The Ring

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Letter from Whitehall

Labour's Schools Bill abolishes the keystone national numeracy and literacy strategies. It gives computer technology a core place in the primary curriculum alongside English, maths and personal skills. **Ian Benson** asks whether this will this mean even more teaching time spent chasing viruses, or a renewal of the pure mathematicians' drive for elementary school conceptual maths?

It is five years since Sociality, a Hall of Fame software company, was approached by Charles Clarke (K 1969), Secretary of State for Education, and asked for help to get better value from the Government's investment in information and communication technology (ICT) in schools. Sociality was approached on the strength of goodwill generated by our work since 1999 on design, analysis and implementation of open systems for co-production of public services.

Our advice to the Secretary of State was threefold:

- The Government could not expect the return on investment that the universities deliver in ICT if local authorities continued with the practice of locking down computers so that they are not programmable by teachers or pupils.
- If the conceptually impoverished unfolding of arithmetic concepts mandated by national strategy were to be left unchanged, software would reduce teachers and children to machine minders.
- If he really wanted to use technology productively then he would need to precipitate a conversation among teachers, parents and pupils about the content of primary education — starting with mathematics.

Our suggested next steps ("Phase 1 terms of reference") were accepted by the DfES Innovation Unit, and we began work in the academic year 2004–5 with a cluster of schools in North West Leicestershire. This had been the site of a failed attempt at maths reform in the 1960s. Our proposal was to re-evaluate that attempt and determine how conceptual mathematics and open ICT might enhance the effectiveness of the rejected curriculum of two leading educators, Georges Cuisenaire and Dr Caleb Gattegno.

Gattegno had been the prime mover of a Commission of distinguished pure mathematicians who he assembled after WWII to meet the needs of the post-war elementary and secondary modern schools. He brought together: Evert Beth, the inventor of the semantic tableau used in formal reasoning; Jean Dieudonné, prominent in the Nicolas Bourbaki group that reformed university mathematics after WWI; and Gustave Choquet, whose work on capacities and integral representations found many applications in analysis and probability. Choquet's "What is Modern Mathematics" became their manifesto for a forceful challenge to the dominant ideology of the eugenicists who had shaped the architecture of the Butler Act.

The historic development of culture, if it has something to bring to our understanding of the present moment, can be entirely foreign to what a mind stimulated in a new way can or could do, unforeseen in the former experience of the group.

These architects, notably the alleged statistical fraudster Sir Cyril Burt, and his collaborator Jean Piaget, argued from a preconceived idea that there are defined stages in the evolution of thought. In Burt's case not only the stages, but also the ultimate level of cognitive capability, were genetic. Gattegno's Commission believed that this was completely erroneous as a vision of what intellectual activity is, in an individual suitably stimulated by his environment. Gattegno wrote that "the historic development of culture, if it has something to bring to our understanding of the present moment, can be entirely foreign to what a mind stimulated in a new way can or could do, unforeseen in the former experience of the group. Too rigid a determinism, coupled with a slightly sentimental historicism, risk making us ignore whole continents potentially present in the mental universe."

Gattegno developed just such an open approach in a series of seven textbooks for children. He used colour-coded rods to help pupils of primary age to learn the four basic operations with algebra before arithmetic. A roll-out to hundreds of Canadian schools showed that it took pupils half the time to master what was expected of them in their six years of primary mathematics. The approach was rapidly

taken up in Scotland and England, only to falter in Leicestershire after a three-way, ill-prepared and small trial. By the mid-sixties a small cabal of educational psychologists, wedded to Piaget, had succeeded in winning back control of "maths education", aided by Piaget/Burt's dogma of statistical assessment which they entrenched as national standards in the US and UK.

In the Cuisenaire-Gattegno approach children learn to speak and write mathematics as a language, and to recognise mathematical activity as the unfolding of concepts that they approach from four distinct perspectives: Actions (using sets of fingers and coloured rods), Behaviour (using imagery generated by these actions), Speaking (using language to describe the images) and Writing (using symbols and notation). By teaching all four operations and fractions together from Year 1, Gattegno's curriculum anticipated object-oriented techniques that minimise complexity and logical dependence in systems.

Norman Jones, head teacher at the Phase 1 alpha site, said:

> "The study involved 73 Year 1 children in four schools. 47 children followed the National Numeracy Framework (NNF); 26 (the 'Nygaard cohort') augmented NNF with Cuisenaire-Gattegno materials. The 26 children were the younger and least able third of the group. We looked to achieve the 15% 'step change' demanded in the 2006 KS2 targets. We found that after one term these children had advanced by one or two quartiles compared to their peers. This gives us hope that the step change can be achieved."

Encouraged by this trial the DTI commissioned Sociality as project managers for a second phase of work which we called the Tizard project. We were asked to create software tools, algebraFirst™, to scale up our proof of concept. We extended Gattegno's approach to analyse the conceptual unfolding of the National Numeracy Strategy/Framework (NNF). We were able to demonstrate and plug systemic gaps in the NNF with algebraFirst™ material. The result was a successful proof of concept and a step change in the understanding of teachers and children.

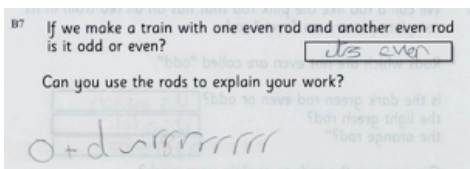
Bricks World™ teaches children to think like mathematicians. Teachers record and encapsulate learning episodes that consist of children's actions, behaviours, spoken and written work. Children learn to recognise that they are working at the same time at four different levels. These are: the activity of putting coloured bricks end to end to form a "train"; the recognition that there are many ways to choose a pair of colours to combine; the simultaneous perception of the train and its component bricks; and the awareness that the written sum is both inherent in the train and distinct from it.

By combining coloured rods with guided free play and written exercises we are able to use ICT to prototype tools for the professional development of adults who work in the classroom: teachers, assistants and parents. We built an open source Web portal, Guildhall™, which is now subsumed into Apple's OS X Server wiki service. The wiki functions as an information system and repository for pupils' work, within a security envelope that gives the individual ownership and control over its publication.

In 2005, in an informal review of Sociality's work, Dick Tizard, outreach pioneer and sometime Senior Tutor of Churchill College, challenged us to recruit 30 primary schools in all. We are now well on the way to that goal, aided by a worldwide network of developers and teachers who have contacted us since Tizard was given its permanent West Coast home at Stanford University Computer Science Department (http://tizard.stanford.edu).

Tizard's programme is now entering its final year. We have tracked and supported over 250 pupils in ten English schools. Our alpha schools have proven and tested over 200 hours of professional development materials that range from Reception to Year 6.

This final year of the project we are piloting a text book with teachers and parents that uses conceptual mathematics to explain how pupils develop their mathematical awareness in Gattegno's approach. Together with schools in France, US and UK we are using his text books to help teachers learn conceptual mathematics.



The illustration shows how one Year 3 girl, aged 8, was able to use equivalence to explain her reasoning in answer to a question about the parity of the sum of two even parities.

With five years of data and experience under its belt, Sociality is well placed to take advantage of the freedoms that schools will gain under the Improving Schools and Safeguarding Children Act to buy support for school clusters and curriculum reform.

Sociality software and services will be ready to meet that challenge and roll back the virus of "counting first".

Ian Benson graduated with a PhD from King's College in 1992.

Find out more about Sociality at www.sociality.com