Whose fingers on the button?

Digital technology will shape learning in the future, and as many children are already computer virtuosos, they will have the power to influence the direction of their own education, says Seymour Papert

- Seymour Papert

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An advertisement for Research Machines, the major British supplier of computers for education, presumably written to reassure educators, promises that teachers will not have to change the way they teach and students will not have to change what they learn. This image of powerful technologies in otherwise unchanged schools suggests modifying a parable I made up some years ago.

A researcher in 1800, seeking to use technology to improve transport, invented a jet engine which he attached to a stage coach to enhance the power of the horses. In my original version, the failure of the experiment - the engine shook the carriage to pieces - led the researcher to conclude that jet engines had nothing to offer transport. But a different ending brings the parable closer to what is happening in classrooms: the researcher reduced the power of his engine to a level where it did no harm and devised delicate tests to demonstrate a small increase in speed.

The parable is meant to provoke us to imagine digital technologies powering forms of learning as far from the classroom of today as the 747 is from the stagecoach. Could learning outcomes change as dramatically as the speed of travel?

Consider this scenario: in a summer workshop, children aged seven to 14 are building with extended Lego sets including motors, sensors (gadgets sensitive to light, touch and heat) and, most interestingly, a special computer small enough to be placed inside the model. Some are building vehicles inspired by the Mars Ranger. Several children are working together to make musical instruments that can be controlled by moving a slider or waving a baton. Two are collaborating on constructing an environment- monitoring station, to be left overnight in the woods to gather and analyse information.

These children are engaged in something that traditional school seldom offers: serious projects that involve working on hard technical problems for many hours a day, every day for several weeks. In the course of doing so, they come into contact with a wide range of technical, scientific and mathematical knowledge, some of which may be in the usual school curriculum, some not. All come out at the end having learnt a great deal more about these subjects than anyone learns in a much longer time in a classroom. In addition, they have had some tough experience learning what it is like to manage a complex project.

The scenario fits the ideal of learning that has been advocated for more than a century by proponents of "open", "progressive", "child-centred" education. But the scenario is radically different in several ways from the forms of progressive education that have been tested in schools and often found wanting.

Indeed, I would argue that anything that could be implemented in a school context without extensive use of digital technologies could not be fully true to the progressive ideal that children should be able to acquire knowledge by using it in activities in which they have a personal interest.

The test is in the learning of subjects such as mathematics and physics. Take an example from my scenario. Children building computerised musical instruments are energised by their love of music to explore more sophisticated concepts from mathematics, physics and programming than anyone would dare to put into an elementary curriculum, and their mastery of the concepts is guided by their understanding of musical principles.

I cannot say categorically that this could not happen outside the context of digital technologies. But I can say that it is enormously less likely that average children would find their way to doing anything of the sort without the help of an extraordinarily talented and knowledgeable adult.

The contribution of the technology to learning environments like my scenario workshop is inextricably tangled with social aspects. The mixture of ages is in sharp contrast to the age segregation typically practised in schools.

This is not just an accident. Curriculum-driven teaching is essentially an assembly line process, and the orderly succession of first year, second year, third year - and first period, second period, third period ... and mathematics, grammar, science - serve the same function as the orderly progression of the car being put together as the line moves through successive workstations.

But in the workshop something very different is required - to allow a child access to an idea when it is needed for a real purpose, rather than learning it because it is the 17th day of the fourth year at school.

In this context, the presence in one learning community of people of different ages and different prior experience contributes to the chance that someone there will be able to help when a problem comes up.

Of course, mutual help is possible without digital technology. But it is made far easier by many factors, of which I can mention here only two.

First, it is well-established that many more children reach virtuoso levels of mastery in working computers than in other technical areas. Second, one of the forms of computer mastery in the modern world is being able to find information in cyberspace.

Both of these factors contribute to the likelihood that a community of children working together can become what my student Michele Evard calls a virtual expert - collectively they are able to serve at least many of the functions of having a real expert on call.

This image of mutual help illustrates the growth of child power in education: power as teacher, power as expert, and, above all, power as an independent intellectual agent.

One of the many ways in which children are becoming more independent is brought out by noting another way in which the activities in my scenario are different from typical school work: although children will do better than usual if they have good guidance, they can and will engage in, and become good at, such activities voluntarily on their own time if they get a chance. And the number who do get the chance grows daily as home computers, products such as computer-controlled construction sets, and access to the internet become more common.

From this follows a political aspect of child power as a factor in the interplay of change and resistance to change in education. For if the computer industry, the education establishment and the politicians have a common vested interest in keeping school as it is, children do not. And if just 10 per cent of children came to school with the experience of far

richer learning outside, and with the expertise to show the school how to do it better, the pressure for change would quickly become irresistible.

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Professor Papert gives the 1998 Cherry Memorial Lecture at Imperial College, London, on 2 June, `Child Power: Key to the New Learning of the Digital Century'. Details: cherryinfo@ic.ac.uk

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