

A POLICY PAPER

THE STRATEGIC AND RESOURCE IMPLICATIONS OF A NEW MODEL OF LEARNING

THE POLITICAL IMPERATIVE

Education, so politicians in many lands are quick to claim, is at the top of the political agenda - the “number one” item. Business people concur. So do community leaders. So do parents. However, it is easy to say we are looking for higher standards. But what standards? What kind of society are we anticipating, or do we desire? How are “standards” to be achieved? If this means spending significantly more money, then given other political priorities surely this would be a non-starter. What does being “number one” on the agenda actually mean?

There is a paradox here because for most people education seems a strangely boring topic. Like religion, people sense that it’s important, but prefer to leave it to others to practice or think about. Search a bookshop and you are most likely to find the education section in some dark, out-of-the-way, corner, and most of the books on the shelves will be about specialised topics of little general interest. Few education books make it to the front of the shop, and even fewer are promoted as best sellers.

This is strange for there is more material now about the nature of human learning and its importance to individuals, to society at large and to the economy than at any previous time. It’s found in books all over the shop - in many different sections. In fact there is so much about the nature and importance of learning that it is virtually impossible to keep up with all the ideas. It is learning which will drive our future economies, and determine what kind of people we become. Yet the education section in the bookshop remains dusty and remote and to search here for a clue as to why education is now the “number one agenda item” is to become even more confused.

What is happening? Is that education, as previously understood to mean schools, is simply being side-lined, and for some reason is unable to keep up with these new discoveries? Has education ceased to be about learning? Why is it that teachers world-wide seem depressed, fed up, disillusioned and unsure of themselves? Is school “dead”?

EXECUTIVE SUMMARY

This Policy Proposal is written to assist those in positions of influence to initiate powerful changes to current educational arrangements.

The circumstantial evidence for such a transformation of learning is drawn from the best in research and practice from around the world and has been categorised under five headings: 1) the biological nature of learning, 2) the science of learning, 3) culture and nurture: how ideas shape our thinking, 4) the implications of new technologies of information and communication, and 5) spontaneous, informal learning; the significance of the home and the community.

The evidence for the Biological Nature of Learning comes from recent findings in the evolutionary sciences, and the brain sciences. The evidence shows that many of our current arrangements for learning are based on misunderstandings about how the brain functions, how learning takes place and how young people naturally mature. It is now clear that every human is born with an inherited set of predispositions to learn key skills and attitudes throughout childhood and adolescence. Current structures of education do not take into consideration many of these predispositions.

The evidence in the Science of Learning comes from cognitive science, anthropology, and developmental psychology, and it shows that a more effective model of learning would be based on our best understandings about the brain and human development. This model would be familiar to what has traditionally been called “apprenticeship.”

The evidence in Culture and Nurture comes from a convergence of findings in the biological and social sciences, and economics and it shows that the economic and social environment in which schools operate is currently moving away from an emphasis on deference to systems towards an emphasis on personal responsibility and creativity.

The evidence in the section on Technologies of Information and Communication comes largely from best practice around the world and it shows that the tools now available to children in both the home and school offers powerful learning alternatives to a simple reliance on classroom based instruction.

The evidence for Spontaneous Informal Learning comes from anthropology, the history of how cultures have traditionally been transferred from generation to generation, and from the social sciences, and the evidence accumulated shows that schools alone are incapable of equipping children with the attitudes, skills and behaviours necessary for a rapidly changing society.

The Paper argues that when all this evidence and experience is taken “in toto” the Western model of education, in light of the needs of the late 20th century, is largely “upside down and inside out.” Fortunately, an alternative model is now available to those countries willing to take current findings and open up space for radical innovation. The Paper shows that better informed, and more effective, models of learning could be organised through a redistribution of expenditures and responsibilities, at a total cost no greater than current levels of expenditure.

For a more detailed description of the issues raised in this paper the reader should refer to the President of the Initiative’s book *The Child is the Father of the Man: How Humans Learn, and Why* to likely be published by HarperCollins in the Summer of 1999. Also refer to our Web Site.

CHILDREN ARE BORN LEARNERS

Humans start life inquisitive. The endless questioning of children can drive us to distraction! It's as if each and every child wants to make their own particular sense of the world around them, as if no one had ever thought about such matters before. Even on a good day, constantly they reinterpret what we say - our cherished personal summing up of the world - in terms of their own experience, their own interests and their patterns of inherited predispositions. These predispositions seem to vary quite enormously; one child in a family seems to think like a poet, another like a mechanic, while a third doesn't appear to think at all! There are things here which scientists are now in a position to begin to understand far better. Many of these reflect what good teachers have known since long before Socrates... that learning is not simply the flip side of teaching.

Like most of our social institutions, traditional learning theory and traditional schools are based on assumptions about the brain and how humans learn that are now deemed to be of limited value.¹ These understandings date from the late 19th and early 20th centuries. Nobel Laureate Gerald M. Edelman has observed, "The workings of the brain more closely resemble the living ecology of a jungle than they do the activities of a computer."² So surely it is right to question whether learning as organised in schools is consistent with what we now know about the brain? Does the brain handle information in the way teachers teach?

The human brain is the most complex organism in the known universe;³ and it is driven by the intrinsic need to "make sense."⁴ Every moment our brains sort through a mass of inputs to identify just those ones which, given our priorities at the time, we need to act upon; the rest it ignores. Change our priorities (say from reading this paper to noting why teenagers wear such outrageous gear) and our brain immediately identifies very different inputs. It does this endlessly and effortlessly. Technically we call the brain a complex adaptive system.⁵ Every human brain is far more powerful and flexible than the most sophisticated of computers - but it does need an "operator" who knows what he or she is after. It is endlessly adept at detecting patterns in the environment, interpreting and responding to these, and changing the rules subsequently so as to be able to do this even better in the future.

Yet, most educators and policy makers know little about the biology of the brain as in-depth research on this is very recent. Is it possible that we are failing to capitalise on these ideas and persist with educational strategies that simply fail to go with the grain of the brain?

Professor Robert Sylwester noted this discontinuity at an Initiative* conference, "*Get rid of that damn machine model of the brain. It's wrong! The brain is a biological system, not a machine. Currently we're putting children with biologically shaped brains into machine-oriented schools. The two just don't mix. We bog the school down in a curriculum that is not biologically feasible.*"⁶

***The 21st Century Learning Initiative** is a transnational assembly of 60 leading researchers, policy makers and educational innovators from 13 countries who met at the Johnson Foundation's Wingspread Conference Centre for six conferences between November 1995 and November 1997. They discussed how to enhance the effectiveness of learning world-wide, and this document is informed partly by those meetings.

CONFLICTING OBJECTIVES

The conflict between the way academics organise learning within the school curriculum is starkly contrasted with the working practices of successful commercial operations in Table One.⁷

Table One:

Conventional academic success has involved:

- mastery of basic skills
- largely solitary study
- generally uninterrupted work
- concentration on a single subject
- much written work
- a high analytical ability

While workplace success now involves:

- mastery of basic skills
- working with others
- constant distractions
- working at different levels across different disciplines
- mainly verbal skills
- problem-solving and decision-making

Many an experienced primary school teacher reacts with passion and frustration to such a comparison. *“We understand all this very well,” said teachers in England, “we were trying to move our curriculum away from an excessive emphasis on the former skills so as to combine the two sets of practices. We saw such a combination as being most appropriate in preparing youngsters for the more open challenges of contemporary work and society. It seemed to be a pattern of working in which children naturally do well. Then the Government told us that to evaluate workplace types of skills was just too difficult and too expensive...and in any case these were about group skills, not about individual performances! So, starting with the previous Conservative Government, and continuing with the present Labour Government, we are being forced back into the academic practices because,” we were told, “these are easier and more economic to assess on an individual basis.”*⁸

*“It’s all terribly wrong,” elementary teachers in America and other lands say bitterly, “it’s just not going to achieve what people expect, nor what the country needs. Children’s learning is more complicated than that.”*⁹

*“Not only is it all wrong,” business people respond with equal passion on hearing that observation, “but an overemphasis on specifically academic skills could be disastrous for youngsters preparing to make a living in the faster moving world of commerce. It is extremely important that young people are good at both sets of skills, but it is critical that they know when which is appropriate. But mark this - the second set, the workplace skills, do not necessarily grow out of the former. They are different. The more entrenched people become in the former, the more frightened they are of the latter. Particularly the academic mind. Academics are neither good at finding novel solutions, nor at synthesising, nor at living with ambiguity, nor taking difficult decisions. Business people worry deeply that academic skills alone are not good enough for a modern economy.”*¹⁰

Conversations such as these are played out daily** as concerned audiences in different lands give vent to deep-seated frustrations. They argue that it is not so much what is studied in school that is wrong, rather it is the way that schools persist with learning strategies that are placed solely in the academic mode.¹¹

**The Initiative Web Site averages more than 5000 pages of text downloaded a week from 49 countries monthly.

They worry that teachers individually have an insufficient understanding of “real-life” skills. This fault mirrors the deep tensions felt by organisations as they struggle to move away from the rapidly disappearing Industrial Age and find a new role in the Knowledge Era. Similar tensions exist as people battle with practical matters in their own social lives. In other words “the school problem” is all part of the still bigger issue - moving into a “a whole new way of doing things.”

“The work place is demanding more innovation and creativity...That’s a fundamental shift from just five years ago when the focus was on simply reengineering and efficiency.”¹²

The emerging economy is contrasted with the Industrial Age in language that goes like this: In the Industrial Age most work was organised hierarchically, and individual responsibility was replaced by systemic controls. Only relatively few people at the top needed to be creative, imaginative and enterprising. Most workers had to be good only at performing highly precise, structured and repetitious tasks necessitating a high degree of discipline but little or no personal initiative. Understanding by employees of the total business process used to be deemed unnecessary, and was actively discouraged. Not so now. Today’s successful businesses tend to be highly decentralised and rely on continuous innovation and employee involvement at all levels. Almost all workers have now to be able to think for themselves, take personal responsibility, identify new opportunities and training needs, and understand the relationship of their business to that of others. Workers must be able to adapt rapidly without waiting for external direction.

“That is why it is so frightening to hear that schools are being encouraged to stick with the strictly academic practices,” gloomy business people lament.

FROM NARROW SPECIALISTS TO CREATIVE EXPERTS

In a world of continuous change where creativity, personal responsibility and innovation are in ever greater demand, the ability of individuals to plan and implement their own ongoing learning without external direction has to be the key to success. Eric Hoffer had it right when he said “in times of change learners inherit the earth, while the learned find themselves beautifully equipped for a world that no longer exists.”

“Learners,” in this sense, are essentially inquisitive people; they are anxious to “make sense” of whatever is going on around them, and they feel personally committed to solving problems for themselves.¹³ “Learning is a consequence of thinking”¹⁴ - of trying to work things out for themselves. Learning is active, demanding work. Such deeply motivated attitudes are utterly essential to deal with all the ambiguity of living within endlessly changing and uncertain circumstances. It is this kind of learning which results in the development of transferable skills.¹ (“I don’t know anything about this new topic,” such a person reflects, “but I certainly know how to apply strategies to find out.”)¹⁵

For years the issue of transferability has been the hoary conundrum of psychology and learning theory. Why is it that some people appear able to move from one set of problems to another effortlessly, while

¹**Transferable skills** are defined as the ability “to learn something in one situation and then apply it in another, significantly different one - for instance, putting the math you learn in school to work in physics class or the supermarket.” David Perkins. *Smart Schools*. (The Free Press: New York), 1992.

others founder? New understandings from meta-cognitionⁱⁱ give us some very clear insights into the nature of transferable skills, which make it critical that policy makers and all those concerned with the development of human potential appreciate the subtle differences between two key concepts that are too often confused in the public mind - specialisation and expertise.

Recent work by two Canadian cognitive scientists, Bereiter and Scardamalia,¹⁶ further extended by the findings of neurologists and systems thinkers, shows that a specialist, by working within the well-defined parameters of a specialism, knows his subject from the top to the bottom. A specialist is the ultimate analyst. He/she knows all the rules, all the tests, and all the possible combinations and formulae. His authority rests on the depth of his knowledge, and is uncluttered by the need to assess extraneous influences. A specialist exudes a confidence in his/her competence - in some this comes through as arrogance. Discussion with such people is often difficult for they know all the answers “in their box,” and if you come from a different box they are not interested. Just where their specialisms fit in a bigger synthesis does not trouble them, for that is essentially unquantifiable, imprecise and highly uncertain. There are no rules for that kind of thing, they say, and so these questions are best left unanswered.

A caricature perhaps, but the world has come - quite rightly - to be fearful of specialists for, in some hard-to-define way, we sense they are just not “real.” They “break the world down into bits,” and that gets us, both individually and collectively, into trouble and makes us schizophrenic. Such thinking is well-exemplified by the first year student at the London School of Economics who remarked, “*Economics is a science. Economic models have to be developed uncluttered by such intangibles as value systems. They’re the concern of...*” the young man was silent for a moment. “*Maybe it’s ethics, or sociology, or even religion. But such things are of no concern to economists - they only clutter it up.*”¹⁷

“Experts,” in contrast, “tackle problems that increase their expertiseⁱⁱⁱ,” whereas “(specialists) tend to tackle problems for which they do not have to extend themselves (by going beyond the rules and formulae they accept). Experts indulge in progressive problem-solving, that is they continually reformulate a problem at an ever-higher level as they achieve at lower levels, and uncover more of the nature of the issue. They become totally immersed in their work - ‘flow’¹⁸ - and increase the complexity of the activity by developing new skills and taking on new challenges.”¹⁹

Experts are quick to grasp the overall situation; they synthesise rather than just focus on a single part. Big issues fascinate them. Howard Gardner of Harvard defines experts as those who think about a concept by drawing on insights from several forms of intelligence.²⁰ They are doing what so-called ‘primitive people’ - living in the unsophisticated wilds - are doing all the time; they are seeing issues in their entirety.²¹

Unlike the specialist’s supreme confidence within a specialism (not much use when the walls of that specialism are falling apart!), the expert is essentially open to different disciplines and questioning. He is more aware of what he doesn’t yet know rather than what is already known. Experts understand the rules but they also know how to reformulate them and expand them to fit new circumstances.

ⁱⁱ **Meta-Cognition** is defined as “the ability to consider how well one is thinking as well as what one is thinking about.” Thinking about thinking. Jerome Bruner. *The Culture of Education*. (Harvard University Press: Cambridge, MA), 1996.

ⁱⁱⁱ **Expertise** comes from the ability to look at your own specialism from “the outside” often with the perspective of seeing how this relates to totally different subjects, hence its connection with transferability.

To paraphrase Bereiter and Scardamalia, a future “expert society” will certainly not be a heaven in which all problems have disappeared, but a realistic utopia in which endless problem-solving will be a highly valued part of life. Experts repeatedly go beyond their well learned procedures, avoid getting stuck in ruts, stay healthier and live longer, and reinvigorate themselves by reformulating problems in an evermore complex and challenging way. They are able to transform apparently insoluble predicaments into soluble problems to the benefit of everyone. This is the essence of transferability.²²

Policy makers take note: Here is the problem. Many of our present institutions, especially schools - be they in any country - penalise expertise rather than cultivate it. Creativity is essentially an aspect of expertise. Unfortunately, creativity can't be taught. Creativity is gained through the experience of problem-solving within a specific domain, and then stepping outside and looking at this with a fresh eye.²³ Only then can you see things to which the specialist, with his tightly defined rules and procedures, is blind. That's when an inquisitive specialist starts to mature, and begins to formulate the processes and perspectives of an expert.

Expertise is a frame of mind that needs to start forming in the nursery.

These findings help explain that while specialisation has become a feature of modern society, it is not particularly natural to the human brain. The brain has evolved over the millennia to be a multi-faceted, multi-tasked organism predisposed to thinking about new data and ideas from various perspectives. The brain works in terms of wholes and parts simultaneously. The glory of human learning is that it is essentially a complex, messy, non-linear process. The brain can, literally, do almost anything, but in its own way.²⁴

Much of what is recommended in this paper is predicated on a better understanding of just what this way is for, wonderful as is the brain, it is also amazingly stubborn if coerced to operate in ways that run counter to its natural predispositions.²⁵

The nature of intelligence, too, fascinates researchers and the public alike. Work over the past 15 years at Harvard by Professors Gardner and Perkins on the nature of intelligence has revolutionised the way we understand such innate abilities. In 1984 Gardner postulated the concept of multiple intelligences.²⁶ Initially he identified seven forms of intelligence, each one of which could be separately identified, and measurements suggested that none of them was directly correlated to any other. These different intelligences enable each person to find their way around the world in different ways - linguistically, numerically, spatially, kinaesthetically, musically, and in terms of interpersonal skills as well as intra-personal skills. With this analysis, researchers have become fascinated in trying to understand the mechanisms by which each child inherits a unique profile of these varying skills. (Why is it that one child is like a poet, another like a mechanic and another apparently nothing, even when their home culture appears identical?)²⁷ Gardner's work confirms that to reduce all forms of intelligence to a single quotient is largely meaningless.²⁸

Perkin's work on the “learnability of intelligence” makes a distinction between the genetic base of intelligence, and those forms of intelligence based on content specific skills (i.e. what makes a good car mechanic or a heart surgeon), as well as that form of intelligence which is based on reflection and a quizzical approach characterised by the nature of expertise.²⁹

Policy makers take note: In a Knowledge Society, where everyone has to be able to function at ever higher levels of thinking, it is not an early bifurcation between specialists and generalists that is needed, rather it is to take specialists beyond their comfort zones into being the “polymaths” that modern society requires, and in which the brain naturally delights. After all, that is how our ancestors survived. Only through peripheral vision did the single-minded specialist avoid being gobbled up by the predators of the past...as inevitably will be the case in some concrete jungle of the future!

SO, HOW DO MODERN SCHOOLS COME TO BE AS THEY ARE?

The discovery of the Chauvet Cave paintings in 1994 fired the world’s curiosity about our early ancestor’s intellectual capabilities. The Lunar Calendar found inscribed on a bone dating from 30,000 years ago staggers the modern mind in coming to appreciate just what our Stone Age ancestors thought about, and possibly even how they thought. While philosophers have speculated about the nature of the human brain for millennia, it has only been within the last 10 to 15 years that scientists have developed fMRI, PET and Cat Scans that enable us to study living brains at work.³⁰

We can now appreciate much more the complexity of the evolutionary principles involved in the structures of our brains. The more we discover the greater becomes our respect for the ways in which successful adaptation strategies made by our ancestors hundreds of thousands, if not millions of years earlier, are still faithfully reproduced in subsequent generations. “You can take man out of the Stone Age, but you can’t take the Stone Age out of man.”³¹ Each of us is the sum of all this experience.

“Humans are born to learn” - that is the generalised statement. What this means is that we have inherited modes of learning which, if developed in an appropriate environment, help us make rapid sense of our opportunities. Our learning is enormously influenced by our environment and the experiences of our ancestors.³² The teasing question is, “Which dominates; nature or nurture?”³³ This has been the classic quandary facing both first year undergraduate psychologists, and the most respected of professors. It was easy for the argument to polarise in the past, but we can now do better than that in sketching out the intricate interplay between the many related factors. This is a very different understanding to that prevailing at the beginning of the century when the brain was essentially seen as a blank slate, and learning was understood to result directly from instruction; generalised credit only was given to an ill-defined sense of a single inherited form of intelligence, which was deemed to be unmodifiable.

Despite the fact that the majority of audiences who enjoyed Shakespearean plays in the 1620’s could neither read nor write, and that less than half the population of England, which gave birth to the Industrial Revolution in the 1820’s and 30’s, had only two years of schooling, contemporary policy makers remain preoccupied with the significance of schools. So preoccupied, that by the mid-20th century educationalists were in danger of assuming that the only valid learning was that which was formally taught. Learning and schooling had come to be seen very largely as synonymous.

The validity of the Chinese proverb: “Tell me and I forget, show me and I remember, let me do and I understand,” was passed over as little more than an historic curiosity from earlier uneducated times. These same dismissive attitudes were applied to the vast array of apprenticeships that had grown up in Britain and other industrialised countries, but which were dismissed as being about practical, rather than theoretical, concerns. Had either the Chinese, the European or the American colonists’ apprenticeship systems

been studied earlier, cognitive scientists would have had a far quicker appreciation of how human predispositions have been honed by evolutionary principles.³⁴

When academics started to study learning, they studied the practices of the classroom and the lecture hall - the learning of intellectuals based on abstractions and simulations, not the learning of ordinary people as practised and shaped by the harsh realities of making a living. Natural learning systems - those that we now understand are deeply encased in the architecture of the brain, and which were the concern of apprenticeship type learning in every “primitive society” ever studied - have been largely ignored until the last few years.³⁵ Apprenticeship was too messy and unattractive a process to merit serious study.³⁶

Yet, it was the breakdown of apprenticeship caused by the transfer of industry from a craft to a factory process in the late 19th century.³⁷ This followed closely on the need to provide an alternative to the control of parents whose future employment was to be within large factories rather than in the home, the small shop, the farm or the artisan workshops. Suddenly, theoretical assumptions about how people might learn had to be shaped to provide a framework for the newly emerging universal school system, which would from that time forward involve all children.³⁸

Policy makers take note: These assumptions, made largely in the latter years of the 19th century and the early part of the 20th century were made by Western, frequently English speaking academics who themselves came from the classical model of education and knew nothing of, and suspected still less, the existence of evolved predispositions. The dominant assumptions can be summarised in Table Two:

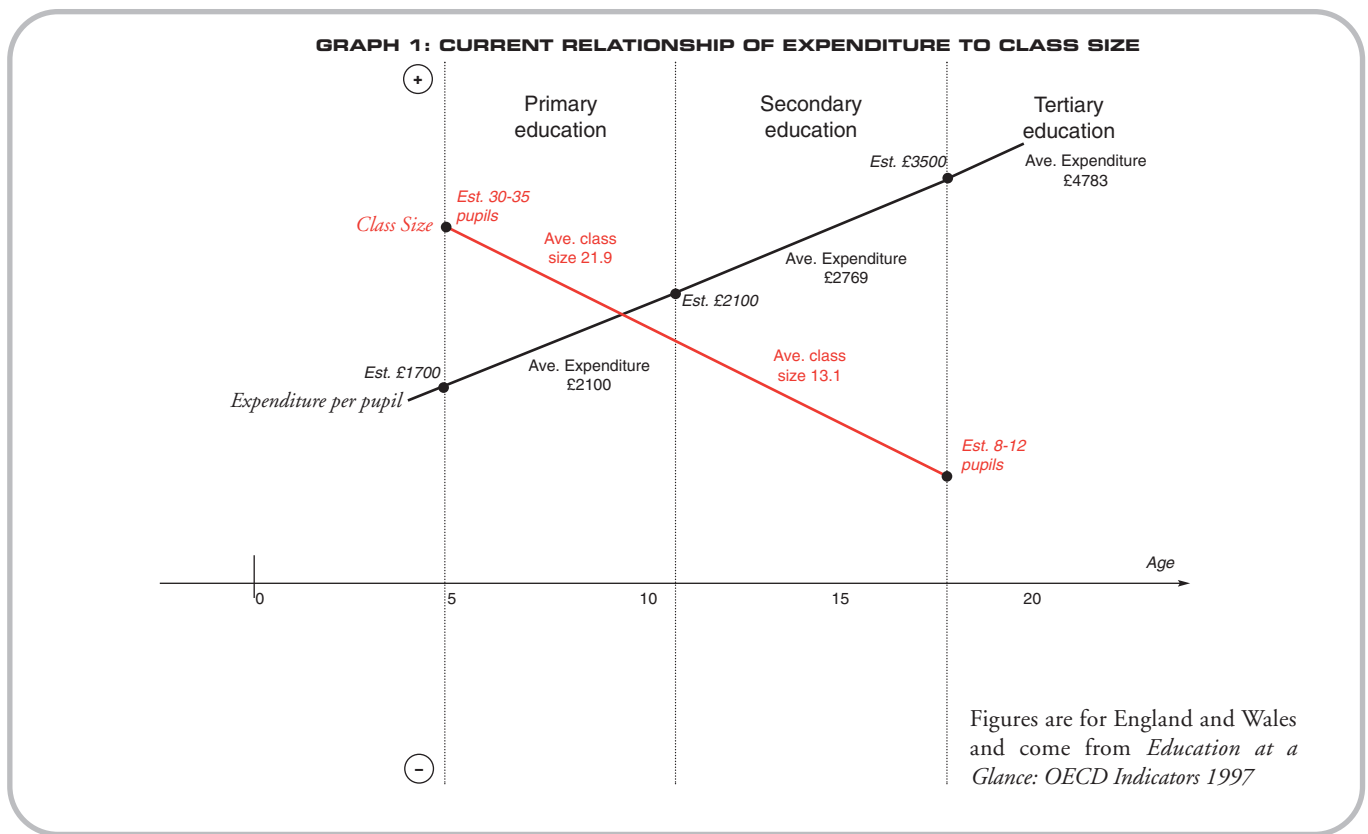
Table Two

- Intelligence was regarded as being largely innate, as was creativity.
- The older the child became the more significant would become their learning.
- Learning was seen as being dependent on instruction and extrinsic reward (behaviourism).
- Learning was seen as being logical, objective and linear.
- Valid learning was seen as that which enabled people to become functionally literate within an industrial society.
- Valid learning was that seen as being formal and measurable.
- Basic skills were those of reading, writing, and calculation and the acceptance of formal discipline and control.
- Most people, it was assumed, would not need “higher order skills,” as they were not expected to show any form of personal creativity.
- All life could be subdivided into separate disciplines, and only those appropriate to a child’s potential status in life would be taught.
- Learning was dependent on the technology of the time: talk, paper and pencil, and textbooks.

All this resulted in a set of policy prescriptions which became enshrined in the very architecture of schools and colleges, and in a massive weight of legislative prescription which ensures their continuation long after the assumptions that led to their establishment have been shown to be faulty and even incorrect.³⁹ They are still there.

These prescriptions can be summarised as follows: children below the age of five were the responsibility of parents and families, and were of little interest to educationalists. The earliest years of primary schooling were seen as a period of sorting, during which the “cream” would float to the surface, and would subsequently be heavily invested in as the “successful” child grew older. Instruction, and retention, were the essence of learning.

It was, therefore, seen as appropriate that expenditure should increase with age from five through to the final year of university. The largest class sizes were when children were five or six, with the most generous staffing reserved for the oldest pupils who remained in the school after the compulsory school leaving age, in classes often a quarter of the size of those of five year olds, with tutorial groups at the Older Universities of only three or four. Critically the system identified and encouraged youngsters with an interest and inclination towards those skills naturally practised in schools (see Table One), not the skills of the entrepreneur or the businessman.



Graph 1 shows a simple graph of educational expenditure in England and Wales for pupils between the ages of five and 18, and of average class size based on these assumptions. Between 80 and 85 percent of this expenditure is on salary for staff, with some three percent on books, and two percent on other forms of learning technologies. The remainder goes to the maintenance of buildings, overheads, etc.⁴⁰ The pattern is simple; the older the child becomes the smaller is the class in which he or she is taught, and the greater amount of money spent on each pupil.

While the level of expenditure has changed with the years, and class sizes have tended generally to fall in each year group, the overall shape of this graph has not changed. With slight individual differences, such a

graph reflects many of the education systems in the developing world which were initially based on comparable assumptions and transmitted through British colonial policy (i.e. the University of Cape Town has an exceptional international reputation, though South African school children consistently come at the bottom of International comparisons).⁴¹

Policy makers take note: Each one of the assumptions on which these policy prescriptions are based is now in the process of being challenged as the serious study of effective learning begins to mature. It is not possible, as yet, to present absolute firm conclusions from this research which could lead shortly to a specific new “theory of learning.” However, it is possible to look at this evidence “in toto” as providing a circumstantial case for the conclusion that we are now dealing with an education system that is in reality “upside down and inside out.”

GUIDELINES FOR THE TRANSFORMATION OF LEARNING

If policy makers are to take notice of these emerging understandings there are five key interrelated issues which have to be better understood for a more effective model of learning to emerge. These issues are:

- 1) **the biological nature of learning**
- 2) **the science of learning**
- 3) **culture and nurture: how our ideas shape our thinking**
- 4) **the implications of new technologies of information and communication**
- 5) **spontaneous, informal learning; the significance of the home and the community.**

The discussion of each of these issues involves recent research, practice and best thinking from a number of disciplines, not all of which are conventionally seen as being closely compatible, nor do they come from any single country. Nor are their languages or assumptions easily understandable to each other. Here is the rub. It is only when these findings are brought together into a “meta-synthesis”⁴² that a general picture which is usable by the public at large, and policy makers in particular, begins to emerge. These disciplines include: evolutionary biology, developmental psychology and evolutionary psychology, neurobiology, cognitive science and cognitive neuroscience, pedagogy and learning theory, cultural anthropology, sociology, business and management studies, philosophy and theology, economics, epistemology, linguistics, systems theory, pedagogy, cybernetics and the science of information technology, political science, quantum mechanics and ecology...all the subjects, in fact, that currently deal so fully and eloquently with the subject of learning and are found throughout the bookshop.

The range of applicable material and perspectives on how humans learn is totally daunting, and challenges one’s ability to see “the full picture.” The eminent quantum theorist Erwin Schrodinger in a much quoted paper in 1943 entitled “What is Life?” wrote, “a scientist is supposed to have a complete and thorough knowledge at first-hand, of some subject, and therefore is usually expected not to write on any topic on which he is not a master...We have inherited from our forefathers the keen longing for unified, all-embracing knowledge...But the spread, both in width and depth, of the multifarious branches of knowledge...confronts us with a queer dilemma...It has become next to impossible for a single mind to fully command more than a small portion of it. I can see no other escape from this dilemma (lest our true aim be lost for ever) than that some of us should embark on a synthesis of facts and theories, albeit with a second-hand and incomplete knowledge of some of them - *at the risk of making fools of ourselves.*”⁴³

In the half century that followed Schroedinger's plea the situation has deteriorated still further.⁴⁴ Intellectual thought has become evermore specialised as the sub-components have become increasingly analytical. Academia has been more concerned to find out why a subject is different than where its concerns may heavily overlap another. Indeed, modern society is a prisoner of its own history for every individual has grown to academic maturity by the present rules of the game (i.e. by being a specialist and an analyst, rather than being an expert and therefore a synthesiser).

In other words, the very issue that has to be addressed - the creation of vast numbers of life-long learners with expertise, flexibility and creativity - has to be undertaken by policy makers, politicians and ordinary people for whom that mode of operating is not normal. Indeed most find it intellectually terrifying. Academia is unforgiving of people seeking to "embark on a synthesis of facts and theories...at the risk of making fools of ourselves." Making approximations across specialisations is not for the faint-hearted. If turf wars are fought, and reputations made or broken by arguments between different branches of neurobiology, these pale into insignificance in comparison to the current conflict between neurology and cognitive science.⁴⁵

The emergence of new hybrid subjects that bridge the physical sciences and the social sciences such as evolutionary psychology present quite enormous intellectual challenges.⁴⁶ Yet, it is at these boundaries where new ideas are most likely to be found, radical transformations made, and new directions discovered.⁴⁷ While cultural anthropology made a form of collaboration with archaeology decades ago, it comes as a shock to realise that archaeology may well contribute towards the understanding of how human intelligence has evolved.⁴⁸ Additionally, systems theory challenges the theoretical base of the curriculum, as practised in schools, to its very core.

ISSUE I: THE BIOLOGICAL NATURE OF LEARNING: THE BACKGROUND

In the past decade the convergence of the evolutionary sciences with neurology, cognitive science and psychology have helped us to understand in some detail why our brains are as they are⁴⁹ and what they might shortly become. "If the evolutionary perspective is simply set aside, the data collected by psychologists and neuroscientists are likely to be grossly misinterpreted."⁵⁰ In other words, if you don't know where you've come from, you won't understand where you can go to!

For the vast majority of time Homo sapiens' experience of living as a wandering tribe in the ancestral environment has shaped the broad structures of our predispositions (which encapsulate various successful evolutionary adaptations). These subsequently have been recreated in the brains of every succeeding generation. Both with regard to language and social skills the young child who could not talk effectively, or empathise with other children would not have been able to survive when the tribe moved around; its genes would simply have perished. Language and social empathetic skills are thus seen in a survival context. All human development is an intricate interplay; "nature and nurture don't compete, they cooperate."⁵¹ "Thus, learning becomes a delicate, but powerful dialogue between genetics and the environment: the experience of our species from aeons past interacts with the experiences we have during our lifetime."⁵²

For reasons that are still not totally clear, the human brain started to grow very rapidly about 100,000 years ago. Some evolutionary biologists and linguists have advanced the theory that there is a direct connection between our ability to use language and the growth of the prefrontal cortex, the frontal part of the brain which processes language and abstract thought.⁵³ As the brain has grown, so has the skull. This has produced a biological “bind” - the child’s head has increasing difficulty passing down the mother’s birth canal. Because of this, human babies - unlike the young of most other species - are born with their brain incompletely formed and so much brain development, which in other species takes place in the womb, has to take place post-birth. Consequently, human young are far more vulnerable than the young of other species.⁵⁴ Nature has compensated for this by equipping every newborn child with an amazing set of predispositions to learn, if put into a stimulating environment.

THE LANGUAGE PREDISPOSITION

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Work on the nature of language development from Chomsky⁵⁵ onwards shows that each brain is born with the strong predisposition to learn language in a particular, natural way. The brain is no clean slate as regards language development, rather the analogy is closer to an old fashioned gramophone record needing a layer of wax removed from its surface before revealing its pre-formed structure.⁵⁶ Subsequently, virtually every child born today has the innate capability of recognising about 100 sounds - quite enough to combine in various forms to create all the alphabets in each of the earth’s 6,000 plus languages.⁵⁷ The neurological structures that make this possible are identical to all races.⁵⁸ “Biology provides a kind of blueprint. The blueprint is that baby’s exquisite ability to hear the differences between all sounds; then culture (nurture) jumps in and provides this information, the input, language information, that the baby’s brain then begins to map.”⁵⁹ “Newborn babies can tell the difference between ‘pah’ and ‘bah.’ By four and a half months of age an infant ‘understands’ the significance of clauses; at 10 months the ordering of noun and verb phrases fit in sentences. Below 18 months babies learn the meaning of new words at about 1/3 of a word a day; from then onwards it speeds up to about ten words a day...By listening to the language spoken around them, kids set the rules appropriate to their own language by 18 months of age, and in many instances earlier.”⁶⁰

To release this language potential virtually all that a child needs is plenty of opportunity to hear people talking, and to be encouraged to join in - “high challenge, low threat environments.”⁶¹ “Every child needs a continuous commentary on everyday life,” said one teacher in Leeds some years ago. Such a predisposition has almost disappeared by the age of seven.⁶²

Those sounds not needed in any specific generation - and they will be different sounds according to the language spoken around the child - will be neurologically pruned, by age four or five. The brain is essentially economic. What is not needed in one generation is replaced by a more appropriate function. A native speaking Japanese will not have the equivalent of an L or R sound in his or her own language. Attempting to learn to speak English at the age of 15 or 20 will present a Japanese person with an almost impossible task of correctly articulating these sounds. (The reverse is also true!) The ability has just disappeared.

IB SOCIAL SKILL PREDISPOSITIONS

Humans are predisposed to friendliness within their own kin group.⁶³ Our Stone Age ancestors survived by cooperating with one another in relatively small groups. They found safety in numbers, but only to a certain extent. Today, amongst the most primitive tribes in the Brazilian Rain Forests if the group gets beyond 12 or 14 fighting men (with women, children and dependent relatives that means a group of 50 or 60 people) it either divides of its own peaceful volition or splits through bloody rivalry.⁶⁴ Evidence from England in the thousand years before the Industrial Revolution suggests that most people lived within groups of less than 12 or 13 people.⁶⁵ Psychologists state that no one is ever likely to grieve deeply for more than 12 people in a lifetime; it is as if there is a ceiling beyond which our hearts don't break anymore.⁶⁶ Younger people are most comfortable within still smaller groups, so it is curious that modern society places children into school classes of 30 or 35 at the age of five.

Psychology is coming to terms quickly with the understanding that the brain, like the rest of the body, is intricately influenced by our evolutionary past. "At times we get the feeling that modern life isn't what we were designed for," wrote Robert Wright. He went on to explain that Freud had seen civilisation as an oppressive force "but a larger threat to mental health may be the way civilisation thwarts civility. There is a kinder, gentler side of human nature, and it seems increasingly to be a victim of repression. Love, pity, generosity, remorse, friendly affection and enduring trust are all part of our genetic heritage. The problem with modern life is less that we are oversocialised than that we are undersocialised - or that too little of our social contact is social in the natural intimate sense of the word."⁶⁷

A further illustration of a latent predisposition is young children's innate desire to play in social, collaborative, problem-solving ways. We now understand better how through play children come to understand work. Play is children's work. It was an intriguing early insight that created the word "toy," for this linguistically is the diminutive for the word "tool." Without the proper stimulation of social skills individual children found survival difficult in earlier times. For if they couldn't empathise they would have been left behind when the tribe moved along. Evidence is accumulating to show that the predisposition towards such empathetic activity is at its strongest below the age of six. If collaborative skills are not valued by that stage then the networks are better replaced with "other" skills that could be useful, such as the behaviour of the isolate and the dependent, or a simple regression towards violence.

Ronald Kotulak, in his Pulitzer Prize winning series of articles for the *Chicago Tribune*, noted, "What we thought we knew about the relationship between a deprived or bad upbringing and the increased risk of criminal behaviour is now being traced to the brain's chemistry. It is the biological 'smoking gun' of violence. We (brain researchers) are now finding the molecular answers to the things that happen in the brain that we could only grope with from psychology, psychiatry and sociology. By failing to provide young children with the supportive and nurturing environments in which they can develop their predispositions towards social, collaborative and team-building skills, young children's brains react with astounding speed and efficiency to the violent world they experience around them by rewiring trillions of brain cells that literally create the chemical pathways for aggression."⁶⁸ Aggression, rather than conciliation, becomes the action of first response.

Policy makers take note: There is much evidence here to worry us deeply. It is highly likely that there is a direct connection between the child who was not encouraged to utilise their innate desire to collaborate in the earliest years of life, and the young graduate who is the despair of his first employer who is stag-

gered to find that “after 16 years of formal education he/she can’t think for themselves, can’t work in a team, and has to be told what to do.” Developing such skills at the age of 23 or 24 is infinitely harder work than developing them naturally at age five or six.

FURTHER PREDISPOSITIONS

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There are other innate predispositions which are likely to become a matter of lively interest and still more research. We know, for instance, that there are critical periods for the development of numerical skills,⁶⁹ and for different forms of musical appreciation.⁷⁰ We know from Gardner’s work of the existence of multiple forms of intelligence, but as yet we know little about their varying maturation rates. We know that individuals have vastly different learning styles.⁷¹ We recognise the differences between children, adolescents and adults in the diurnal pattern of their activities.

As a guiding principle it is highly likely that the more we come to understand these predispositions, the more we will come to appreciate how different evolutionary traits from long past have shaped our preferred ways of doing things. Amongst these has to be the recognition of the significance of emotion in providing a “short-circuit” in the way in which the brain responds to those things of high emotional interest - a vastly different set of innate responses to those of more logical and abstract significance. The role of the amygdala^{iv} will undoubtedly receive increasing attention as is shown by the rapidly growing interest in “emotional intelligence.”⁷² The link between the emotions and intrinsic motivation should surprise no one; consequently the sterility of emotionally drained and aesthetically neutered learning environments has to be understood as contributing to low learning achievement.

The most effective learning strategies are those that build on and extend these natural predispositions; learning that goes with the “grain of the brain.”

There is an additional factor that has also to be considered, namely Brain Plasticity. The basic idea is simple. We make our brain as we use it. Its very shape and the efficiency of its processing is a measure of the way we operate. The more we use our brain in these naturally evolved ways, the more useable it then becomes. A well-used brain actually gains weight. Even a brain at quite an advanced age can learn to do things which at an earlier stage were seen to be quite impossible. What is most significant however is that the process takes much longer than if it is being attempted during a window of opportunity (predisposition). A damaged brain can, under certain circumstances, reorganise its remaining faculties so that it is able to perform almost as well as before it was disabled.⁷³

^{iv} **The amygdala** - that little almond shaped section of the limbic system within the brain that regulates our aggressions, emotions and sex drive - intentionally bypasses all the carefully constructed logical functions within the brain that enable us to perform a whole array of activities efficiently from day to day. Those processes normally take time...the well-trained academic weighs the evidence and becomes indecisive. Herein, is an important clue to the workings of the human brain - and the nature of human learning. In very many ways emotion is more significant than logic in driving attention spans, shaping action, and certainly in memory retention.

ID THE BIOLOGICAL BASIS OF ADOLESCENCE

Adolescence is currently perceived as a “problem” in Western society though, interestingly, the word “teenager” did not enter the English Language until 1954.⁷⁴ Adolescent hormones leave the rapidly maturing child unaware of its new physical strengths, confused as how to direct these, and holding on nostalgically to more infantile behaviours which it associates with security and predictability. While modern parents and teachers find adolescents disruptive, earlier cultures directed this energy in ways that benefited the life of the community, and strengthened those skills on which the community was dependent for its ongoing survival. In providing clear definitions of what was required of adolescents, those adults of an earlier age ensured that young people learned, and practised, what was seen as appropriate and useful social behaviour.

So far, science knows far less about the neurological changes at this stage of life than it does about the predispositions that operate roughly below the age of seven. However, pre-industrial people saw in these natural predispositions a steady move away from ultra-dependence in the earliest years to full autonomy by 16 or 17. Numerous induction ceremonies by different cultures reinforced this, (Barmitzvah; Confirmation...) a process which can best be described by the biological term of Weaning.^v

In the first study of its kind, researchers at McLean Hospital in Massachusetts have used findings from fMRI of adolescent brains to show definitively “age-related physiological changes in the brains of adolescents which may help explain the emotionally turbulent teenage years. (From this they concluded that) adolescents are more prone to react with ‘gut instinct’ when they process emotions, but as they mature into early adulthood, they are able to temper their instinctive ‘gut reaction’ responses with rational, reasoned reactions. Adult brains use the frontal lobe to rationalise or apply brakes to emotional responses. Adolescent brains are just beginning to develop that ability.”⁷⁵

From an evolutionary perspective there must be a reason for the emotional energy of adolescence. Earlier societies saw adolescence as a period of great potential, as well as one of turmoil. Such societies knew how to use this to extend and improve the welfare of the community.

In the West, we have indeed lost something of the utmost significance if adults see adolescence as a problem, and if adolescents themselves see this as a time of boredom, isolation and disillusionment. By contrast there is nothing more inspiring than an adolescent with a vision, ideally one that is both mentally and physically demanding. In culture after culture, the years leading up to and including puberty are a period of progressive weaning, a breaking away of dependence on outside assistance and an induction into adult responsibility. Adolescents have energy to spare, and they have a predisposition to apply this usefully, even altruistically.

A recent illustration comes from Estonia. With money for only three years of information technology education, a decision is likely to be taken that would concentrate this on 12, 13 and 14-year olds, and then require such young people to spend five hours or more a week in each of the subsequent four years as teacher assistants in elementary schools working with children six or eight years younger than themselves. In this way adolescents learn from their experiences of being useful. This will enhance the adolescents’ sense of responsibility, and by becoming teachers themselves will make them better learners.

^v **Weaning** - to cause a young child to become accustomed gradually to food other than its mother’s milk. *Webster’s*.

Policy makers take note: The Estonian example is a splendid application of a brain compatible strategy. This is vastly different to the experience of many teenagers in wealthier countries whereby adolescents have few, if any, direct responsibilities until they are past 18, and the teenage years are seen as a mixture of disconnected “theoretical learning,” and extensive holidays.

ISSUE II: THE SCIENCE OF LEARNING

Findings in the cognitive sciences and developmental psychology, now help us to understand why learning has to be much more than simply good instruction. Learning is a collaborative, problem-solving, activity that occurs through progressive construction of individual knowledge; information transfer is only a limited part of learning.⁷⁶

Argument rages, however, as to the relative significance of inherited intellectual predispositions, and a constructivist theory of learning. There is nevertheless a resolution: predispositions are latent potentials - if the environment is not appropriate they do not develop. Nurture and culture have to be nicely balanced - as always.

The work of Gardner and others on the learning of very young children show children’s amazing capability to form “naive theories of everything.” Gardner capitalised on this with the title of his most seminal work, *The Unschooled Mind*. In this he argued that within adults, be they university graduates or not, there was a “five year old unschooled mind struggling to break out.” In other words, however sophisticated might have been subsequent explanations that might have been learnt, in very many instances these were only shallowly acknowledged and did not replace those “common sense” theories that remain embedded from early childhood (like a ton of lead being heavier than a ton of feathers). It is extremely difficult for formal instruction to shift these personally formulated naive theories.⁷⁷ (This deep confidence in intuitive understanding may have improved our chances of survival).⁷⁸

Constructivist theories are predicated on the progressive construction and deepening of “meaning.” The emphasis is on “understanding,” as a process which is much deeper than transferred information, or even knowledge.⁷⁹ “Understanding” relates to revising earlier theories in the light of subsequent experience in ways which build stronger sets of theories. It leads on to wisdom. Constructivism sees learning as a highly energetic, personally motivated, problem-solving activity.⁸⁰ Such learning has traditionally been associated with apprenticeship; recently it has been extensively studied by cognitive scientists looking to establish what could be seen as the brain’s natural learning strategies.

“Cognitive Apprenticeship” is a “high falutin” description of a set of aeons-old processes that people with few resources to spare used to induct the next generation into the skills and values already practised by adults. The Russian psychologist Vygotsky wrote knowledgeably on this in the 1920’s, but his work only became available in the West in the 1960’s.⁸¹ But that hardly matters. All that Vygotsky was doing was to describe in academic terms what ordinary people had known since long before people started to theorise about this. Such apprenticeship recognised four stages. Children are inquisitive, and if initially fascinated by some mighty works, they do not find it difficult to practice whatever subtasks are first needed. **The first stage** of such Cognitive Apprenticeship involves an older person modelling that subtask, so that the learner sees the significance of this to the final product.

Cognitive Apprenticeship progressively built new skills onto earlier basic skills, and took for granted that skills once learnt and subsequently practised were something that the individual learner would then assume full responsibility for themselves. Busy adults, in such essentially subsistence cultures, had only the time and energy to provide scaffolding, **the second stage**, for those tasks in which the learner was still uncertain. As the learner's confidence increased so **the third stage** - that of the "fading" of support - came into play, and the earlier scaffolding was progressively removed. The more proficient the learner became, the more they became independent of the teacher.

Throughout this process there was **a fourth critical stage**, that which the human race is incredibly good at doing - namely endless talking - "dialogue." In those cultures which it has been possible to study, such talking is only partly about the nature of what has to be done in the task, but is mainly about the circumstances and the culture in which the learning is being developed. It was intuitive, contextual learning. Learning was a group activity and individual learners were indirectly teachers of their colleagues.

"If young men are not working alongside their parents," asked the Nomadic chieftain in the Mountains of Iran in the mid-1970's, "how can young people ever learn the wisdom of their parents?"⁸² "In its many functions...(cognitive apprenticeship) provided a safe passage from childhood to adulthood in psychological, social, and economic ways for a large number of peoples over long periods of time."⁸³

Cognitive Apprenticeship builds on "what comes naturally" to extend all these innate predispositions in ways that simply flow with the "grain of the brain." The English language is full of expressions that describe this: "Jack of all trades and master of none" well describes the person who has only a rudimentary understanding and an incomplete set of skills. "Jack is as good as his master" was the ultimate compliment to the person who had completed his "Masterpiece" which showed that he was now out-performing his teacher.

In all this, Cognitive Apprenticeship as an underlying theory exploits the biological processes involved in weaning. In the parlance of cognitive science a Cognitive Apprenticeship has been successfully completed when a young person has developed "the ability to think about thinking, to be consciously aware of oneself as a problem solver, and to monitor and control one's mental processing."⁸⁴ The key to meta-cognition is that it makes thinking visible; it transfers the critic's role from the teacher to the student. It is not sufficient for the teacher alone to be a reflective practitioner; children have the need, and the right, to be reflective practitioners.

Recent work at the Salk Institute in California ("The Neural Basis of Cognitive Development: a Constructivist Manifesto.")⁸⁵ suggests that the way we use our neural networks at the earliest stages of childhood may literally shape the initial development of our brains, whilst also allowing for the opportunities created by predispositions. This may well help provide neurological explanations for the processes encapsulated in Cognitive Apprenticeship that have emerged from Cognitive Science, Cultural Anthropology, Pedagogy and Evolutionary Psychology.

ISSUE III: CULTURE AND NURTURE: HOW OUR IDEAS SHAPE OUR THINKING

With the above understandings of learning processes, let us now look carefully at concepts which have significantly shaped the culture of thought in our times. “We make our houses, and then we have to live in them,” says another Chinese Proverb.

All forms of Western thought have been vastly influenced over the past 300 years by three concepts taken from the natural sciences and then assumed to apply to social structures. These concepts were further extended at the end of the 19th century by Taylor’s “Scientific Management” of human activity understood as a logical, mechanical process. Learning and educational systems became caught up in the midst of this. Once accepted as valid organising principles, the application of these concepts much conditions the way we have thought about managing our activities, and indeed have thought about ourselves. This is not always comfortable, for such concepts have led us to do things in ways which have undesirable consequences as well as very many and obvious benefits.

The first of these concepts is Newtonian Physics and the supremacy of reductionism, determinism, and universal truths in the scientific enterprise. To classify knowledge in separate components was immensely attractive to the scientific mind of the Enlightenment, and enabled quite enormous strides to be made through the development of specialised disciplines. Reductionism gave enormous status to the specialist, and to the predictability of causal effects, while reducing people’s ability to see things in their entirety. Such progress came at a cost, as the Luddites of the late 18th century in England fully appreciated. By the early 20th century the study of quantum mechanics led physicists to a better understanding of the fluid nature of matter, and the “permeability” of what people had come to see as self-contained, reducible, specialisms. Increasingly, science was forced to recognise the significance of context and connections in the evolution of further scientific understandings.

The second concept was Darwin’s Theory of Evolution, predicated on the survival of the fittest; a theory which was instantly persuasive. An immediate overemphasis on the dominant species, and the lack of appreciation of the collaborative nature of nearly all everyday activity, led to an apparent scientific justification for the pre-imminence of competition over collaboration. **The third** concept was the emerging understanding from psychology which initially emphasised the Behaviourist nature of incentives and rewards.⁸⁶ The brain was seen as being an empty and blank slate waiting for external inputs to shape it, regardless of any inherited characteristics. External motivation, argued the Behaviourists, drove behaviour, especially learning. What was needed was instruction - hence the emphasis on schools.

These scientific ways of understanding led to some brutal, unintended, consequences when they were applied wholesale to the organisation of human behaviour. Frederick Winslow Taylor^{v1} took these understandings and studied their application to manufacturing industry. He quickly calculated that craftsmen could be much more productive if they worked as operators to well-timed machines rather than as thoughtful individuals. “In the work of Frederick Winslow Taylor we have the first clear statement of the idea that society is best served when human beings are placed at the disposal of their techniques and technology, that human beings are, in a sense, worth less than their machinery.”⁸⁷

^{v1} **Frederick Winslow Taylor:** (1856-1915) American efficiency engineer born in Pennsylvania who devoted himself to organizing the management of manufacturing concerns. He was the originator of scientific management in business.

Taylor's Principle was simple: "you do it my way, by my standards, at the speed I mandate, and in so doing achieve a level of output I ordain, and I'll pay you handsomely for it, beyond anything you might have imagined." ⁸⁸ By this simple principle Taylor had merged reductionism (each worker does one specialised part of the manufacturing process) with the predictability of determinism (engineers would determine the best way of doing every bit of the process and then tell the workers exactly what to do) with the belief that there was one best way to do every job. Darwin's survival of the fittest played out as successful workers slowly moved up the shop-floor from one specialised job to another better paying one, and those who couldn't stand the pace fell by the wayside.

Extrinsic motivation (i.e. higher wages) was the key to the whole process working successfully. This was predicated on Behaviourism. Scientific management led to such levels of improved efficiency that it was quickly applied to most other fields of human endeavour, including education and government. It is of more than passing interest to note that in 1914 a machinist gained prominence by debating with Taylor that "we don't want to work as fast as we are able to. We want to work as fast as we think it is comfortable for us to work. We haven't come into existence for the purpose of seeing how great a task we can perform through a lifetime. We are trying to regulate our work so as to make it auxiliary to our lives." ⁸⁹

This concept reached its zenith at the Chicago World's Fair in 1933 when it proudly proclaimed as its motto "Sciences finds, Industry applies, Man conforms." ⁹⁰ It was a complete turnabout - the day of the thinking, reflective, imaginative craftsmen was dead. In future, man would live to work, not work to live.

We now know that Scientific Management was nothing if not a Faustian Bargain. Workers were forced to operate in ways that went against their evolved human modes of functioning. However, in return for their submission to the specialists society became increasingly rich, while potentially creative people became listless and frustrated. Adam Smith understood this clearly in the late 18th century when he observed that factory work led to "stupefaction;" ⁹¹ in England many workers pathetically retreated to their market garden plots as the only places where they could feel personally creative.

This Bargain certainly led to vastly increased productivity, but effectively shattered the earlier seamless web of living, working and learning, which had previously melded together man's mental predispositions with working practices.

Policy makers take note: Nowhere was the link between scientific management, behaviourism, intellectual reductionism and the survival of the fittest more dominant than in this application to education. It has resulted in the concepts of instruction, courses, supervision, grades, modules, tasks, assignments, programs, tests, intelligence measurements, placement, and specialisation.

The connection between education and the new definition of jobs requiring basic skills, uniformity and conformity replaced the earlier concept of work as part of living, and learning as an integral part of both. "Such a system must seek to produce economically useful knowledge, and to sort people efficiently into various positions that need to be filled in a stratified occupational structure." ⁹²

Young people were quicker than the designers of National Curricula to recognise that such a system failed to acknowledge many different kinds of aptitudes, interests and experiences. This was so antipathetic to their natural predispositions to regard learning as sense making, that vast numbers of young people became bored and disinterested. To compensate for the loss of intrinsic interest itself the system became buttressed with extrinsic rewards (marks, grades, prizes, scholarships), so keeping people going in things that didn't

interest them. “Most of the time, what keeps students going in school is not intrinsic motivation, but extrinsic rewards that come from the real or perceived consequences associated with success or failure.”⁹³

The present curricula of schools reflect the sum of all these competing interests and ideas - yet, it is essentially a shifting compromise,⁹⁴ which reflects public opinion and is usually at least a generation behind what research and best practice would argue is now desirable (and which commerce is coming to understand is essential).

...NOW THE IMPACT OF THIS ON CULTURE

“If a job’s worth doing, it’s worth doing well,” fast became a dictum of the past as society became dominated by a culture of economic efficiency. A job for many became totally separated from individual creativity. Dr. Johnson, in his 1755 Dictionary, had defined a job as “petty, piddling work; a piece of chance work” whereas in pre-industrial societies work was, and for some people still is, about the role we play in life. “What’s your job?” people ask, and we respond by describing the role that defines who we are. This choice of words is fascinating for role comes from the old French word “rolle” which was the parchment from which an actor read his part. Status and work went together.

Contemporary society is having to come to terms with finding new roles which are separate to the creativity of work. This is a desperately difficult task as it represents a real discontinuity with our evolutionary past where every adult had a role to play in the well-being of the group. As Matthew Fox has remarked “an unemployed adult male is unique amongst the species of the world for having no role to play.”⁹⁵ And there are now more than one billion adult males in the world either unemployed or so underemployed that they can’t earn their own living. This is about one adult male in three.

Now, in the closing stages of the 20th century scientists are increasingly coming to terms with the limits of a reductionist, deterministic model of the world, and the brain in particular⁹⁶ - but social scientists have been slow to recognise the critical importance of context and connectivity in all forms of social arrangements.⁹⁷

Darwinian concepts of evolution and mutation involved in developing new species, show the critical significance of exploiting niches which are dependent on other species. In other words collaboration and mutual tolerance are as much a part of biology as is survival of the fittest. Behaviourist psychology is now seen as an overly simplistic understanding of extremely complex processes.

The world moves on.

Yet again there is a convergence; as science clarifies its early assumptions (“it’s not as simple as popular works on science used to lead people to think!”), and as we get a better understanding of the processes involved in human learning, so too are organisations coming to understand the vital differences between short-term efficiency, and longer-term effectiveness. This convergence has massive implications for the way school curricula have to be devised so as to prepare young people for the decisions they will have to make to create policies in their lifetimes which are ecologically sustainable, and morally and socially equitable. Yes, it’s a tall order.

ISSUE IV: TECHNOLOGIES OF INFORMATION AND COMMUNICATION

“Quantifiable” learning, particularly over the last 100 years, depended upon close association with an instructor who utilised “chalk and talk” to convey information. The curriculum moved at the speed of handwriting. Learning was depended upon verbal assimilation and memorisation, checked by tests, all at a specific time, in a specific place, and in a stepped relationship to other learning.

To make it palatable good teachers attempted to be charismatic; they looked for any form of intrinsic motivation to humanise the far less attractive incentives of grades, exams, promotion, etc. This, in its turn, created another unintended problem. Pupils looked for teachers who could make essentially uninteresting material interesting - they “jollied” people along, if necessary by telling numerous funny stories! However, if the critical balance between “external good-humour,” and the development in the learner of their own intrinsic interest and responsibility was not appropriate, this led inevitably to good pupil performance in the test being associated with the charisma of the teacher. The classic “teaching for the test syndrome.” This led, on the part of pupils, to teacher dependency and a lack of personal responsibility. It is of this which leaders of industry and commerce have been so critical. “*Give me guides on the side, not sages on the stage,*” declaimed the Chief Executive of Boeing in a swingeing attack on this over-dominance of teachers in pupil learning.⁹⁸

Just as we are undoubtedly on the brink of new understandings about learning and the brain, so too are we beginning to see how radical developments within technology could enhance the way in which young people acquire and assimilate knowledge. New information and communication technologies could expand enormously opportunities for individual and group learning. At their best they offer multi-sensory, reflective, and collaborative learning environments unconstrained by time, place and formal structures. These could encourage exploration and discovery thus supporting students in the construction of new understandings; construction, that is, not simply the transference of information. The significance of these technologies lies in their ability to be interactive and to simulate activity that would normally be impossible within a classroom.⁹⁹

According to John Seely Brown, head of the Xerox Palo Alto Research Centre (and co-author of a most influential study on Cognitive Apprenticeship), the technologies of information and communication compel a change in the prevailing pedagogy. Before the advent of interactive technologies “pedagogy had to do with optimising the transmission of information. What we now find is that kids don’t want optimised, pre-digested information. They want to learn by doing - where they synthesise their own understanding - usually based on trying things out.”¹⁰⁰ Learning becomes experiential. Yet, as Seymour Papert has observed about the dominant model of education, “The scandal of education is that every time you teach something, you deprive a child of the pleasure and benefit of discovery.”¹⁰¹

Of the technologies which offer a new learning paradigm the simplest and oldest is word processing. It challenges to the core present school curricula, based as they are on handwriting technology. On average children can learn to type three times faster than they can write by hand. Already this technology has revolutionised the office, and has enabled vast numbers of people to escape from thinking about writing as a strictly linear activity. Adults move ideas around until they are satisfied that they have finally described their intended meanings.

Educators are comfortable teaching with the assistance of information technology, but policy makers are still not prepared to let the technology change the way pupils do things. The technology therefore remains in the hands of the teachers, but not in the hands of the pupils. This is at its most pronounced in the structure of formal examinations where pupils, who on a day to day basis are fluent users of the keyboard, are constrained to write by hand in their critical final examinations.

Policy makers take note: Formal schooling is being sidelined by all this technology as the restrictive and unimaginative practices of schooling are increasingly recognised, and the point of action becomes the home. The earlier passive technologies of television and video, when linked with active technologies such as the computer, CD ROM systems and the Internet, provide an astonishing array of tools for constructivist learning.

To exploit this “delivery” potential necessitates a new pedagogy which emphasises the child’s growing responsibility to make valid choices between techniques and technologies, and to distinguish between useful and useless information.^{vii}

It is a sad reality that schools have been unable to release the potential of this technology simply because it does not fit comfortably within a classroom dominated by formal instruction. The technology is of strictly limited significance unless it changes the conventional role of teacher and learner.¹⁰² Those children who have an inquisitive attitude, a sympathetic home environment, and who can access all these computer based technologies on demand from home have an enormous advantage over those who are simply dependent on a few minutes a day of “special activity” within schools.

Current school curricula remain predominantly about facts, not about processes. As such, the power of these technologies within formal education is being constrained to work alongside curricula firmly fixed in the working practices of an earlier age - high levels of memory skills, instruction and paper and pencil dexterity. With such vestigial thinking, these technologies are relegated simply to a vocational skill by most conventional educators. Their potential as a tool to enhance learning is being ignored, and trivialised. It is like transporting a jet engine on the back of a horse and cart! That engine is likely to remain inert in the cart until there is a genuine convergence between new understandings of learning and technology...then it takes off but leaves the cart and most people behind!

ISSUE V: SPONTANEOUS INFORMAL LEARNING; THE SIGNIFICANCE OF THE HOME AND THE COMMUNITY

“No curricular overhaul, no instructional innovation, no change in school organisation, no toughening of standards, no rethinking of teacher training or compensation will succeed if students do not come to school interested in, and committed to learning...We need to look not at what goes on inside the classroom, but at students’ lives outside the school walls.”¹⁰³

^{vii} **A note on technology:** The largest study of its kind in the US found “where technology is used wisely and where the teachers are given the right kind of support and training and the right kind of equipment, then they are able to actually implement some of the best theory and practice regarding the teaching of writing...students are more willing to do more editing, to spend more time reviewing their text and improving it. But to provide a computer and think that students writing will somehow magically improve - that’s just wishful thinking.” In *Education Week on the Web*. (November 4, 1998) <<http://www.edweek.org>>

Few policy makers, even now, recognise that young people between five and 18 spend only 20 percent of their waking hours in a school. The rest of their time is spent in the home and the community. School is strictly a secondary activity. Learning can (and does) happen anywhere. Formal education, for reasons which now must be very clear, is strangely ambivalent about the role of the community and informal experiential learning. Only slowly are educators coming to talk about “AOTs,” an awful acronym for “adults other than teachers” - all those people, parents and others, who intentionally or unintentionally impact on the experience of young people.

By contrast with the emasculated form of community we now experience, our ancestral environment where our cognitive predispositions were shaped was rich in varied forms of multi-generational interactions, and tasks. Margaret Mead observed that “every civilisation requires the living presence of at least three generations to ensure transfer.”¹⁰⁴ In other words, when parents are too busy working it is the grandparents who transmit culture^{viii}

It was these numerous interventions that provided the motivation, inspiration and information which was encapsulated in Cognitive Apprenticeship. It was learning that gave a community its *raison d'être*. As Ben Franklin remarked ruefully at the signing of the Declaration of Independence “we must indeed all hang together, or, most assuredly, we shall hang separately.” Can an atomised society successfully induct young people into a participatory democracy?

It is an arguable thesis that it was the taking of responsibility for learning away from the home and community, and placing this in institutions, that effectively undermined the proper functioning of both community and home. Another unintended consequence? The same could happen if “home” work is replaced by more “school” work. Learning is not only a collaborative activity, it is a community building activity as well. As St. Augustine shrewdly commented 1,500 years ago, “I learnt most, not from those who taught me, but from those who talked with me.” Modern research shows just how perceptive, and exact such a statement was.

In contemporary society such intentional interactions between adults and young people are continuously declining. The pressures of modern life, it is too quickly accepted, make it much harder to find time to interact with children. “I must work harder to satisfy my rising expectations” people explain as they subconsciously fall prey to the invidious influences of advertising. This has a powerfully negative impact on children. A father of a 14-year old now spends on average no more than five minutes a day in solo contact with his child.¹⁰⁵ “Half the children in my class have no father at home,” state many teachers. So the role of family nurture falls solely on the mother, who is now being forced to become the primary breadwinner. Consequently, there is less time for good people to be involved in the community, and this means children rarely experience spontaneous forms of learning that can trigger real passions for exploration and discovery.

^{viii} “Throughout the hominid line, the family has been the foundation of group structure. Among modern hunter-gatherers we usually see a division of labor between men and women, with men being the hunters and the women being the gatherers. The two sexes thus form a cooperative unit. However, there is cohesion not only within the core family (husband, wife, children) but also among members of the extended family (grandparents, siblings, cousins, uncles, aunts). The extended family is important not just for mutual help but also for cultural cohesion and transmission to the next generation. The breakdown of the extended family and even the core family is one of the basic roots of the cultural breakdown in inner-city slums.” Ernst Mayr. *This is Biology: The science of the living world*. (The Belknap Press: Cambridge, MA), 1997.

Yet, “the most stunning change for adolescents today is their aloneness. The adolescents of the 1990’s are more isolated and more unsupervised than other generations...not because they come from parents who don’t care, schools that don’t care, or a community that doesn’t value them, but rather because there hasn’t been time for adults to lead them through the processes of growing up.”¹⁰⁶

“In just 2,000 years human mothers have gone from spending 24 hours a day in contact with their infants to spending two or three hours of what we now call ‘quality time.’”¹⁰⁷ Jane Goodall has observed that “during my 37 years studying the social behaviour of our closest living relatives, the chimpanzees, we have collected data that demonstrates the importance of early experience - especially the type of mothering and family structure - in the moulding of adult behaviour. Those individuals with affectionate, supportive and playful mothers are those who are best able to form relaxed relationships with other members of the group throughout life.”¹⁰⁸

Parenting is a biological necessity for humans, a necessity that is, for the child who has no way of accumulating the wealth of intuitive understandings, cultural mores, and emotional maturity, unless he or she is cared for unstintingly over many years, by patient, well-meaning, and determined parents, supported by other adults in the extended family, which in turn is supported in the greater community.¹⁰⁹

Basic parenting at a subsistence level is undoubtedly an innate activity, but high quality parenting of the kind we must be interested in is undoubtedly a learnt skill. Quality learning doesn’t happen automatically, as is now becoming terrifyingly obvious in many countries.

For most of human history the family and the community have been the historic homes for learning of all kinds, including how to successfully raise children. They have largely lost this function in the past 150 years as more and more schools were established, and teaching became evermore professionalised. But today the community and home are changing as well. Both are struggling to find new roles that respond better to human need.¹¹⁰

New definitions of learning could be the clue to revitalising the home and restoring a practical role to the parents, especially the father. New technologies could open up the home as a form of electronic cottage industry. Children and parents could be poised to recognise the force of learning together.

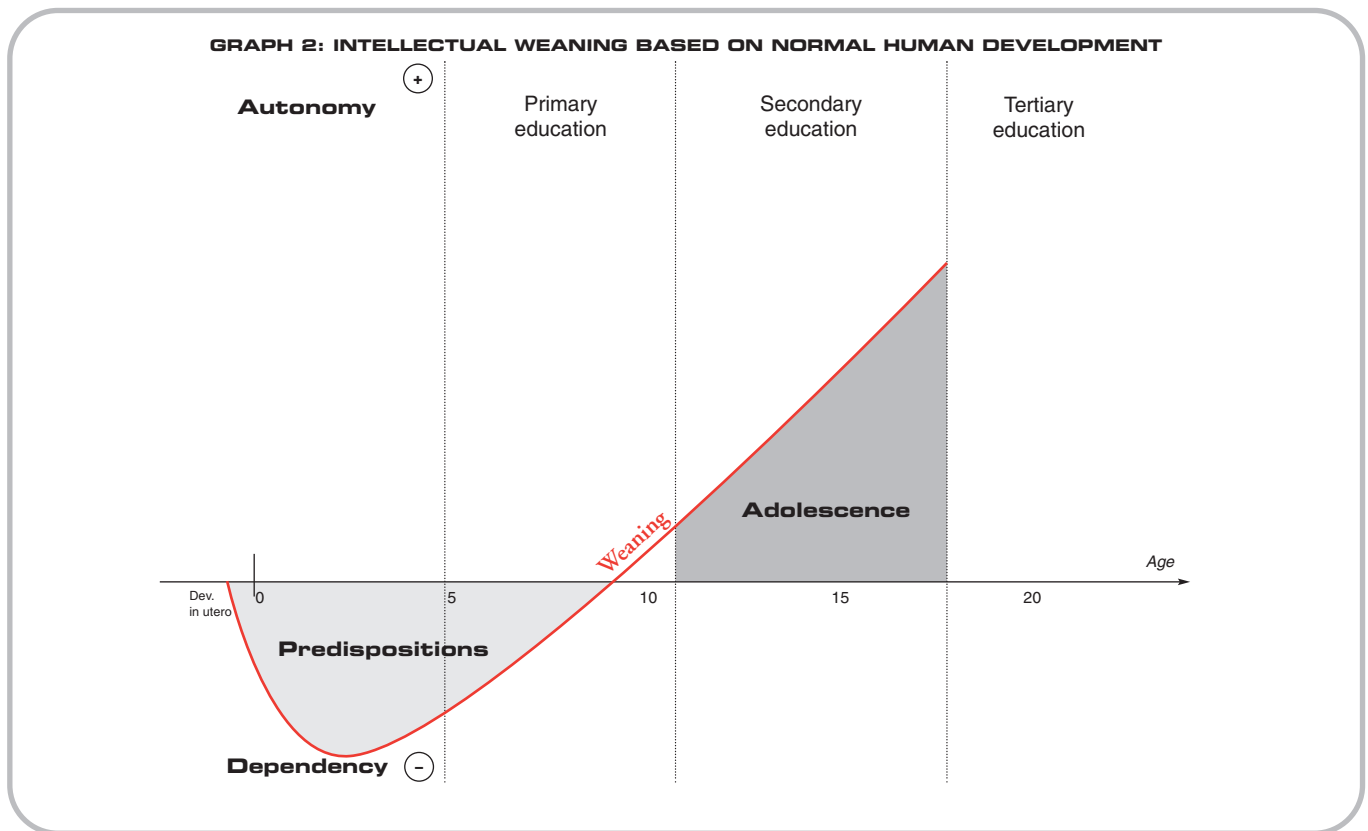
But are they? There are stark choices to be made.

THERE IS NOW A VALID ALTERNATIVE TO CONVENTIONAL ARRANGEMENTS FOR LEARNING

Drawing on these five issues consider what a graph of human development predicated on our new understandings about predispositions, the growth of intelligence and creativity, and the critical role of adolescence might look like.

Graph 2 projects a line moving from heavy dependency on teachers and others, to an increasing autonomy and induction into adult responsibilities. The graph is based on children's inherited predispositions to learn, and shows the operation of the weaning process (moving away from dependence on formal instruction to autonomous learning) as children enter adolescence. Pre-industrial societies understood this Weaning principle extremely well.¹¹¹

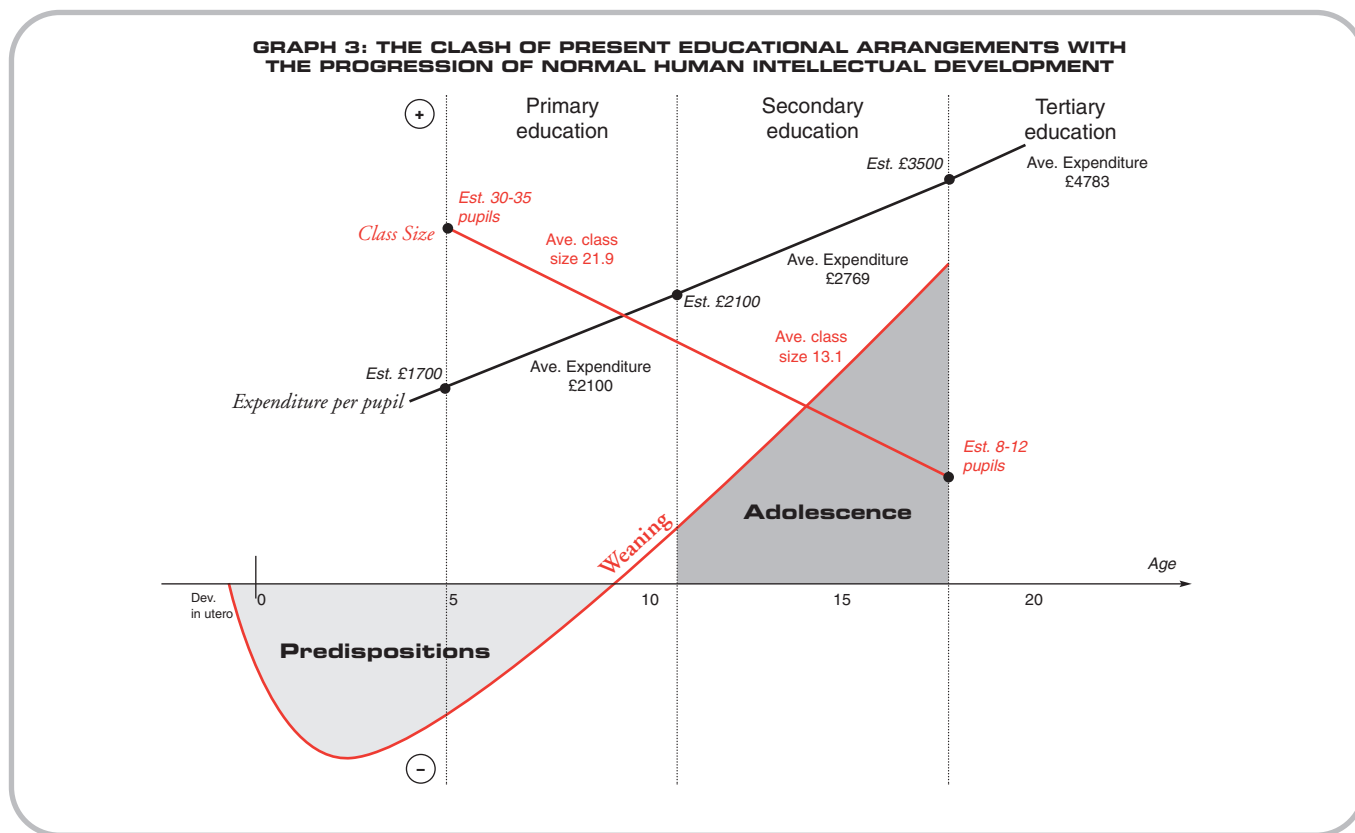
It was a tough principle for there was no way for those people unable to 'graduate' as autonomous, to survive. The gaining of autonomy was impossible, moreover, if the innate predispositions had not been properly stimulated and developed at the earliest stages. Without these key skills (which were much more than what are commonly called Basic Skills) autonomy could not be developed. Whilst this progression from dependency to autonomy drew the best out of the young learner it also matched the pressure on the "ageing teacher" (in practice, parents, shopkeepers, artisans, etc.) whose own energies were diminishing with time!



It is a fascinating model for as children enter adolescence they yearn for the opportunity to show their independence and maturity. In our generation this requires a system that would wean children of their dependence on formal instruction while increasing their access to learning technologies (in Estonia 12, 13, 14 year olds will not only do more independent work with Information communication technologies but actually teach younger students how to use it), and to learning opportunities in the real world of the greater community.

An example of this comes from the United States; a 17-year old girl, largely studying the sciences, and hoping to get into an Ivy League College to study medicine, works as a birthing assistant at the Birthing Centre in the local hospital. For two days a week she helps mothers who are in labour, and during the three days she is in class she carries a beeper to answer the call of the hospital. If the delivery room is short-staffed they beep her for her assistance. She is taking on adult responsibilities and learning in a very real-life setting. The high school has two rules that govern her activities. First, whatever class time she misses she has to make up in her own time, and second if she behaves in a way, in the environment in which she is working, that might bring disrespect on the school she is reprimanded publicly in the presence of her peers and taken out of the program.¹¹² This example seems almost unbelievable to most teachers today, but this is what could be possible for most young people if we get the structures for learning absolutely right. The advantages for whichever society first gets this right will simply be enormous.

With all this in mind now look at what happens when Graph 1, showing current educational arrangements, is superimposed on Graph 2 showing the natural progression of autonomy through the weaning principle.



The clash is dramatic. The first graph is based on the assumptions summarised simply for academic success in Table 1, while Graph 2, which incorporates the findings both of the biology of the brain and the science of learning, looks reasonably similar to the practices called for by commerce in Table One. Why is this? Maybe it is simply because commerce, continuously tuning its practices to that which enable it to be economically successful, has intuitively found many of these processes as it has analysed successful working experience. Educationalists, without such self-correcting imperatives, have not started to remove formal education systems from the strangle hold of the Industrial Model.

When children currently enter school at about the age of five many of the key predispositions for learning have already peaked, or as in the case of language development are actually fading away. Note how the natural progression towards autonomy (weaning) works in exactly the opposite direction to the way in which the current arrangements - class size and total expenditure per pupil - are organised. This helps to explain why many children fail to benefit from their early years of schooling in ways which would, in other circumstances, work towards their own independence by demonstrating increased responsibility during adolescence. By ignoring the opportunity offered by the predispositions in the early years, the system is missing a powerful opportunity to provide children with the skills they need to develop in advance of puberty. This could surely be remedied by smaller class sizes at the earliest years of education?

Educationalists and some politicians alike give tacit acknowledgement to the problem of large classes in Primary Schools, but they do so without questioning any of their other assumptions about schooling. As Peter Mortimore, Director of the London Institute of Education, has observed American research shows conclusively that “small classes in primary schools are beneficial.”¹¹³

But British politicians, playing on the fact that while there are a number of small scale research projects on class size none looks at class size and learning styles in conjunction, nor over a long enough period of time. They have concluded that “I do not believe there is any proven connection between class size and the quality of education,” as was stated by Eric Forth in the House of Commons in 1994.”¹¹⁴

“A relatively minor issue,” commented Kenneth Clarke.¹¹⁵ Tim Eggar, the Schools Minister when asked if he would take action on class size in 1991 replied simply, “No.”¹¹⁶ Eggar found this easy to do, as the previous year Professor John Tomlinson, one-time Chairman of the Schools Council, had said “reducing class size to the point where student achievement would be likely to benefit is prohibitively expensive.”¹¹⁷ Within the context of current assumptions Tomlinson might well have been right because those assumptions were not predicated on changing the system. A more insightful comment came from two researchers at the Far West Laboratory for Educational Research in the United States. “Large reductions in school class size promise learning benefits of a magnitude commonly believed not within the power of education to achieve.”¹¹⁸

Teachers Unions have been most vocal both on the damage large classes do to children, and the strain these put on teachers.¹¹⁹ Whilst intuitively people know that smaller classes should result in better learning opportunities, the research suggests that there is very little improvement unless the class size changes dramatically. To move as the present Government suggests from 35 to a maximum of 30 will be expensive, and marginally more comfortable for the teacher. However, this will not open up any significant opportunity to move towards those styles of teaching and learning that would effectively draw out natural predispositions to learn.

Policy makers take note: Over the years teachers have come to fear the aimlessness and apparent reckless irresponsibility of so many adolescents. So the call has constantly been for more resources to “control” youngsters, who are already feeling increasingly sullen and misunderstood. Adolescents’ criticism of teachers and the system is immediately thrown back on them for being uncooperative. At the very stage in which they are impelled by their natural predispositions to take responsibility they are inhibited by their lack of early skill development and become frustrated, disillusioned and awkward. In ways which often seem inarticulate to worried adults their energies are expended in kicking the system.

Rather than having the energies of adolescence working to the advantage of the community young people and the older generations find themselves continuously at cross-purposes. As long as youngsters start education with a form of provision that virtually guarantees many of them will not develop sufficient skills to become autonomous learners then the requirement to “raise standards” will always (as long as the current model - Graph 1 - remains the norm) imply further expenditure throughout the system.

Most conventional school reform has failed to realise its potential because it has attempted to mandate new structures without changing the important rules in the system.¹²⁰

“If we change our representations of intelligence, learning, and teaching, we can change the interactions between students and teachers in the classroom...(we) may have to change our representation of what classrooms and schools should look like. We may have to get over the idea that good schools should be like the ones we attended.”¹²¹

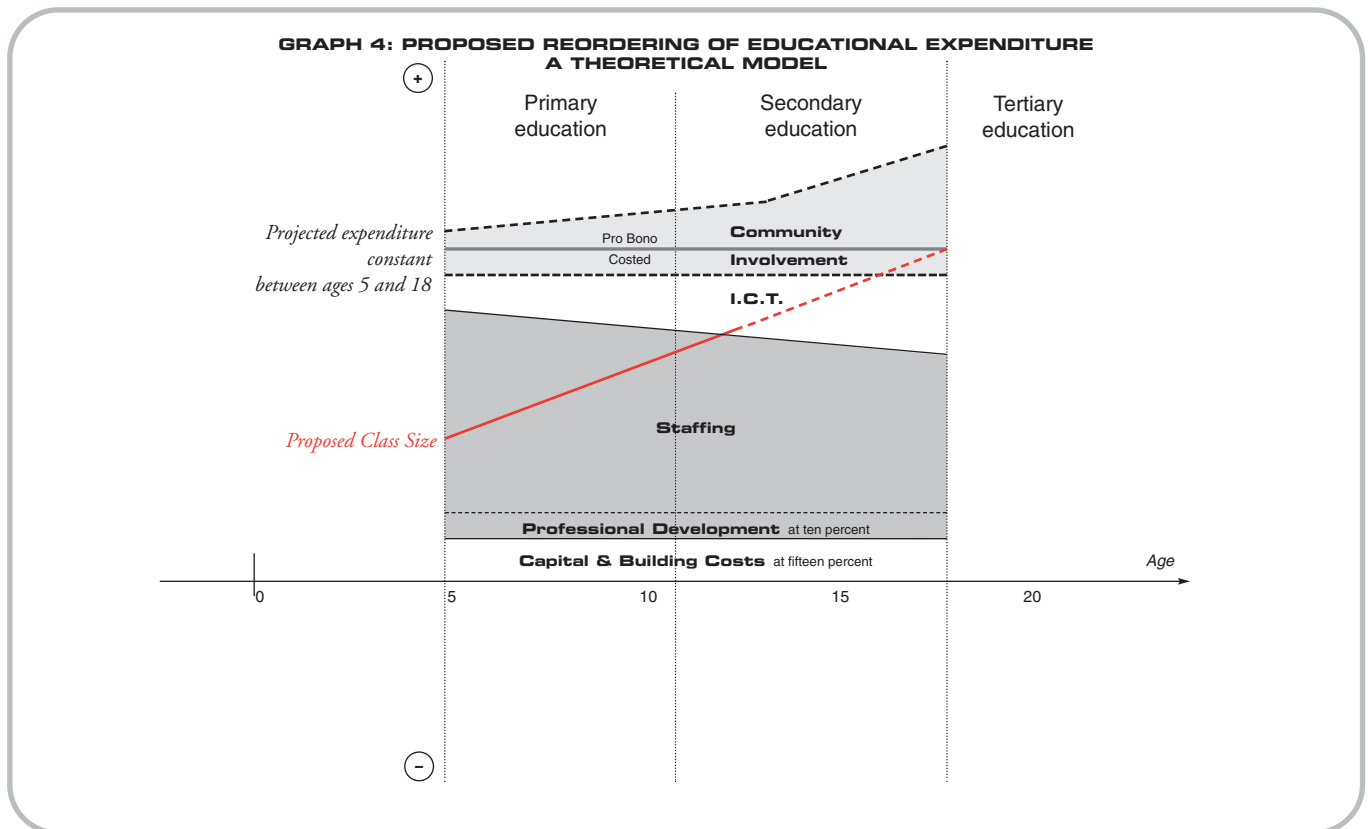
Perkins wrote in 1992 that “hardly anything in the conventional education practice promotes, in a direct and straightforward way, thoughtfulness and the use of strategies to guide thinking. Those students who acquire reflective intelligence build it on their own, by working at personal repertoires of strategies. Or they pick it up from the home environment, where some parents more than others model good reasoning in dinner table conversations, press their children to think out decisions, emphasise the importance of a systematic approach to school work and so on.”¹²²

Policy makers take note: There is too much evidence now available for us to continue deceiving ourselves. Our present community and school structures are finely tuned to outdated assumptions about how humans learn. These new understandings simply undermine the old assumptions on which present structures gained their authority. If we are to capitalise on the understandings and opportunities described under the “Guidelines for the Transformation of Learning” we must recognise that the changes necessary are of such a scale that normal processes of incremental innovation are totally inadequate.

The conventional units of change (a single school or state wide government) are no longer appropriate; new, intermediate units which correspond more closely to human expectation and community needs have to be developed.

THE PROPOSAL

This proposal is based on the assumption that it is essential to create a society of life-long learners at no greater cost than at present. It is based on the understandings outlined above that show the motivation for life-long learning resulting from early educational experiences that help children develop their innate abilities to understand their own learning processes, and subsequently use these to take responsibility for their own learning.



The theoretical model in graph 4 is predicated on fully exploiting the opportunities created by a better understanding of the Weaning principle. It assumes a constant level of per capita expenditure between five and 18, but dramatically changes the relative relationship of the forms of expenditure.

Resource distribution of this kind would provide all young people with such ample teacher support in their earliest years of schooling (classes of 10 to 12) that, as they grow older they would actually need less direct formal instruction and would utilise extensive, richer and more stimulating learning environments which are defined as including books, libraries, museums, information communication technologies, community mentors and significant real-time commitments to community-based projects outside the school.

Now consider the Policy Implications.

POLICY CONSIDERATIONS

1) Weaning: As they grow older pupils would progress from an intensive relationship with teachers towards more open and interactive situations where they would be held increasingly responsible for answering to a tutor for the proper and successful application of their time (“this will mean that the pupils are tired at the end of term, not just the teachers!” exclaimed a happy educationalist.). Increasingly the pupils will become active workers with a strong vested interest in their own success, and less the recipient of received wisdom, seeking to match goals set for them from outside. While the school will remain important throughout, the maturing learner will increasingly come to see the community as the place to which they already belong, and to which they must contribute, as well as take.

2) Staffing: The role of the teachers will change as the pupils mature. Initially the pupil-teacher relationship will be very close, but even during the earliest years it will be organised in such a way as to encourage young people to see the goal of learning as the development of skills for which, in the future, they will have to take full responsibility. Teacher support would reduce as the pupil demonstrated increased confidence in the application of the initial skills - the application of both “scaffolding” and “fading” as described under the term Cognitive Apprenticeship. At all stages the teacher will encourage much discussion, using this to build-up inter-pupil collaborative learning styles. As the pupil becomes more involved in monitoring his own progress, the teacher will become more Socratic, and increasingly advise learners on the validity of alternative learning strategies.

As the use made of learning resources increases (in a genuinely open, on-demand way, and not as an alternative way of organising classroom directed time), so the need for formal instruction will reduce. *This changes the concept of class size in a dramatic way.* For instance: if thirty-six 17-year old pupils need to be taught for each of eight periods in a day, and there is only one teacher available at any one time, then a class of 36 is the inevitable result. However, if such thirty-six 17-year olds are effectively working under their own direction for half the time (and for the previous 12 years have been prepared to do just that) then, certain time-table logistics permitting, they could effectively be taught in classes of 18 for each of four lessons, or classes of 12 for each of three lessons, directing their own work for the remaining time.

Something else changes also. Currently we think in terms of teachers and learners. Our simplistic understanding of this encourages the idea that older pupils are still not skilled enough, or mature enough, to act, as mentors of younger pupils. In the model of learning here advocated it would actually be desirable if part of the experience of older adolescents also involved some commitment to working formally with younger pupils - not as a money saving strategy, but as part of their own preparation for subsequent parenthood.

3) Professional Development: All these innovations are dependent on a properly thought through programme of professional development for all teachers, and other staff. This is not a “once and for all issue.” Lively teachers advising young people on how to improve their learning have also to be energetic learners themselves. Professional development has to become a continuous process, fully integrated into the whole life of the school. Only in this way can teachers resist slipping into the category of the “learned.” This proposal recommends that 10 percent of total staffing expenditure should in future be applied to teacher development - it is the most essential element in introducing and maintaining such reforms.

4) Community: Opening up the resources of the community is not easily done. We have largely forgotten how to structure that set of informal, intentional, interactions that were once at the heart of apprenticeship and of genuine “learning communities.” It is irresponsible to suggest that this can happen without funds being made available both to facilitate arrangements, and to provide some key elements of training. Expenditure rising to 10 percent of total costs, planned and integrated over a period of years, could uncover a whole wealth of otherwise untapped and wasted human resources (the early retired; professionals with a few spare hours a week; senior citizens; mothers working from home, to name but a few), as well as the numerous community projects which are currently stillborn for lack of cash, but which could involve enormous learning opportunities for young people.

5) Information and Communication Technologies (I.C.T.): So far schools are inhibited in their ability to exploit the opportunities created by the new technologies because of the current resource allocations. At this level nothing much changes - unless a child has parents that have access to the technologies at home. This offers individual opportunities of using the technologies in ways that help them rapidly outpace their classmates. These fortunate students soon feel constrained and frustrated by the slower and restrictive practices of the classroom. This Proposal suggests that, by the age of 18, 20 percent of all expenditure should be allocated to learning technologies and books (the knock-on effect of this on younger pupils would be enormous.)

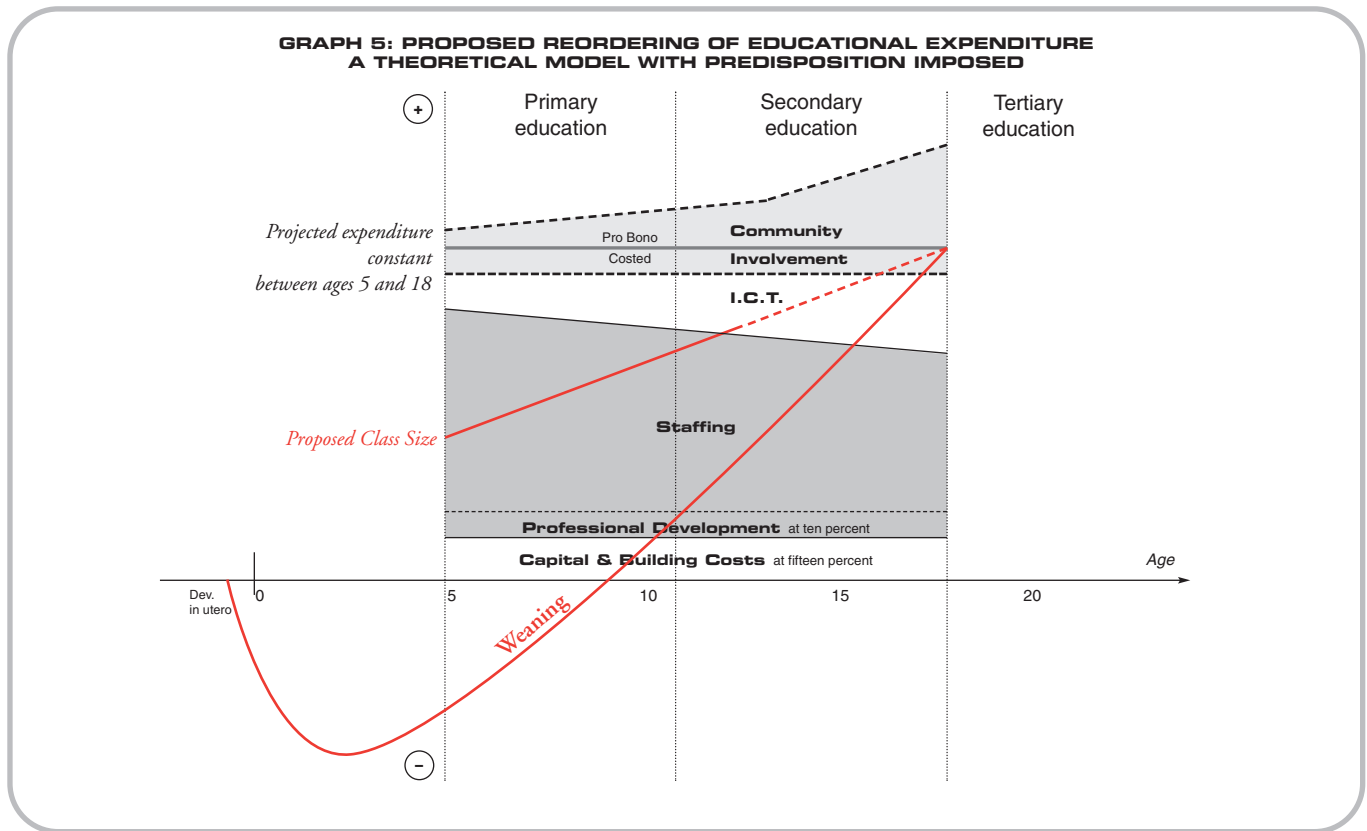
6) There are two other vital components: appropriate assessment systems and the informed understanding of society in the development of community.

Discussions about appropriate forms of assessment have been lengthy, tortuous and always cast within current assumptions. A new model of learning could not be developed unless, in parallel, new assessment methods were also developed that would measure process skills as carefully as modern techniques assess content. It is both sets of skills from Table One that have to be assessed - not just the academic skills.

Secondly, such a programme has to be well understood by society at large - both the reason for its introduction, how it will work, and what will be its outcomes - if it is to have a reasonable chance of success. People are nervous about the future of education. They know that education has to change but, strangely, most don't want their own children to be in the forefront of innovation.

For a new model of learning to emerge it is necessary to have the wholehearted support of society at large including, but not dominated by, Government. It has to be recognised that such educational innovation, being implemented over many years is essential to the nation's continued well-being. The nation which first unlocks this quite enormous reserve of energy and expertise will have a huge social and economic advantage internationally.

With all these proposals in mind now look at Graph 5 which superimposes the proposed Reordering of Educational Expenditure on the graph for Intellectual Weaning based on normal human intellectual development.



What are we waiting for?

Before coming to our conclusions there are two other critical issues that have to be addressed.

There are two areas on graphs 4 and 5 not as yet covered by this Proposal; those relating to the Under-fives, and that involving Tertiary Education. The lines showing proposed distribution of resources for the five to 18 age group pose fascinating questions.

If full and proper provision is not made for children and their families below the age of five, then society has largely missed out on the richest period of children's predispositions to learn. At the Tertiary level the significance of the graph reflecting the Weaning process, when projected further within the context of "life-long learning," could change dramatically the conventional pattern of Tertiary Education.

This could release resources sufficient not only to fund a considerable expansion in the number of students participating in Tertiary Education, but could release other moneys that could then be applied to the support of parents with young children.

THE UNDER-FIVES

The significance of the earliest years of life, and the opportunities currently being missed to develop natural pre-dispositions when they are at their most open, is now well understood. Indeed, there are a plethora of policy suggestions in many lands. Most of these however seem predicated on the acceptance of the primacy of present institutions and economic trends, all of which encourage the release of parents as rapidly as possible from the responsibility of parenthood, and replace this with “childcare.”¹²³ Many arguments are being advanced which suggest that as many parents don’t understand their nurturing role very well, institutional provision with its emphasis on trained professionals could do this better. The economic attraction of this argument is strong. Such care providers would probably be paid less than the wealth which working parents could contribute to the national economy. This in turn creates a niche market for unskilled women who could be trained as day care workers.¹²⁴

Everyone would appear to gain.

Or would they?

As with most complex problems, the simple solution is not necessarily the best one. Dr. Donald Cohen of Yale University has identified quality care of children as simply “being there when (young children) need you. Sometimes when they need you is when they are upset and distressed. At such times, a lot of important work goes on between the parents, who are devoted to this child, whose primary preoccupation is this child. So, when the child is crying or is hungry or has fallen down or is disappointed, how the parent responds is critical. It makes an enormous difference whether it’s your child, a child you really love and care about, or somebody else’s child. It also makes a difference how awake you are, how stressed you are.”¹²⁵

The difference between a paid provider and a normal parent child relationship is enormous. It has a simple basis - unconditional love. In fully functioning societies this is as significant to the parent as it is to the child. This was best described by John Bowlby in his early work on “attachment theory.”¹²⁶ The parent grows as the child draws more from the parent; the parental supply of love is enlarged through use, not reduced.

While it is possible for caregivers to provide high levels of technically appropriate care and stimulation,¹²⁷ the absence of a genuine emotional component places limits on that range of social and empathetic skills on which children’s full intellectual and personal development are dependent. The American psychologist Stanley Greenspan suggests that we are at an evolutionary cross-roads. He writes: “For the first time in history there is a growing trend for more and more middle and upper middle-class parents to farm out the care of their babies to others, often in settings not conducive to meeting children’s irreducible needs. The impact will likely be slow and insidious. People may gradually become more self-centred, and less concerned with others. Thinking may become more polarised...impulsive behaviour, helplessness and depression may increase.”¹²⁸

In so much of the work emerging from biological and evolutionary studies as summarised in this proposal, it is the emotions that are associated with growing up that appear to be such a major component of the driving factor in learning, and in the full application of the weaning principle, that a further lessening of the emotional care of children could make an already serious situation disastrous.

TERTIARY EDUCATION

Universities and colleges are largely locked into similarly outdated assumptions about learning, and the resources needed for teaching.¹²⁹ It is amazing to note that the success of the “Open University” seems to be evermore appreciated the further from England one travels!

However, once the changes postulated for the Under fives start to impact, and the full reversal of resource allocation in the school system is linked to all these other factors, the preparedness of young people entering further education to learn in a far more expanded way, will challenge current models of university education to the core. At one level, people will see this as being essential as it is obvious that an ever increasing proportion of people in the 21st century will need more and more university-type qualifications.

But the second significance is deeper still. The most problematic part of this Proposal centres on societal changes needed to accept the critical importance of the nurture of the youngest children. For years this will mean support programs for parents to compensate for those arts of parenting which have been lost. While parenting is innate, good parenting has to be learnt - and that is going to cost a society much money. That costs could, in the long run, be off-set by reducing the cost of University Education. (i.e. instead of three or four years of on-campus study it would be possible to have two years of direct instruction and additional years of distance education using information and communication technologies).

CONCLUSION

The decision as to which route to take at this evolutionary cross-road will profoundly shape the nature of future society, and means that society now confronts a stark choice.

Do we expect children to grow up as “battery hens” ideally conditioned to fit the exact specifications of institutional and economic arrangements as they currently exist (assessed, measured, and weighed according to the effectiveness of “converting” clearly understood inputs) as specialists? Or do we wish them to be able to roam “free-range,” as do farmyard chickens, growing ever stronger and developing their individuality as experts, able to survive in any environment?

If we are dealing only in the short-term (which it seems that sometimes older people are inclined to do) then the attraction of the former is apparent. Yet, the limitations of such short-term thinking are quite enormous. We have had nearly a century of that Faustian Bargain which has reduced the development of humanity’s intellect to a concept of “Scientific Management.” Such a concept is too simple, too contrived, too restrictive of what our ancestors thought they were bequeathing to us as civilised society.

What happens now to parents and children below the age of five is a test of our commitment to the development of creative, flexible and thoughtful life-long learners.

The German Philosopher and Theologian, Dietrich Bonhoeffer, writing a short while before his murder in a Nazi Concentration Camp said, “the ultimate test of a moral society is the kind of world it leaves to its children.”

This Paper proposes a powerful and radical alternative to the wholesale extension of childcare provision, the ever lowering of the school entry age, and the expansion of current arrangements for schooling.

It is based on the better appreciation we now have of those inherited predispositions which make us human, and relates these to the potential creativity of each and every learner. Like all good solutions, it is not necessarily easy to administer, and to some looks like a compromise. Yet in the experience of our ancestors living, working and learning within a community of manageable proportions - that yearning which is deep within each of us - was all of a single piece.

Learning did not take place in isolation from working. Teaching was concerned with much more than just the mastery of skills, it was about emotional development and those empathetic skills needed for a functioning community. Parents “taught” as they worked, and “teaching” was more about an invitation to watch, and gradually participate, than it was about instruction. As a highly contextualised activity children came to see that learning had direct consequences across a wide array of human endeavour.

It has been estimated that in Stone Age times only 18 percent of adult waking hours were spent finding food and providing shelter.¹³⁰ Regardless of the validity of that statistic it must be obvious that such people had a vast residual of time that enabled them to talk and socialise in ways which provided the environment for children to understand who they were, what skills they needed and what their later responsibilities would be. That is what children still expect.

Modern society can't have it both ways. If we want to induct our young people into adult life in ways which will give them the wisdom to solve problems that older generations have not solved, then we cannot continue to pursue those goals which deny us the time and the energy to educate our children fully. We simply can't have our cake and eat it at the same time.

Actions speak louder than words. It is impossible to bring children up to be intelligent in a world that does not appear intelligible to them.

There is just one major policy guideline that follows. It is this. No innovation of this scale can occur unless society is broadly aware of how all the issues raised here interconnect. This is not solely about schools, but about reconnecting children with adults in ways that develop their social, emotional, practical and intellectual skills. This involves a policy initiative broader than anything normally conceived of as the responsibility of a nationally designated Ministry of Education.

Three sub-policy guidelines emerge from this. The first relates to the provision of resources and a theoretical concept for the proper development of children below the age of five, and for the needs of their parents. These have to be conceived in terms of practices that aim to wean children into becoming self-standing life-long learners, during the course of formal schooling.

The second sub-policy relates to implementing the proposal as set-out in this Paper to reverse the current “Upside Down and Inside Out” model of schooling. Through such a reversal it is possible to bring education systems in-line with what is now understood about the natural processes of learning.

The third sub-policy involves properly relating the emerging strategies for self-directed learning into a full-fledged model of continuous life-long learning that would meet the needs of the entire nation. Such a policy would subsume current arrangements for universities and colleges into a broader and more universal concept.

As this policy, and its sub-components, are worked out within numerous communities so thinking-people’s attention will inevitably turn towards the creation of initiatives and curricula that will better equip young people to handle holistically the complex social, economic, technological and environmental issues that will be the essence of sustainable success in the 21st century.

This Proposal, by focusing on learning rather than schooling, provides the clue for the transformation of educational provision in ways that can be accommodated at no higher cost than at present.¹³¹

What are we waiting for?

ENDNOTES

1 Numerous books and articles are being published on “Complexity Theory” and how this new organizing model can provide a better more inclusive paradigm for understanding the complexities of the brain, human behavior and indeed the universe. For examples refer to John Cleveland. “Learning at the Edge of Chaos. The Chaos Network. (August 1994); Fritjof Capra. *The Web of Life: a new scientific understanding of living systems*. (Anchor Books: New York), 1996; Mitchell Waldrop. *Complexity: The emerging new paradigm at the edge of order and chaos*. (Simon & Schuster: New York), 1992; and John H. Holland. *Emergence: From Chaos to Order*. (Helix Books: Reading, MA), 1998.

2 Gerald M. Edelman. *Bright Air, Brilliant Fire: On the Matter of Mind*. (BasicBooks: New York), 1992.

3 “The secret of the human brain’s remarkable power lies in its extraordinary complexity. There are something like one million million cells (10 to the 12th power) in the brain...The total length of ‘wiring’ between the neurons is roughly 100,000 kilometers. The number of connections between the neurons is about one thousand million million (10 to the 15th power). The total number of neurons is one hundred thousand million (10 to the 11th power). To put this last number in context, it rivals the number of stars in our galaxy.” Peter Coveney and Roger Highfield. *Frontiers of Complexity: The search for order in a chaotic world*. (Fawcett Columbine: New York), 1995.

4 Intrinsic Motivation (the desire to do something simply because one wants to). “Studies have revealed that higher intrinsic motivation is linked to higher school achievement and psychological adjustment in children, adolescents, and college students,” in *Basic Behavioral Science Research for Mental Health: A National Investment*. (National Institutes of Health: Washington), 1995. Refer also to Edward L. Deci. *Why We Do What We Do*. (Penguin Books: New York), 1995; and Alfie Kohn. *Punished by Rewards*. (Houghton Mifflin Co: New York), 1993.

5 Harold Morowitz and Jerome L. Singer (eds.). *The Mind, The Brain, and Complex Adaptive Systems*. (Addison-Wesley Publishing Co.: Reading, MA), 1995; and Stuart Kauffman. *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity*. (Oxford University Press: New York), 1995.

6 From a discussion at the 21st Century Learning Initiative’s November, 1995, Wingspread Conference.

7 There has been a plethora of articles and books on the “new economy,” and what it might mean for employees. For examples refer to Charles Handy. *The Hungry Spirit*. (Hutchinson: London), 1997; Kevin Kelly. *New Rules for the New Economy: 10 Radical Strategies for a Connected World*. (Viking: New York), 1998; Paul Krugman. *Pop Internationalism*. (MIT Press: Cambridge), 1996; William Greider. *One World Ready or Not: The Manic Logic of Global Capitalism*. (Simon & Schuster: New York), 1998; Lester C. Thurow. *The Future of Capitalism: How Today’s Economic Forces Shape Tomorrow’s World*. (William Morrow and Company: New York), 1996; The Council of Economic Advisors. *Economic Report of the President*. Washington, DC: US Government Printing Office, 1997; Robert Reich. *The Work of Nations*. (Vintage Books: New York), 1992; and Daniel Yergin and Joseph Stanislaw. *The Commanding Heights: The Battle Between Government and the Marketplace that is Remaking the Modern World*. (Simon & Schuster: New York), 1998.

8 Sir Douglas Haig, formerly a personal adviser on financial affairs to Margaret Thatcher when she became Leader of the Conservative Party said at an Education 2000 Conference in 1991, “your idea is actually more radical in its truest sense than present Conservative Policy. You’re talking about a system of education that would create really enterprising people; people who don’t need a system to tell them what to do. Unless Government is careful in its zeal to reform it will over-legislate, and become far too prescriptive. What you are talking about would create very different communities, communities that would want to take control of their own futures, because their futures mattered to them, not because Government told them to do so. That is the essence of what I think “basic Conservatism” in the future should be all about, but it is devilishly difficult to implement, and it hardly fits the dogma of any political party.” This statement appears to be highly compatible with what Tony Blair, and other politicians around the world, are now defining as the Third Way. (political polarization)

9 Comments are based on generalised statements made at conferences in North America, Colombia, Southern Africa, Southeast Asia and Europe.

10 What commerce calls commercial skills cognitive scientists are now calling “higher order skills.” It is clear that higher order skills and basic skills can only be effectively developed in tandem. John Bruer and many other cognitive scientists have shown that the development of basic skills and higher order skills are not contradictory, but are actually developed in concert. Bruer has noted, “we should be as concerned with how we teach as we traditionally have been concerned with what we teach.” John Bruer. *Schools for Thought: A science of learning in the classroom*. (MIT Press: London), 1993.).

11 “The rules for work are changing...These (new) rules have little to do with what we are told was important in school; academic abilities are largely irrelevant to this standard. The new measure takes for granted having enough intellectual ability and technical know-how to do our jobs; it focuses instead on personal qualities, such as initiative and empathy, adaptability and persuasiveness...This is no passing fad, nor just the management nostrum of the moment. The data that argue for taking it seriously are based on studies of tens of thousands of working people, in callings of every kind.” In Daniel Goleman. *Working with Emotional Intelligence*. (Bantam Books: New York), 1998.

12 Geoffrey Colvin. “What Money Makes You Do,” *Fortune Magazine*. (August 17, 1998).

13 For a review of the primary importance of intrinsic motivation in learning and creativity refer to Teresa M. Amabile. “How to Kill Creativity.” *The Harvard Business Review*. (September-October), 1998.

14 “Learning is a consequence of thinking,” comes from David Perkins. *Smart Schools*. (The Free Press: New York), 1992.

15 “Probably the most critical issue in any type of learning is how well the learning transfers from one situation to another, particularly to the actual performance of a task.” The National Research Council. *Learning, Remembering, Believing. Enhancing Human Performance*. (National Academy Press: Washington), 1994.

16 Carl Bereiter and Marlene Scardamalia. *Surpassing Ourselves: An inquiry into the nature and implications of expertise*. (Open Court: Chicago), 1993.

17 John Abbott. *The Child is Father of the Man*. (HarperCollins: London) to be published in 1999.

18 Flow is described as a state of high effectiveness by the well-known psychologist Csikszentmihalyi from the University of Chicago. Mihaly, Csikszentmihalyi. *Flow: The Psychology of Optimal Experience*. (HarperPerennial: New York), 1991.

19 Carl Bereiter and Marlene Scardamalia.

20 Howard Gardner. *Multiple Intelligences: The Theory in Practice*. (BasicBooks: New York), 1993.

21 Jared Diamond, writing of his time living with “primitive” New Guineans noted: “they impressed me as being on the average more intelligent, more alert, more expressive, and more interested in things and people around them than the average European or American is. At some tasks that one might reasonably suppose to reflect aspects of brain function, such as the ability to form a mental map of unfamiliar surroundings, they appear considerably more adept than Westerners.” Jared Diamond. *Guns, Germs and Steel: The Fates of Human Societies*. (W.W. Norton & Co.: New York), 1997, p. 20. Also refer to Tim Ingold. “Culture, nature, environment: steps to an ecology of life.” in Bryan Cartledge (ed.) *Mind, Brain and the Environment*. (Oxford University Press: Oxford), 1998.

22 Carl Bereiter and Marlene Scardamalia. The paraphrase is based on the leaf of their book *Surpassing Ourselves*.

23 Margaret Boden. *The Creative Mind: Myths and Mechanisms*. (Weidenfeld and Nicolson: London), 1990; and for a general review of creativity and how businesses develop it refer to Geoffrey Colvin.

24 Geoffrey and Renata Caine. *Making Connections: Teaching and the Human Brain*. (ASCD: Alexandria, VA), 1991.

25 A classic illustration of this is the way in which the brain subconsciously decides which are matters of real significance to it which are then placed in its long-term memory systems, and which other information is assigned only to short-term memory. David Schacter. *Searching for Memory*. (Harper & Collins: New York), 1996.

26 Howard Gardner. *Frames of Mind: The Theory of Multiple Intelligences*. (Paladin: London), 1985.

27 For a review of what personality and character are and how they are developed refer to Lawrence Wright. *Twins and What They Tell Us About Who We Are*. (John Wiley & Sons, Inc.: New York), 1997; Dean Hamer and P. Copeland. *Living with Our Genes: Why they matter more than you think*. (Doubleday: New York), 1998; Matt Ridley. *The Origins of Virtue*. (Viking: London), 1996; and Peter Barnes, J. Oates, J. Chapman, V. Lee and P. Czerniewska (eds.). *Personality, Development and Learning*. (Hodder & Stoughton: London), 1984.

28 Of course the debate about IQ still goes on, but the evidence against basing the future of children on such a psychometric measurement is irrefutable. For examples refer to R.J. Herrnstein and Charles Murray. *The Bell Curve: The Reshaping of American Life by Difference in Intelligence*. (Free Press: New York), 1994; Stephen Jay Gould. *The Mismeasure of Man*. (W.W. Norton & Co.: New York), 1996; Robert Sternberg. *Beyond IQ: A triarchic Theory of Human Intelligence*. (Cambridge University Press: Cambridge), 1995; and Gardner and Perkins.

29 David Perkins. *Outsmarting IQ: The emerging science of learnable intelligence*. (The Free Press: New York), 1995.

30 "In the 1990s, researchers made remarkable gains in understanding how a child's brain develops, grows and produces uniquely human capacities. At the same time, they discovered new ways to foster greater intelligence by nurturing brain growth during its most active phases." Marian Diamond and Janet Hopson. *Magic Trees of the Mind*. (A Dutton Book: New York), 1998.

31 Nigel Nicholson. "How Hardwired is Human Behavior?" *Harvard Business Review*. (July-August 1998).

32 For a solid scientific review of the impact of genes and the environment on human development refer to Bryan Cartledge (eds.). *Mind, Brain, and the Environment*.

33 There is a great debate raging within the research community about the role of Nature and Nurture in the development of human behavior. For examples refer to Henry Plotkin. *Evolution in Mind*. (The Penguin Press: London), 1997. Plotkin described the importance of the interdependence of nature and nurture in the development of the human brain/mind when he argued that "nurture has itself evolved. Nurture can only be fully understood in light of historical causes. Nurture has nature." Refer also to Azar, B. "Nature, nurture: not mutually exclusive." *APA Monitor*. (May 1997); Greenspan, S. *The Growth of the Mind and the Endangered Origins of Intelligence*. (Addison Wesley: New York), 1996; Dawkins, R. *The Selfish Gene*. (Oxford University Press: Oxford), 1976; Judith Rich Harris. *The Nurture Assumption: Why children turn out the way they do*. (The Free Press: New York), 1998.

34 "Predisposition implies a Relatively Stable Characteristic, one likely to have arisen under the influence of natural selection." Robert A. Hinde. "Humans and human habitats: reciprocal influences." *In Mind, Brain and the Environment*.

35 One of the most influential articles written on cognitive apprenticeship is by Allan Collins, John Seely Brown and Ann Holum. "Cognitive Apprenticeship: Making Thinking Visible." *The American Educator*. (Winter, 1991).

36 Refer to W.J. Rorabaugh. *The Craft Apprentice: From Franklin to the Machine Age in America*. (Oxford University Press: Oxford), 1986; and Howard B. Rock, Paul A. Gilje, and Robert Asher (eds.). *American Artisans: Crafting Social Identity, 1750-1850*. (The Johns Hopkins University Press: Baltimore), 1995.

37 Andy Green. *Education and State Formation: The Rise of Education Systems in England, France and the USA*. (The MacMillan Press Ltd.: London), 1992.

38 As Tony Hill, Headmaster of Melbourne Grammar School said at a conference of Australian Secondary Head Teachers in October 1993, "schools are inward looking - and increasingly unproductive in economic terms. Our time-tables are conditioned more by school bus schedules than intellectual considerations. We have teachers who, by and large, have a limited experience of the wider world; we make little provision for their induction, we rarely have a systematic appraisal of their performance, and we fail to build professional development into their normal teaching lives. Teaching is equated with telling, knowledge is equated with facts, and learning is measured by our students' ability to recall. Our methods our inefficient with students waiting their turn to participate in groups that are too large for genuine interaction. Common sense tells us that each individual grows and learns at a different rate, yet our class organization, teaching methods, curriculum and time-table take no account of this obvious fact. Whilst we spend large amounts of money on new technology, we rarely use it creatively to assist in learning. We do not really help our students learn how to think."

39 Donald Kennedy, former President of Stanford University was quoted by Daniel Greenberg of Johns Hopkins University as saying “the academic culture nurtures “a set of policies and practices that favor the present state of affairs over any possible future. It is a portrait of conservatism, perhaps even senescence. (senescence = aging onto death). Editorial Page. “Churning Out PhDs.” *The Washington Post*. (September 30, 1998), p. A. 17.

40 These numbers come from *Education at a Glance: OECD Indicators 1997*. (Center for Educational Research and Innovation OECD: Paris), 1997.

41 The most commonly cited International Comparison is the Third International Mathematics and Science Study (TIMSS) published by the TIMSS International Study Center (Chestnut Hill, MA), 1998.

42 The term “meta-synthesis” was first applied to the work of the Initiative in the Spring of 1998 by Wadi Haddad, former Personal Advisor to the President of the World Bank.

43 Erwin Schroedinger. *What is Life?* (Cambridge University Press: Cambridge), 1944.

44 Professor Thomas Mitchell, Provost of Trinity College Dublin, in September 1998, observed “Universities have tended to grow too big, grasping at every opportunity for new activity...their mission has become fuzzier, the institutions have become more impersonal, more fragmented...students become ciphers and isolated...faculties as a whole become ‘ghettoised,’ less interactive, further removed from the synergistic community of scholars that was the glory of Plato’s academy. (Unless this is reversed) universities will stifle rather than stimulate, produce technocrats rather than professionals, pedants and intellectual eunuchs rather than scholars and thinkers, and specialists who, as the cliché states ‘knows more and more about less and less, and cannot communicate with one another.’ And universities will fail in their most sacred responsibility to society, to foster creativity and progress informed by appreciation of the different domains of learning, of the many facets of human achievement, and of the many-sided needs of a developed society.” Opening Address given to the Dental Educators Conference on September 16, 1998. From Plato to the Internet.

45 For a review of the “chasm” between neurology and cognitive science and what each may mean for education refer to John T. Bruer. “Education and the Brain: A bridge too far.” *Educational Researcher*. (November 1997).

46 For readings on evolutionary psychology refer to Jerome H. Barkow, L. Cosmides, and J. Tooby. *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. (Oxford University Press: Oxford), 1992; and for a more general overview refer to Robert Wright. *The Moral Animal*. (Little, Brown and Company: London), 1994.

47 Of course, there are an increasing number of people who are trying to reach a similar sort of “meta-synthesis,” but as far as we know the Initiative is the only group trying to apply such understandings to the very real world of education. People who are starting to synthesise across numerous fields of knowledge include E.O. Wilson with his epic work on *Consilience*, Ervin Laszlo (*The Whispering Pond*), John Polkinghorne (*Beyond Science*), Ian Marshall and Danah Zohar (*The Quantum Society*), Sally Goerner (*Web World and the Turning of Times*), Stephen Jay Gould (*Life’s Grandeur*), Stuart Kauffman (*At Home in the Universe*) and William McNeill (*History and the Scientific Worldview*). Social scientists are also coming at this as well such as David Landes (*The Wealth and Poverty of Nations*), Thomas Sowell (*Conquests and Culture*), Paul Krugman (*The Self-Organizing Economy*), and Michael Rothschild (*Bionomics: Economy as Ecosystem*).

48 Steven Mithen. *The Prehistory of the Mind*. (Thomas and Hudson: London), 1996.

49 In asking what are brains for? The Dartmouth Cognitive Neuroscientist Michael Gazzaniga argues from a purely evolutionary perspective “Sex. (The passing along of our DNA) Indeed, I would argue that the cathedrals we build, the books we read and write, the science we create, the cars we drive, the stocks we buy and sell, all of the mergers, the politics, and the wars we wage - in short, everything that constitutes the intricate web of life that we have constructed around ourselves with our amazingly large brains - serves a simple purpose. Sex.” Michael Gazzaniga. “What Are Brains For?” in Robert Solso (ed.). *Mind and Brain Sciences in the 21st Century*. (The MIT Press: London), 1997.

50 Michael S. Gazzaniga. *The Mind’s Past*. (University of California Press: Berkeley), 1998. P. 6. John Tooby and Leda Cosmides have made the case that “because human and nonhuman brains are evolved systems, they are organized according to an underlying evolutionary logic...A familiarity with the basics of modern evolutionary biology is, therefore, an important working tool for cognitive neuroscientists.” In *The Cognitive Neurosciences*. (editor-in-chief) Michael S. Gazzaniga. (MIT: Cambridge), 1995.

- 51 Dr. Patricia Kuhl. "The White House Conference on Early Childhood Development and Learning: What New Research on the Brain Tells Us About Our Youngest Children." White House Information Office. (4-17-97).
- 52 Robert Sylwester. *A Celebration of Neurons*. (ASCD: Alexandria, VA), 1995.
- 53 Ian Tattersall. *Becoming Human: Evolution and Human Uniqueness*. (Harcourt Brace & Co.: New York), 1998.
- 54 For an easily understandable review of how the brain develops from conception to adolescence refer to Marian Diamond and Janet Hopson. *Magic Trees of the Mind*. (Dutton: New York), 1998.
- 55 Refer to Noam Chomsky. *Language and Mind*. (Harcourt Brace Jovanovich: New York), 1972; and Noam Chomsky. *Language and Problems of Knowledge: The Managua lectures*. (MIT Press: Cambridge), 1988.
- 56 Michael S. Gazzaniga expands this beyond just language development when he argues "over the past 30 years the mind sciences have developed a picture not only of how our brains are built, but also of what they were built to do. The emerging picture is wonderfully clear and pointed. Every newborn is armed with circuits that already compute information enabling the baby to function in the physical universe. The baby does not learn trigonometry, but knows it; it does not learn how to distinguish figure from ground, but knows it; does not need to learn, but knows, that when one object with mass hits another, it will move the object." In Michael S. Gazzaniga. *The Mind's Past*. (University of California Press: Berkeley), 1998.
- 57 Christopher Wills. *The Runaway Brain*. (HarperCollins: London), 1994.
- 58 For a detailed review of language acquisition in humans refer to Terence Deacon. *The Symbolic Species: the co-evolution of language and the brain*. (W.W. Norton & Company: New York), 1997; or what may be the seminal work in this area, Stephen Pinker. *The Language Instinct*. (Allen Lane: London), 1994.
- 59 Dr. Patricia Kuhl.
- 60 Kenneth Wexler, Cognitive Scientist at MIT; Richard Aslin, University of Rochester; and Peter Jusczyk, Johns Hopkins University at the American Association for the Advancement of Science. (Philadelphia, February 1998).
- 61 Renata and Geoffrey Caine.
- 62 Steven Pinker.
- 63 "Our minds have been built by selfish genes, but they have been built to be social, trustworthy, and cooperative...They come into the world equipped with predispositions to learn how to cooperate, to discriminate the trustworthy from the treacherous, to commit themselves to be trustworthy, to earn good reputations, to exchange goods and information, and to divide labour." In Mathew Ridley. *The Origins of Virtue*. (Viking: London), 1996.
- 64 Refer to Jane Goodall. *In the Shadow of Man*. (George Weidenfeld & Nicholson Limited: London), 1988; and Steve Jones. *In the Blood: God, Genes and Destiny*. (HarperCollins: London), 1996.
- 65 Peter Laslett. *The World We Have Lost*. (Routledge: London), 1983.
- 66 To be added later.
- 67 Robert Wright. "The Evolution of Despair." *Time Magazine* (August 28, 1995).
- 68 Ronald Kotulak. *Inside the Brain: Revolutionary Discoveries of How the Mind Works*. (Andrews and McMeel: Kansas City), 1996. Also refer to Bruce Perry. "Incubated in Terror: Neurodevelopmental Factors in the Cycle of Violence," *Children in a Violent Society*. J.D. Osofsky (ed.). (Guilford Press: New York), 1997; and Karr-Morse, R. and M.S. Wiley. *Ghosts from the Nursery: Tracing the Roots of Violence*. (The Atlantic Monthly Press: New York), 1997.
- 69 Stanislas Dehaene. *The Number Sense: how the mind creates mathematics*. (Oxford University Press: Oxford), 1997.
- 70 Michael Posner and Daniel Levitin. "Imaging the Future." In Robert L. Solso.

71 “Learning is as personal as fingerprints - no two people learn exactly alike. Each has a different speed, a different rhythm, a different attention span.” Peter Drucker. *The New Realities*. (Mandarin: London), 1989.

72 Joseph LeDoux. *The Emotional Brain*. (Simon & Schuster: New York), 1996, and Antonio Damasio. *Descartes’ Error: Emotion, Reason and the Human Brain*. (Picador: New York), 1994.

73 For a detailed review of “neural plasticity” refer to M.M. Merzenich, K.A. Grajski, W.M. Jenkins, G.H. Recanzone, and B. Peterson. “Functional cortical plasticity. Cortical network origins of representation changes.” Cold Spring Harbor Symposium on Quantitative Biology 55. 1991; or “Cognitive Neuroscience and Neural Plasticity,” in *The Neuroscience of Mental Health II*. (The National Institutes of Health: Washington), 1995; or Brian Kolb. *Plasticity and Behavior*. (Lawrence Erlbaum Associates: Mahwah, NJ), 1995. For an explanation more accessible to the general public refer to Diamond and Hopson.

74 For a history of the “American Teenager” refer to Grace Palladino. *Teenagers: An American History*. (BasicBooks: New York), 1996.

75 Deborah Yurgelun-Todd. “Physical Changes in Adolescent Brains May Account for Turbulent Teen Years.” Press Release from McLean Hospital. (June 11, 1998).

76 For a review of constructivism refer to J.G. Brooks and M.G. Brooks. *The Case for the Constructivist Classroom*. (ASCD: Alexandria), 1993.

77 For a review of how children develop powerful, yet naive, theories of the how the world works and how their minds work refer to Howard Gardner. *The Unschooled Mind: How children think and how schools should teach*. (BasicBooks: New York), 1991, and Bruer’s *Schools for Thought*.

78 Ian Tattersall.

79 Teaching for “Understanding” is well worked out by Perkins, Gardner, Bruer, and Bereiter and Scardamalia.

80 “Children learn by constructing, elaborating, and modifying representations. Knowledge is constructed by learners, not transmitted by teachers. Learning is active, not passive.” In R.S. Siegler and Klahr, D. “When do children learn? The relationship between existing knowledge and the acquisition of new knowledge.” 1982; also refer to the work of the Institute for Research on Learning in Palo Alto, California.

81 Lev Vygotsky. *Thought and Language*. (Eugenia Haufmann and Gertrude Vakar, Trans.) (MIT Press: Cambridge), 1962.

82 John Abbott.

83 W.J. Rorabaugh.

84 John Bruer. *Schools for Thought*.

85 Quartz and Sejnowski.

86 For a review of the “behaviouristic approach to human activity” refer to B.F. Skinner. *Science and Human Behavior*. (Free Press: New York), 1953; and B.F. Skinner. *About Behaviourism*. (Random House: New York), 1976.

87 Neil Postman. *Technopoly: The Surrender of Culture to Technology*. (Alfred A. Knopf: New York), 1992.

88 Robert Kanigel, *The One Best Way*. (Viking Penguin: New York), 1997.

89 S. Zuboff, *In the Age of the Smart Machine*. (Heinemann: Oxford), 1988.

90 Donald A. Norman. *Things That Make Us Smart*. (A William Patrick Book: Reading, MA), 1993.

91 Adam Smith. *The Wealth of Nations*. (Modern Library: New York), 1994.

- 92 David F. Labaree. *How to Succeed in School Without Really Learning: the credentials race in American education*. (Yale University Press: New Haven), 1997.
- 93 Laurence Steinberg. *Beyond the Classroom*. (Simon & Schuster: New York), 1997.
- 94 Kieran Egan. *The Educated Mind: How cognitive tools shape our understanding*. (The University of Chicago Press: Chicago), 1997.
- 95 Matthew Fox. *The Reinvention of Work*. (HarperSanFrancisco: San Francisco), 1994.
- 96 For a review of why reductionism alone cannot unlock the mysteries of the brain and the mind refer to George Sperling who wrote "I believe there is a profound difference between classical physics and the biological sciences that lies even deeper. I suggest that there is a twofold reason for the complexity of psychology and biology. Darwinian Evolution has provided organisms with complex, interacting, innate mechanisms; and learning makes the current state of complex organism (such as human) an incredibly complex function of its history." George Sperling. "The Goal of Theory in Experimental Psychology," in Robert L. Solso.
- 97 In 1997 Geoff Mulgan of the DEMOS Think Tank in the UK published an excellent work on "Connexity," and the need for a new ethic of interdependence. Refer to Geoff Mulgan. *Connexity: Responsibility, Freedom, Business and Power in the New Century*. (Vintage: London), 1998.
- 98 Speech given to the National Association of Secondary School Principals at Orlando, Florida, in March of 1991.
- 99 As Stated by the President's Committee of Advisors on Science and Technology "However compelling we may believe the argument in favor of constructivist practice to be, and however plausible we may find its theoretical underpinnings to be, the proposition that constructivist techniques, as currently understood, will in fact result in more favorable educational outcomes must still be regarded as largely (though not entirely) a collection of exciting and promising hypothesis that have yet to be rigorously confirmed through extensive, long-term, large scale, carefully controlled experimentation involving representative student populations within actual schools...the panel...believes there to be a high "likelihood" that many, or all of the essential elements of this approach could play a major role in improving the quality of our nations elementary and secondary schools...While some benefits may be obtained by using information technologies to pursue existing curricular objectives...the richest harvest is likely to accrue from a fundamental restructuring - at least at the level of the individual course, and ideally, across disciplinary boundaries as well." *Report to the President on the Use of Technology to Strengthen K-12 Education in the United States*. (Office of the President: Washington), 1997.
- 100 Don Tapscott. *Growing Up Digital: The Rise of the Net Generation*. (McGraw-Hill: New York), 1998.
- 101 In the largest study of its kind in the US the Educational Testing Service confirmed that "computers can be an important learning tool, but only in certain circumstances and when teachers are well-skilled in their use." Jay Mathews. "Study Faults Computers' Use in Math Education: Repetitive drills, lower scores linked." [The Washington Post](#). (September 30, 1998).
- 102 Seymour Papert. *The Connected Family: Bridging the Digital Generation Gap*. (Longstreet Press: Atlanta), 1996.
- 103 Laurence Steinberg.
- 104 Margaret Mead. *Coming of Age in Samoa: a psychological study of primitive youth for Western Civilization*. (William & Morrow Co.: New York), 1988.
- 105 Mihaly Csikszentmihaly and R. Larson. *Being Adolescent: Conflict and Growth in the Teenage Years*. (BasicBooks: New York), 1984.
- 106 Patricia Hersch. *A Tribe Apart: A Journey into the Heart of American Adolescence*. (Fawcett Columbine: New York), 1998.
- 107 Susan Allport. *A Natural History of Parenting*. (Harmony Books: New York), 1997.
- 108 Jane Goodall. "The Whole Child Initiative." The State of the World Forum, 1997.

109 Look where most parents are when their children are at their most impressionable. A professor of psychology in America recently illustrated the problem of ‘latchkey kids’ by way of an analogy. “Let’s assume you had some other industry,” he says. “The Industry made shoes and then you took a large chunk of the labor force out, something like 40 percent, and you changed nothing much else - you wanted to make the same amount of shoes of the same quality with the same technology. Everybody in the world would think you have lost your mind. Well, that’s basically what we did to parenting.” Karl Zinsmeister. “Why Encouraging Daycare is Unwise.” *The American Enterprise*. (May/June), 1998.

110 The late historian Christopher Lasch noted, “the more time parents spend working outside the home, the weaker the family, already in critical condition, will get...Radical restructuring of the workplace is needed to let parents raise their own children, instead of turning them over to the care of others. Caring for their own children, after all, is what most parents would like to do.” In A Survey of Recent Articles. “The Battle of Child Care.” *The Wilson Quarterly*. (Autumn 1998).

111 All societies able to think in the long-term have to be concerned with this tough principle. Elders feared if youth could not accept responsibility, for they became an ongoing cost to the community. It is interesting and sober to note that amongst the Navajo Indians the first animal they sought to kill in the Spring was any unweaned yearling of the previous season. Unweaned within the normal period of development such young creatures would have been a continuous threat to the mother’s ability to wean the newborn and, and while this is so far unproven, might lessen subsequent fawns willingness to become independent of their mothers.(Allport) In the interest of keeping the herds around them healthy, the Indians planned such culls in their own self-interest.

A civilised human society is marked by its determination to support its weak, but this can never be at the cost of not expecting from the healthy an acknowledgement of their responsibility to be properly inducted into adulthood. A society has to be strong and healthy, if it is also to be humane and caring. Weaning was not simply tough on the young learners, it was tough on the adults. If they failed to successfully induct their own young into productive adult life the implications for their old age were dire. They would simply perish when they could no longer earn their own livelihood. Weaning was an integral part of a balanced form of life.

112 John Abbott.

113 Judith Judd and Wendy Berliner. “Class size - does it really matter?” *The Independent*. (16 February 1995).

114 Eric Forth. Education Minister to the House of Commons, 1994. From *The Independent*. (16 February 1995).

115 Kenneth Clarke. Education Secretary, 1992. *The Independent*. (16 February 1995).

116 *The Independent*. (16 February 1995).

117 *The Independent*. (16 February 1995).

118 *The Independent*. (16 February 1995).

119 The American Federation of Teachers recently shared “**The Tennessee STAR study follow-ups (1990-1997)**. In what many consider to be the “gold standard” of class-size studies because of its large scope and rigorous design, researchers (Word et al., 1990) found that Tennessee K-3 students in small classes significantly outperformed students in larger classes in both mathematics and reading every year, at all grade levels, across all geographic areas...A study conducted last year by Princeton University economist Alan Krueger validated the original STAR findings.” From <<http://www.aft.org>>

120 “The method people naturally employ to acquire knowledge is largely unsupported by traditional classroom practice. The human mind is better equipped to gather information about the world by operating within it than by reading about it, hearing lectures on it, or studying abstract models of it.” Schank and Cleave, “Natural Learning, Natural Teaching: Changing human memory,” as published in *The Mind, The Brain and Complex Adaptive Systems*. The Santa Fe Institute for Studies in the Science of Complexity, 1995.

121 John Bruer. *Schools for Thought*.

122 David Perkins. *Smart Schools*.

123 Refer to The White House Conference on Early Childhood Development and Learning: What new research on the brain tells us about our youngest children on the web at <http://www.ed.gov/offices/OERI/ECI/ses2-all.html>

124 President Clinton sees daycare as not only beneficial for working parents, but also as a mechanism for getting welfare recipients into work. He argued “Because states are getting money for welfare reform based on the peak caseload in welfare in 1994, and we’ve reduced the welfare rolls by 2.8 million since then, most states, for a period of time...will have some extra funds that they can put into more child care. This gives states the opportunity they have never had before to train more child care workers, to use funds to help even more people move from welfare to work and perhaps even to provide more discounts to low-income workers to make child care affordable for them. This welfare reform effort, if focused on child care, can train lots of people on welfare to be accredited child care workers and expand the availability of welfare in most states of the country.” Ibid.

125 Dr. Donald Cohen of Yale University at The White House Conference on Early Childhood Development and Learning: What new research on the brain tells us about our youngest children. (April 17, 1997).

126 John Bowlby. *A Secure Base: Parent and Child Attachment and Healthy Human Development*. (Basic Books: New York), 1990.

127 “Contrary to persistent concerns, young children, including babies, can thrive in child care when it is of good enough quality. Now the key to quality lies with the care giver. Good care giving looks like the good mothering and fathering that you’ve been hearing about on this panel. Children show significantly better cognitive and language and social and emotional development when they are cared for by adults who engage with them in frequent affectionate responsive interactions, who are attentive and know how to read the baby’s signals and the baby’s temperament and know when to turn up the volume on an interaction because the baby wants more and when to turn down the volume because the baby is absorbed in something of their own or is tired and needs to take a nap.” Comments are of Dr. Deborah Phillips, Institute of Medicine, Washington DC. The White House Conference on Early Childhood Development and Learning. (April 17, 1997).

128 Psychiatrist Stanley Greenspan as quoted by Zinsmeister in “Why Encouraging Daycare is Unwise.” The American Enterprise. (May/June), 1998.

129 A recent study in the United States showed the cost of Tertiary Education had risen 50 percent in constant dollars between 1987 and 1997 while the median family income rose 1.5 percent. “Educators say the cost of higher education has been skyrocketing for a variety of reasons. All schools are personnel-driven, with many institutions spending between 80 and 85 percent of their budget on salaries and benefits.” Valerie Strauss. “College Tuition Continues to Rise.” The Washington Post. (October 8, 1998).

130 This information was shared with the Initiative by Professor Robert Sylwester at the November 1995 Initiative Conference.

131 President Clinton’s Committee of Advisors on Science and Technology observed that “as a result of current budgetary pressures along with a persistent historical pattern of significant inflation-adjusted increases in educational expenditure, economic considerations have in fact assumed a position of central importance in ongoing deliberations surrounding the topic of educational reform.” In *Report to the President on the Use of Technology to Strengthen K-12 Education in the United States*. (Office of the President: Washington), 1997.