implementing, process. In getting interested in, and finding out about, their own learning, students will necessarily be involved in extending their own learning capacity.

In the last couple of years, I have been lucky enough to be involved in a number of student-led projects on becoming better learners. I have worked with teams of 8-year-olds who have been visiting each others' schools to find out about 'How the school helps us to become better learners'. I have watched a group of sixteen Year 9 students design and deliver a two-hour workshop for 400 Year 8s about 'How to Be a Better Learner'. I have watched four 14-year-olds run a 90-minute INSET session on learning to learn for the entire staff of their school. I have listened to the 13- and 14-year-old members of Bristol youth band The Naturals explain to a Professor of Education, Martin Hughes, and a room full of academics, how they have developed their own collective learning process²³. I have talked to the Head of a First School in Harrow who routinely invites three- and four-year-olds to give her feedback about how she could be a better teacher. And as a result I am now completely convinced that young people are

very interested in the process of learning, knowledgeable about it, and keen to find out more — if they are given the opportunity and encouragement, and their voice is taken seriously.

Transfer thinking. A second lesson to take from Julie Green's lesson on magnets relates to her immediate invitation to the children to take what they have been learning about questions into new contexts, so that they will look for wider relevance. I think that it will become a routine part of an epistemic classroom that students are encouraged to be continually on the lookout for other opportunities to use aspects of their expanding learning capacity. Teachers' regular questions might include:

- Where else could you use that?
- What else might that be good for?
- What learning muscles do you use in your football training that might be helpful here?
- Can you imagine yourself using that at home?
- How do you think John Terry / Jacqueline Wilson / Stephen Hawking might use that learning muscle?

Through such continual prompts, teachers aim not just to encourage transfer, but to build up students' meta-level disposition to look out for transfer opportunities for themselves.

Progression. Some of the pioneering approaches to the development of learning capacity had no sense of progression. You were told the Right Way to do a Mind Map, just like you might have been told the Right Way to add fractions, and that was that. Not only was there no critical discussion — who says there is only one right way? — there was nothing to explore. But now we have realised that learning capacity can be expanded hugely over time, and that therefore we need some way of talking about progression. If Julie Green's ten-year-olds can begin to think productively about what makes a good scientific question, where can they go next? How can they strengthen, broaden and deepen that exploration even more? Unlike some of the earlier approaches, I think it will prove essential that 'expanding learning capacity' is seen as a gradual, long-term, cumulative process that infuses the life of a school; not a bolt-on or a quick fix.

Ingenious teachers are only just beginning to develop some ideas about this sense of progression. But the ones I know are agreed on how to go about finding out more. Ask the students. Share the question with them. Get the Year 6s to think about what they could do to help the Year 5s — or the children in Reception — to develop greater determination. Get the Year 11s to think about where the development of imagination might lead next — and what similarities and differences there might be in the uses of imagination by poets, designers, athletes and scientists. I would now be very surprised if they did not take such a question and run with it to very interesting effect.

Modelling. The last ingredient of an epistemic culture that I think is going to turn out to be essential takes us back to the idea of modelling learning. If the brain is born ready, willing and able to imitate, then an epistemic culture has to make as much use of learning by example as it can. And if Vygotsky is right that, to put it crudely, you pick up your mental habits from the people around you, then we want young people to be around adults, and other students, who are themselves paragons of learning, rather than of knowing.²⁴ It becomes part of a teacher's professional role to be continually saying 'I don't know', 'Oops!', 'I didn't expect that to happen', 'Now I wonder why?' and so on. Their job is to look in the bathroom mirror every school day and ask themselves: 'How can I best model curiosity, or open-mindedness, or empathy, for my students today?' Some teachers, those who have been socialised into the ridiculous idea that they have to appear omniscient, can find this strange and hard to begin with. 'What if they lost respect for me?' they wonder. But they needn't fear. We find that students like their teachers to be fallible and inquisitive, and not Know-Alls. I asked one teacher who had been practising saying 'I don't know' to his students whether he found it risky. 'No,' he said, 'I find it a relief.' And many have agreed with him.

The teacher is not the only learning role-model that students can benefit from. There are fictional, historical or media characters who embody the qualities of resilience, playfulness, hard reasoning, good practising or open-mindedness. They can be the subjects of stories, discussions and projects. What kind of learner is Ron Weasley, or Bilbo Baggins? Students can be role models for each other, if they are encouraged to share their out-of-school experiences of difficult learning. Caretakers, dinner ladies, secretaries and parents probably have fascinating stories of their learning to tell that could inspire the students, and make the rocky learning journey behind an apparently effortless achievement more visible.

There is much more I could say about the small, practical seeds that might contribute to an epistemic culture change, from the displays in the corridors to the way staff-meeting agendas are set; from marking to reporting, from the School Council to the involvement of parents. There are dozens of additional ways in which students can be given the message: Our School Is About Developing the Capacity to Learn. But this may be enough to give you a flavour of the infusion approach, and how it is different from the 'Hints and Tips', 'Learning Labels', 'Wishful Thinking' and 'Teaching Cognitive Skills' approaches.

And will it work?

But now I need to turn, very briefly, to my last cluster of questions: Is the infusion approach effective? Does it do what it says on the tin? What are the essential ingredients, and what are optional extras? These are not easy questions to answer, partly because the approach is so multifaceted, and partly because the development of learning capacity is not easy to measure. If I am right in thinking that we need to look at multi-faceted culture change, rather than single-variable, clearly circumscribed interventions, then an experiment is never going to be able to isolate cause and effect relationships. There are too many potential 'causes' being varied all at once. We may just have to live with the fact that, to get effective change, teachers may need to modify their language, put up some different displays, encourage more student questioning, create more open-ended projects, encourage the use of learning diaries, model more uncertainty and rearrange the desks — all at once!

And they may need, as many teachers in our projects have attested, to change the mix and the pace from class to class, 'Best practice' for expanding learning capacity is more likely to look like a cloud of possible small changes that precipitates differently in different contexts. At a conference in Bristol in April 2006 called *This Learning Life*, American academics David Perkins and Shirley Brice Heath agreed that educational innovation happens not by replicating good practice, but by 're-growing' it, under different conditions. All the headteachers we have worked with, for example, find they have to make their own idiosyncratic distinctions between what I can do tomorrow, what I can aim for in a year, and what will take two or three years' preparing the ground before it becomes practicable. People who still think that Best Practice can be distilled, bottled and sold will find the small print on the label now contains the warning 'Beware: Contains Snake Oil'.

In practice, there seems to be a gathering consensus that small-scale, practitioner-led action research projects often have more impact than more rigorously controlled studies. In recent articles, both Mary James and Sally Brown, drawing on the TLRP results, and David Hargreaves, drawing on his work with the Lifelong Learning Foundation, have acknowledged that such small-r research studies have as much validity as expensive big-R funded projects.²⁵ Teachers are much more likely to change what they do if they see someone else doing it differently, or hear or read a short story about a small-scale intervention which they like the sound of. Our 250 or so action research reports, deriving from the Cardiff and the Oxfordshire projects, have been very successful at inspiring other practitioners to make small experiments of their own.²⁶

Nevertheless, some properly controlled evaluations of the infusion approach to expanding learning capacity are essential. But even the decision about what to record and measure is problematic. The TLRP project on Learning How To Learn, based at Cambridge, Reading and King's College London, could not find a satisfactory instrument, and had to fall back largely on measures of school achievement.²⁷ The trouble with this, as I have already argued, is that many students who get good grades are hardly what one would call robust, broad, rich all-round learners. Remember Dweck's correlation between high achievement in maths and lack of resilience in so-called 'bright girls'. It is also a racing certainty that many young people are highly effective and creative learners in some areas of their out-of-school lives, yet — for a host of reasons — do poorly on school-type tests.

Several self-report instruments have appeared recently that aim to track the development of learning capacity. Some like Bob Burden's *Myself As a Learner*, MALS, scale, or ELLI, the *Effective Lifelong Learning Inventory*, pioneered by Patricia Broadfoot, Ruth Deakin-Crick and myself at the University of Bristol, have reasonably well established reliability, but doubts about their validity. MALS lacks an underpinning model of learning capacity, while ELLI is a rather lengthy instrument that may not sustain respondents' conscientious engagement throughout.²⁸

Maryl Chambers and I have had a go at devising on-line Learning Capacity quizzes that give students a chance to think about how their learning capacity — what we call 'learning power' — is developing, and how they might like to broaden, strengthen and deepen particular learning muscles in the future. However, these 'cheap and cheerful' quizzes are not designed as summative evaluations. Nor are they mainly for the diagnostic use of the teacher, though they can be used in that way. Their main intention is to give students ideas about how to talk to each other about their learning capacity, and prompts to think about how they could expand. *Tracking Learning: On-line* is about to be used as a summative instrument in a BECTA research project, looking at whether the use of hand-held computers can contribute to an expansion of learning capacity, but how well it will serve this purpose we shall have to wait to find out.²⁹

At the moment my group only has a range of indicators, none conclusive by itself, that infusion attempts to expand learning capacity can be effective. Preliminary data from the ELLI project show that self-report ratings of resilience, resourcefulness and so on go up, from KS2 to KS3, for students in an epistemic culture, and down for those who are not. We have a range of OFSTED reports that say things like this:

Pupils' personal development is good and is very well promoted through the school's '4R' code — resilience, reciprocity, reflection and resourcefulness. Pupils understand what these words mean and they are used very effectively, both in lessons and around the school, to bring about the very good atmosphere of learning and playing ... The 'distraction scale' is proudly displayed in all classrooms and encourages pupils to take part in managing their own behaviour ... Using the '4R' code well, they have good attitudes and are happy to take on a variety of responsibilities and show initiative ...³⁰

We have an independent evaluation of a large epistemic culture change project with the Bristol Education Action Zone by Joan Whitehead and a team from the University of the West of England. The 2004 report concluded that the infusion approach 'was regarded by teachers as going beyond other initiatives such as High/Scope and Thinking Skills, and having additional benefits ... Teachers believed that 'pupils had improved their learning habits', and that pupils exposed to the approach 'were becoming more confident learners'.³¹

One of the teachers interviewed for the UWE evaluation made this observation:

The maths SATs paper this year had lots of reasoning. The class did brilliantly at those sorts of questions — even children who wouldn't previously have attempted them. All the children who've been through [the programme] attempted every question from all

sorts of angles, even though they may not have got the right answer. The children are much freer, more courageous [than they used to be].

And we have reports from a number of schools, such as the City Academy in Bristol, who are convinced that their efforts to create an expanding learning culture are the direct cause of a surge in their examination results. Of course they could be wrong. But, as I say, the signs are encouraging.

Most important of all would be to find evidence that epistemic school cultures create more powerful, confident learners out in the big wide world. Even better would be to show that, as young people become more confident and capable in the face of uncertainty, complexity and responsibility, they resort less to stress-reducing behaviours that are reckless or self-destructive. We don't have that data yet — but it would be worth a million pounds of ESRC money to see if such correlations might be there to be found. (Any bright young researchers looking for a project, please see me at the end!)

One further point. I think we are going to need copywriters as well as researchers, if 'expanding the capacity to learn' is to become a new end for education. To become more powerful learners, young people have to be willing to be stretched and challenged. They have to sign up for some hard work, and understand why they should. If you want to get physically fitter, you have to be prepared to get sweaty and tired. And the exertion becomes tolerable — even pleasurable — because you know that it is getting you where you want to go. You have a narrative that gives value to the effort, and this story helps you get through the hard times, and put in the hours.

But where is the compelling story about the real-world value of education that can get young people to turn up and put in the graft? Surely they are not persuaded by the old story that says: 'If you study you will obtain good qualifications and you will get a good job'. They know, however we may fudge it, that the Qualifications Game is one that does not work without a good proportion of relative losers: around 40% at the present time. Without their generous willingness to fail, the Winners' winnings would not be worth anything. But contributing to your friend's delight in her four A's by only racking up three D's yourself is hardly a good reason to turn up and do your best. And as they watch Alan Sugar's *The Apprentice*, in which the two confident, successful women finalists can barely muster 5 mediocre GCSEs between them, young people are not inspired to go back to their maths revision.

So it is not enough that schools expand young people's capacity to learn. We have to get buy-in. We have to explain to young people that school isn't really about the Tudors and the Periodic Table. It is about becoming a brave and skilled explorer; a cunning detective; an imaginative creator; a tough competitor — in whatever field of life they want to work and play in. We have to talk to them seriously about what we are up to; what they can expect to gain; and what they will have to put in. We have to tell a story about the end of education that is inspiring.

Kyle is a 14-year-old from Cardiff. This is his story about why he goes to school.

Why do I come to school? To develop my learning power, of course! They give us interesting things to explore that get harder and harder. In finding out how to grapple with them, we develop the 'learning muscles' and learning stamina that will enable us to get better at whatever we want, for the rest of our lives. People like scientists and historians have figured out special-purpose ways to learn: as we get older, we practice those, and think about how they might help us in everyday life. As powerful learners, we will be better able to learn new skills, solve new problems, have new ideas and make new friends. We know that learning itself is the one ability that will never go out of date — guaranteed — (unlike programming your iPod!). And learning power is learnable. No matter how so-called 'bright' you are, everyone can get better at learning. Even professors have learning difficulties! Oh, and by the way, as we become more powerful

learners, so we naturally do better on examinations too! It's a no-brainer, really.
(Kyle, 14, Cardiff)

We need to improve on Kyle's story, so that it can fire up thousands of his peers for a learning life.

Where next?

Let me conclude. You will know the story of the journalist who asked Mahatma Gandhi what he thought of Western civilisation. 'It is a great idea', said Gandhi. 'I think it is time somebody gave it a try.' Something similar might be said about expanding young people's capacity to learn. It is a great idea — but we haven't really done it yet.

Wish-lists of desirable personal qualities are useful, but they are no more than a small start. Formulating good intentions is the easy bit. Without clear suggestions about what, in practice, a real epistemic school culture looks like, and how to get there, they are not worth very much. Hints and tips — techniques like 'spider diagrams' and revision strategies — can also make a useful contribution to expanding learning capacity, but only, I suspect, if they become the subject of intelligent appraisal and debate in a classroom, whether that be Reception or Sixth Form. Likewise, giving children a Learning Styles questionnaire may provoke a fruitful discussion about when and how they learn in different ways. But simply to be informed that you are a 'kinaesthetic learner' or a 'reflector' is to have your learning capacity not expanded but curtailed. Nor does the attempt to train 'thinking skills' through stand-alone programmes seem to be the answer. Students have fun, but, as we have seen, gains are usually weak, unstable and short-lived, and often do not generalise to other situations.

But I am optimistic. I think we now have enough experience under our belts to do better. My work with teachers over the last ten years has convinced me that expanding young people's capacity to learn is an achievable objective. More than that, it holds out some hope that we might be able to offer all young people — not just the academically inclined — something that speaks to their urgent need to deal better with the complicated predicaments in which they find themselves. Current educational reforms are by and large merely tinkering with a system that is structurally unfit for purpose. We need to remember two premises: that education is preparation for the challenges and opportunities of life as we anticipate it will be; and that all young people have a right to expect clear and substantial gains from their education, that they perceive as relevant to the challenges they face. If we design an education system from which 40% of young people emerge with little but a sense of failure, there is a fault not in them, but in the system.

I think they, and we, know what they need. It is not knowledge, but character; not certificates but courage and confidence to face whatever life throws at them. That is what they have a right to expect. That, many of them, is what they lack. That lack is what is reflected in their escapism and desperation. Trying to find a form of schooling that enables all young people to get better at learning — to come at life venturesome, imaginative and questioning — is the most important task that faces educational research. And trying to find a way of presenting and explaining this, so that youngsters see the point, and are willing, in much greater numbers, to put in some effort and give it a go, is the most urgent bit of PR that our society faces. We need the brains of BERA and the ESRC to be venturesome and imaginative. And we need the advertising gurus of London's Berkeley Square to turn Kyle's clumsy story into something that can re-ignite the enthusiasm of young people and their parents for an education equal to the times. I think we are making a start.

Copies of this paper, and the accompanying presentation, can be downloaded from:

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Notes

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