

CONSTRUCTING KNOWLEDGE AND SHAPING BRAINS



By John Abbott
and Terence Ryan

Like many liberal studies teachers, I was slow in coming to terms with the use of the computer. It was not so for my then nine-year-old son Peter who, from the moment we bought him a computer to use at home, quickly learnt to manage an ever-increasing range of sophisticated programmes. He either taught himself, or learnt to solve problems through working these out with his friends. At an early stage teachers asked for his help as more computers were put into his school.

A common enough story, repeated time and time again; young people, as young as nine or ten, learn an immense amount when deeply engaged in tasks that fascinate them.

A year or so later my second son, David, three years younger than Peter, decided that he too wanted to use the computer. To start with Peter was immensely patient as a teacher, and David learnt fast. But then I noticed something curious. Peter sensed that David was coming to rely too much on him to explain new processes, rather than using what he already knew to find the answer for himself. One evening Peter's frustration erupted, "Dad, David is just being lazy; by asking me to tell him what to do he will never learn to solve problems for himself. That's the only reason why I know what to do - because I had to work it out for myself. If David doesn't

learn to work it out like that, then he'll never really learn!"

That sage observation came from an eleven-year-old - a boy who had never even heard of constructivism, but who understood exactly that by bringing all his previous experience to bear on a new problem he could construct his own novel solutions. As a boy Peter learnt to listen intently to everything that he heard, and noted everything that he saw because he realised at a deep and profound level that it was he, and he alone, who could direct his own learning.

An interesting anecdote, which bears out the truth shown in recent long-term research studies, that four out of the five greatest predictors of eventual success at University are applied and achieved before a child even enters school; namely the quantity and quality of discussion in the child's home, the clarity of value systems, strong peer group support, and the amount of independent reading.¹

Inquisitiveness is what drives children's learning, and constructivism is the theory that Cognitive Scientists have devised to explain how a child progresses from inquisitiveness to new knowledge. Just how does this work?

In searching for answers researchers in the 1990s uncovered a massive amount of interrelated evidence in the brain sciences, the biological sciences, and even archaeology and anthropology

which are starting to show in considerable detail how it is that humans actually learn. We now can see why learning is much more than just the flip-side of good teaching and schooling. Rather than thinking of the brain as a computer it is now seen as a far more flexible, self-adjusting, biological analogy - the brain as a living, unique, ever-changing organism that grows and reshapes itself in response to challenge, with elements that wither through lack of use.

As scientists study the processes of learning they are realising that a constructivist model of learning reflects their best understanding of the brain's natural way of making sense of the world.² Constructivism holds that learning is essentially active. A person learning something new brings to that experience all of their previous knowledge and present mental patterns. Each new fact or experience is assimilated into a living web of understanding that already exists in that person's mind. As a result, learning is neither passive nor simply objective. Constructivist learning is an intensely subjective, personal process and structure that each person constantly and actively modifies in light of new experiences. Constructivists argue that, by definition, a person who is truly passive is incapable of learning. With a constructivist form of learning, each child structures his or her own knowledge of the world

into a unique pattern, connecting each new fact, experience, or understanding in a subjective way that binds the child into rational and meaningful relationships to the wider world.³

Such a view of learning contrasts harshly with the perceived wisdom of many educationalists. A European Professor of Education recently commented, "Those involved in school management draw a sharp boundary between the areas of education which are so-called professional areas, and therefore reserved for professions (i.e. teachers), and those in which other members of the community (e.g. parents or retired people) can legitimately be involved. While many schools encourage the involvement of members of the community for certain activities, those activities are clearly separated from the 'professional' work of teachers. It is very difficult and indeed might well be foolhardy to try and blur this distinction."⁴

Note the assumptions here. In the light of recent research on how children learn, this distinction is now desperately, dangerously, outdated. As the neuroscientists Chang and Greenough at the University of Illinois noted in 1978 there are two sets of neurons that enable us to learn - one set, they suggested, captures general information from the immediate environment while the other constantly searches through an individual's earlier experience as it seeks meaning. Very recent research at the Salk Institute has suggested that this is a false dichotomy. Rather than representing two distinct strategies within the brain these are two separate parts of the same process.⁵

Constructivist learning is the dynamic interaction between the environment and the individual brain.

In a constructivist model of learning nature and nurture don't compete, rather they work together. It is clear from the biological sciences that humans are who-we-are in large part because of our species' evolutionary experience

over millions of years. The vast developmental experience of our species has provided each new generation with a powerful toolkit of predispositions that go a long way in explaining our ability to learn language, cooperate successfully in groups, think across problems, plan for the future, and empathise with others. Predispositions, both in young children and adolescents, provide individuals with a whole range of skills that enable them to relate flexibly to their environment. Yet, because for most of human history people tended to live in relatively small groups, these skills have to be developed collaboratively as very few individuals ever possess all these attributes. The speed with which our inherited predispositions evolve seems to be incredibly slow, and it is thought there have been no major changes in brain structure during the last 30,000 years.

By melding neurological discoveries in an evolutionary framework it's possible to see how, within a single generation, the influences of millions of years of human development mingle with the priorities of a particular culture. As was stated graphically in the Harvard Business Review in late 1998 "you can take man out of the Stone Age, but you can't take the Stone Age out of man."⁶ We are enormously empowered by an array of evolved predispositions which enable us to adapt to vastly different sorts of circumstances, yet these predispositions inhibit us as well.

As we learn more about the brain and how it naturally learns it is essential to devise learning environments that go with the grain of the brain. That "grain" we are now in a far better position to understand. The relationship between nature and nurture is well summarised by the English Professor of psychobiology Henry Plotkin who wrote, "nature has itself evolved. Nurture can only be fully understood in light of historical causes. Nature has nurture."⁷ This goes a long way towards explaining just why humans learn the way they do. The balance between emotion and logic, the role of intuition, and the relationship

between intrinsic and extrinsic motivation are all part of the "complex adaptive system" that best describes the brain's ability to deal with the messiness of ordinary everyday life situations. Constructivist learning, by drawing on the full range of a learner's experience, strengthens the individual's ability both to find novel connections, and to harness peripheral perception.⁸ Rather than a focus on intense, encyclopaedic recall, constructivist learning leads to deep understanding, sense-making, and the potential for creativity and enterprise.⁹

This is where it all becomes fascinating, and essentially hopeful. Research from the biological sciences shows the innate nature of these collaborative higher order skills and attitudes, and how with appropriate stimulation at an early age (as would have been the case in pre-Industrial times) they quickly develop in youngsters. Today, children are born with latent predispositions, equipping them to function successfully as part of a community. However, during much of this century formal schooling has struggled, absent the support of the larger community, to provide appropriate simulation of real life situations. It has met, inevitably, with only limited success. The reason for this from a constructivist perspective is all too obvious. Such limited learning environments only stretch part of young people's intellectual and social predispositions. For all those who have been able to succeed in the decontextualised setting of the school, there are so many for whom schooling has made very little impact. These children are the ones who often feel school, and indeed society, has no place for them.

Which inevitably means that we have now to ask deeper questions about the very institutions of schooling than have so far been raised in the school reform movement with its short-term panaceas of more accountability, site-based management, standardised tests, prescribed curricula, and longer hours for teachers and students. We have to

be much smarter than this and accept that we are dealing with a deep systemic crisis. Constructivism collides head on with so many of our institutional arrangements for learning.

It is a cruel twist of history that systems which were set up with the noblest of intentions can, over the course of time and changing circumstances, create the next generation of problems. Isn't this what educators are now having to grapple with? Isn't it because we have for so long misunderstood the nature of early years learning that we now have such difficulty in secondary education with bored and disillusioned adolescents? Doesn't this explain why the conventional reaction of teachers to such criticisms has been to take on still more responsibilities, and to accept onto their own shoulders matters which are surely more appropriately undertaken by parents and community?

Are we not stuck with an education system that has progressively turned childhood into an ever more extended virtual holiday, and shut the classroom door on the world of adult affairs and social responsibility? Given neurology's emerging understanding of adolescence this would suggest that we are trivialising their energy and idealism at the very stage when they need support and encouragement to learn to mediate and direct their energies and emotion. The truth is, you can't bring children up to be intelligent in a world that does not seem intelligible to them.

It is only very recently, however, that it has become possible to put all the pieces of this argument together. Such learning theory that dominated education in the late 19th and early 20th centuries was generally behaviourist - people expected rewards to do tasks; our brains were blank sheets awaiting instruction; and intelligence was dimly thought of as being innate and largely inherited. So, as rapidly industrialising nations created education systems for the masses (initially as much to keep children

off the streets as to give them useful skills), so these rapidly came to reflect the industrial factory model. When universities were asked to advise on the curriculum they did so by suggesting a highly reductionist model of learning. To such early educational experts the study of learning was a strictly academic affair. They measured what happened in classrooms when people performed abstract tasks, but they hardly ever deigned to study the calculating ability of an apprentice such as Benjamin Franklin working on the job, or a street trader on the Whitechapel Road in the East End of London.

It is true that this late 19th century compromise between the scientific understandings of the day, the needs of industry, and the desire to give all children basic skills increased productivity and lifted standards of living most significantly. But this came at a cost. Deep down many children became deeply frustrated, with so much of their latent predispositions just untapped by the daily routine of instruction. The daily challenge of making sense of their environment has been replaced by a dull recognition of waiting to be told what to do and how to do it.

Everything that we understand about our intellectual development suggests that below the age of seven or eight, particularly below the age of three, we are heavily dependent on external encouragement and stimulation to develop the brain in ways in which survival skills (the ability to collaborate and see across issues) develop. If such skills are not stimulated at an early stage then learning them later on is simply far more difficult. In late twentieth century terms the functional skills of reading, writing and numeracy also fit into the category of survival skills. At an early stage of life every youngster needs to make great demands on adults if he or she is to master these basic survival skills. While adults may be ambivalent about their roles as parents and caregivers, to a child good parenting is utterly essential if their mental

facilities and social skills are to develop.

The natural tendency of young people when they move into puberty is to reverse their dependency on adults. They want to be in control; not because they want to be bloody minded, but because all the hormonal changes going on within are pressing them to show that they can now use what they learnt earlier to become fully functional independent people. If they are not equipped with the basic survival skills described earlier, then adolescents are desperately ill-prepared to deal with the physiological changes of adolescence and end up mentally, emotionally and socially adrift.

Now, consider the current model of schooling. In elementary schools in very many countries the largest classes are when children are very young; thus, when predispositions are at their most fertile we have children in classes of 30 or more. In secondary school we have ever-decreasing class sizes which clash with the adolescent's increasing wish to be independent at about the age of 14 or 15. Many adolescents, for the most natural reasons, get completely turned off by schooling at this stage because it simply does not seem real in comparison to the emotionally charged environments they experience away from school with their peers.

The argument we are advancing shows that for the brain's predisposition towards a form of learning described as constructivist to thrive, it is essential that all aspects of a child's learning environment be considered. We repeat, constructivism is open-ended, as is the neural structure of the brain. Outcome based education, national curriculum targets, for all their achievements, are essentially specific and do not support the genuinely creative or the entrepreneurial. An ever-increasing pace of change has made the ability to learn far more important than any particular skill set.

It is the territory between the schools and the community where the difficulty for so many

policymakers and the general public lie. Yet increasing numbers of people are starting to recognise that for a more dynamic form of learning like constructivism to succeed it will require strong partnerships among all those who make up the environment in which children learn and grow. This "middle ground", incorporating the home, school, and community, sometimes facilitated by new technologies, is still not well defined or fully understood by professional educators or by community leaders.

There is an irony in all this. It is this. Those people most actively challenging the protected and isolated nature of current educational arrangements are those who are often the greatest proponents of outcome based education. Those who most strongly support the concept of constructivism are those with unlimited faith in public education and often are least prepared to recognise the need for major institutional change.

This article is a call for an organised middle way. To repeat - constructivism is not only an open-ended form of learning it is essentially about reality, connectivity and the search for purpose. There is growing evidence that a constructivist form of learning

Whilst the anecdote that starts this article relates specifically to John Abbott's experience, the argument as set out is the joint production of he and Terence Ryan in interpreting the ideas from the Initiative. The authors would like to give special thanks to M. Layne Kalbfleisch, M.Ed., research intern at the Initiative, for her assistance in developing the discussion on the neurobiological basis of constructivism.

matches the brain's natural learning patterns. Constructivist learning dictates that learning arrangements must move beyond what occurs just in a classroom - it requires a whole new understanding of a learning

community..... and that involves everyone, not just teachers. Constructivism, as set out here, provides the debating points for those involved in education reform and those responsible for the revitalisation of communities.

The ideas outlined above are further developed in John Abbott's book "The Child is Father of the Man: How Humans Learn and Why". Copies of the book are available through the UK Initiative office.

For more information and resources please refer to the Initiative's web site at <http://www.21learn.org>

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Endnotes:

¹ John Abbott and Terence Ryan. "Learning to Go with the Grain of the Brain." Education Canada (Spring 1999. Vol. 39, No. 1), p.8.

² David Feldman of Tufts has observed, "The selection of novelties over evolutionary time occurs at every point along the continuum from unique to universal; in the few most successful instances, the novelty (and its attendant domain) travels the entire route. In the process, there is a shift from deliberate, systematic instruction to transmit the body of knowledge to a spontaneous (most likely biologically supported) predisposition in the individual to construct the knowledge from his or her everyday experiences in the environment... This incorporation process does not have to be a conscious one in the same way that biological selection is neither conscious nor deliberate." David Feldman. *Beyond Universals in Cognitive Development*. (Norwood, NJ: Ablex Publishing Corp), 1994, p.54.

³ This comes largely from Kenneth G. Wilson and Bennett Daviss. *Redesigning Education*. (New York: Henry Holt and Company), 1994, p.176.

⁴ Quote comes from a critique sent to the offices of the 21st Century Learning Initiative.

⁵ Cognitive Development: A Constructivist Manifesto." Behavioural and Brain Sciences (Issue 20), 1997, p.19.

⁶ Nigel Nicholson. "How Hardwired is Human Behaviour?" Harvard Business Review. (July-August 1998), p.135.

⁷ Henry Plotkin. *Evolution in Mind*. (London: Allen Lane), 1997, p.19.

⁸ Jerome Bruner. *On Knowing: Essays for the Left Hand*. (New York: Belknap Press), 1974, p.63.

⁹ Kalbtleisch, M.I.. The Neural Underpinnings of Consilience. In L.Rogers (Ed.) *Semiotics and Third Space: A Cross-Disciplinary Exploration*. Kent, OH: Kent State University Press, 1999.