

## Chapter 5

### Raising expectations - rethinking 'intelligence'

*The intelligence of an individual is not a fixed quantity, a quantity that one cannot augment... We must protest and react against this brutal pessimism.* (Alfred Binet, 1913, inventor of the first 'intelligence test').

*Our pupils are first generation academics.* (Jim Bleakley, headteacher)

In times of change, the capacity to deal with new situations and solve new problems can be more important than the acquisition of large amounts of knowledge. This capacity, which we variously call intelligence, ability or creativity, is central to the concept of educational improvement.

At the same time, a tacit belief that intelligence is fixed for life underlies so many of the actions of teachers and of the way schools are organised. It is too easy to speak blandly of 'high ability' and 'low ability' children, often based on limited evidence and with a fair dose of cultural prejudice. Too many teachers still speak as if lower intelligence were a normal attribute of working-class children. Specific barriers to learning have often been confused with a general lack of 'intelligence': children placed in lower ability groups because their mother tongue is not English, and those in wheelchairs sent to special schools with a restricted curriculum.

The relevance of concepts of intelligence to the raising of expectations is demonstrated by Carol Dweck's research into the different responses of people who believe their intelligence is fixed from those who believe that it develops. The former tend to become defeatist when they fail at a task, believing that it has exposed their innate stupidity. They reject opportunities to learn by avoiding taking risks, for fear of what the outcome might reveal about their intelligence, whereas people who hold a developmental theory accept challenges more readily. People who believe

in fixed intelligence often believe that truly intelligent people don't need to make a great effort (Dweck 2002).

Many common beliefs about intelligence are rooted in an early 20<sup>th</sup> Century psychology which was strongly influenced by the conditions and prejudices of the age. Recent research has made available more dynamic and hopeful models of intelligence which school improvement needs to debate and deploy.

The purpose of this chapter is

- to engage in what Foucault called 'archaeology of knowledge', by looking at the circumstances in which contemporary beliefs about ability developed – including a significant variation on the theme, the concept of language deficit
- to explore recent theories such as multiple and distributed intelligence
- to identify the significance of different assumptions and theories for school improvement.

### **Class, racism and IQ: a short history**

Before the Twentieth Century, little emphasis was placed on the concept of intelligence as we now use the term. When Victorian writers used the term intellectual ability, for example, they seem to have had a more contextual view, referring to an ability to pursue particular activities within an assumed cultural environment. The relationship of ability to class was both explicit and direct; for most Victorian policy makers, it was simply unthinkable and intolerable to educate working-class children 'above their station in life'.

Different views of ability are generated in particular historical circumstances. There were cultural variants in Britain; within a Calvinist tradition of universal literacy, many teachers in rural Scotland assumed that poor spelling must be the result of a moral failing - idleness - to be cured by a good beating. In Pacific Rim countries, the prevalent notion appears to be that all children can learn the same things provided they work long enough at it – a theory which is not without benefits.

Changes occurred in early 20<sup>th</sup> Century Britain for a combination of cultural and political reasons:

a) Culturally, the eugenics movement was strong, and with it a common concern, shared even by progressive thinkers such as Wells, Shaw and the Webbs, that the quality of the British 'race' could decline if the poor (or worse still, the 'feeble minded') were allowed to breed so much. This

had its roots in the transfer of Darwinist evolutionary theory to the human arena, within a hierarchical and imperialist society, and was to have murderous effects when it transferred to German fascist ideology. Since few tools were available to measure intelligence, phrenologists in the late Victorian period measured the size and shape of the skull to estimate its physical capacity to hold knowledge, while others simply assumed that upper-class people were born with more intelligence. (See Chitty 2001 and Carey 1992)

b) Politically, this period saw the rise of the Labour Movement, including a massive increase in trade union membership and the foundation of the Labour Party. Internationally, organised labour proved strong enough to stop war by revolution in Russia, Germany and elsewhere, and even in Britain the government was threatened by the anti-war and industrial revolt spreading from 'Red Clydeside'. It became too risky for governments to speak in patronising Victorian terms of educating boys and girls 'for their station in life' or of the general intellectual inferiority of the 'lower orders'. When employers' representatives were asked by the Consultative Committee on Higher Elementary Schools (1906) 'What is the kind of product most to be desired?', they answered bluntly 'To make them efficient members of the class to which they belong'. This is probably the last time, in a public document on education, that such crude class language appears.

Faced with such increasing radical activity, the language of class arrogance was hardly appropriate. It was becoming no longer possible to dismiss the vast majority of working class children as being unfit to receive a secondary education because of their class alone. (Cowburn 1986:122-125)

This, and the skills shortage after World War I, formed the context for the introduction of new ideas and practices. Though less overtly discriminatory, they continued to confine most working-class children to a cheap elementary education until they left school at 14, though a few proceeded into white-collar employment. (The different Scottish tradition already provided a well-marked route, with financial support, for some working-class boys and girls to go through university.)

The answer came in the form of intelligence testing. Alfred Binet, director of the psychology laboratory at the Sorbonne, had previously developed a battery of test items, on the request of the minister of public education, to identify children who needed additional help to benefit from a normal education. The items were a mixture of logical and practical tasks from which a score was derived as a general indication of acquired abilities. From diverse and rather arbitrary tasks such as

distinguishing ugly from pretty faces, naming the months of the year in correct order and finding three rhymes for a word within a minute, a score was calculated; the age at which that score was typically attained was noted; and, by subtraction, the difference between mental age and physical age. It is important to note that Binet saw his test score as a general indicator of acquired abilities at a particular point in time. He totally rejected the idea of a fixed innate intelligence.

What most amazes me about Alfred Binet... was the conclusion he did not jump to, the theory he did not assert... He figured out a way to measure intelligence. However, he held back from the obvious conclusion – intelligence as a pure essence measured out more to some people and less to others. He left the door open for learnable intelligence. He focused simply on how one could put a number to a phenomenon – the phenomenon of intelligent behaviour.

(David Perkins 1995:23-4)

The adoption of his methods in Britain and America gave a radically different twist: intelligence testing was thought to identify innate intelligence and related to social class (Britain) and racial difference (USA). In place of subtraction, a new method was adopted of dividing mental age by chronological age to give an intelligence quotient (IQ) which would supposedly remain the same through life. Binet's fluid notion of intelligence was grafted on to the phrenologists' mechanistic concept of brain *capacity*:

Capacity must obviously limit content. It is impossible for a pint jug to hold more than a pint of milk. (C Burt, 1937)

In Britain Cyril Burt and others immediately linked intelligence testing to their firm prejudice that working-class children were genetically poorly equipped (see Cowburn 1986; Rose, Kamin and Lewontin 1984).

Burt's arguments lacked logic, but were well rooted in class prejudice and fitted the contemporary intellectual climate. While still an undergraduate student at Oxford, he had noted:

The problem of the very poor – chronic poverty: little prospect of the solution of the problem without the forcible detention of the wreckage of society or otherwise preventing them from propagating their own species. (in Rose et al 1984:87)

Significantly, Burt was launched on his career with the Greater London Council as the first educational psychologist in the English speaking world on the recommendation of his father's friend Sir Francis Galton,

who first coined the word *eugenics*. Burt built his reputation on a series of studies of identical twins brought up by different families; the high correlation between the separated twins' intelligence levels was said to prove that intelligence must be hereditary. Only after his death was it discovered that the research was fictitious: the tests were never identified, the research assistants had emigrated years before they supposedly administered the tests, the adoptive parents' intelligence quotients were simply guesses, and the data was nowhere to be found (ibid:98, which also critiques other identical-twin studies).

Burt's research reports would have been discredited during his lifetime if his arguments had not been ideologically convenient. IQ tests were used in the USA and Britain to shunt vast numbers of working-class and minority children into inferior and dead-end educational paths (ibid:87), not to mention providing justification for the sterilisation of 'morons' and the preference given to immigrants from North-West Europe to the USA.

In America the emphasis was on racial difference. Tests which asked Polish, Italian and Jewish applicants for entry permits to give the nicknames of professional baseball teams, or to say whether a 'Caucasian' or a 'Negroid' face was prettier, were used to reject potential immigrants on the grounds of their supposed low intelligence. Psychologists such as Terman, Spearman and Goddard presented the American authorities with seemingly scientific evidence of the superiority of white 'Anglo-Saxons'. There was no satisfactory explanation of what was being tested – Boring (1923) defined intelligence tautologically as 'what intelligence tests measure' - but the practice took hold.

Stated in its boldest form, our thesis is that the chief determiner of human conduct is a unitary mental process which we call intelligence; that this process is conditioned by a nervous mechanism which is inborn; that the degree of efficiency to be attained by that nervous mechanism and the consequent grade of intellectual or mental level for each individual is determined by the kind of chromosomes that come together with the union of the germ cells; that it is but little affected by any later influences except such serious accidents as may destroy part of the mechanism. (Goddard 1920, cited by Perkins 1995)

The concept was used ideologically to support politically conservative arguments. In a lecture at Princeton University in 1919, Goddard was already using the 'fixed character of mental levels' as the reason why some were rich and others poor, some employed and others unemployed:

How can there be such a thing as social equality with this wide range of mental capacity?... As for an equal distribution of the wealth of the world, that is equally absurd. (Rose et al 1984: 86)

The concept of fixed intelligence survived despite overwhelming evidence that test scores rose substantially as a result of education. IQ tests are periodically restandardised against a mean of 100 for the current population; strange effects emerge when they are re-standardised against a constant level of difficulty.

- A massive rise was recorded in the average IQ of Italian Americans over a generation, as formal education was extended (see Perkins 1995:40-64)
- The average IQ of American services recruits in World War II was a standard deviation higher than in World War I (Humphreys 1989)
- Conversely, the measured IQ of African Americans was found to decline substantially as they went through school
- The correlation between tests administered a decade apart was shown to be less than .70 (Humphreys 1989)
- The Dutch military tests all young men, using Raven's Progressive Matrices (a non-verbal mental ability test). In 1952 31% scored more than 24 out of 40; by 1981 this had risen to 82%
- When average IQ scores for a British sample were adjusted to maintain constant levels of difficulty, the average had risen from 73 in 1942 to 100 in 1992 (Flynn 1999)

The challenge to the hegemonic concept of IQ was assisted through the struggle for comprehensive schools, when it was noticed that some children who had failed the 11+ examination went on to succeed in examinations at age 16.

One secondary modern school for girls serving a working-class district in a large industrial city, which took in only children who had *failed* to get into either a grammar or a selective central school, entered girls for the O level examination in 1954. Of those who gained five or more passes, one had had an IQ of 97 on entry to the school in 1949, another an IQ of 85. This was at a time when an IQ of 115 or over was generally considered to be necessary to profit from examination courses. And other schools were soon in a position to tell similar success stories, so that there were real problems involved in defending the psychometrists' standpoint. (Simon 1955: 64-66)

Nowadays the scientific basis for theories of innate general intelligence has little support, despite some recent attempts to justify ideas of racial superiority. However, at the level of popular - and professional - folk mythology, it is alive and kicking. Its impact on academic expectations and achievement would be an interesting subject for School Improvement research, since it is difficult for teachers to raise their expectations of pupils while the ideology of fixed ability levels remains strong. School improvement requires a rigorous debate of such debilitating myths.

### **Language deficit**

Wilf Cowburn (1986) continues his political history of constructs of ability and working-class achievement by examining the concept of *language deficit* developed by Basil Bernstein. Once again, a convenient argument was adopted into professional and popular thinking on the basis of fundamentally flawed research.

After Burt's theories were exposed, and despite the establishment of comprehensive schools, working-class achievement remained relatively low and a new theory had to be developed. Bernstein correctly identified a dysjunction between the cultures of home and school, and a difference in patterns of language use. Sadly, though critical of the decontextualised learning normal within schools, he chose to focus on the working-class family as the source of the problem.

The notion of language deficit had already been applied to Caribbean creoles; it was falsely argued that their grammatical deviation from Standard English prevented logical thinking. Bernstein argued that working-class families use a 'restricted code' which is generally sufficient, in a familiar environment, for talking about things you can feel and see, but which is seriously prejudicial to intellectual development. He acknowledged that 'middle-class families' (i.e. non-manual occupations) also use a restricted code when the meaning is clear:

A: Tea, dear?

B: Ah hum.

but argued that these families also have at their disposal an elaborated code, allowing for explicit reference to events which are not physically present.

Labov (1969) in New York and Rosen (1972) in London challenged this deficit theory, exposing its crude and misleading generalisations. They gave illustrations of the discourses through which complex political and philosophical issues are debated in marginalised communities. Labov

makes the point that children had been taken from the Harlem ghetto into an alien environment and then judged to be inarticulate by the deficit researchers. Teachers can easily make the same mistake, confusing a child's anxieties in school or difference in linguistic expectations with an inability to communicate. Labov met with African American adolescents in their own neighbourhoods, and found them extremely articulate about a range of high-level philosophical, theological and political issues, though using a different linguistic code and register.

Bernstein's theory spread like wildfire. His generalisation that working-class mothers smack their children rather than explain to them became urban myth among teachers. There was no quantitative evidence for generalising his anecdote of the stereotypical middle-class mother who says 'Please sit down, dear, you might hurt yourself if the bus stops suddenly' while the working-class mum responds to 'Why?' with a slap. The formal research which took place on different speech patterns was logically flawed. Children were presented with cartoon drawings of boys playing football. One boy kicks a ball over a fence, breaking a window; the boys run off, leaving the neighbour shouting angrily. The working-class boys, we are told, tended to use pronouns (a marker of restricted code): 'He kicks the ball through the window, then they run away' whereas the middle-class boys used nouns (elaborated code). Since the children had the cartoon in front of them all the time they were speaking, pronouns were perfectly sensible. The middle-class children simply had a better appreciation of the groundrules – the expectations of a different register for formal quasi-educational settings.

Despite these problems, the concept of language deficit prospered throughout the 70s and into the 80s and served to justify lower expectations of inner-city students. It is still important for School Improvement to learn from sociolinguists such as Rosen and Labov, to prevent confusion between linguistic deficit and different social registers. This is not to say that working-class children must not be helped towards the 'elaborated code' of more abstract language, but simply that the process involves building upon and working through, rather than rejecting, more contextualised uses of language.

The concept of language deficit, as originally applied to Caribbean creoles and Black American English, was fundamentally prejudiced. It was wrongly argued that double negatives or the frequent omission of the verb 'to be' indicated illogicality. In fact, double negatives are the norm in French, and neither Russian nor Arabic uses 'to be' in the present tense. The argument of linguistic inadequacy indicates social prejudice, not linguistic science. The confusion, of course, went beyond these specifics, and

was mixed with older prejudice about the supposed inferiority of regional dialects and languages.

Draw a sharp distinction between the language of the home and the street and the language the school is trying to achieve. Teachers should not set children to talk or write about their homes or neighbourhoods, because that would be inviting them to use the wrong language.

(The Teaching of English in the Elementary Schools of London, 1929; cited in Pradl 1982)

In their different ways, both these 20th Century models, innate intelligence and language deficit, provided discursive protection for practices which systematically failed working-class pupils. A number of pedagogical and cultural issues emerge from this which should be of keen interest to the School Improvement project:

- questions about the social and experiential development of intelligence
- the relationship between practical activity and theoretical learning
- the forms of language which are valued in schools
- the accumulation of facts and concepts in a low-experience environment
- the way in which working-class children experience figures of authority
- the ways in which children of different backgrounds internalise their positioning as passive and relatively silent learners at school
- the relationship between school learning and community needs as experienced by working-class children and adolescents.

Positive strategies similar to those developed to assist bilingual pupils' transition from everyday transactional and conversational English into an academic code should be explored in order to enhance working-class achievement. This would involve structured opportunities to articulate problems, form hypotheses and suggest solutions, in which the teacher's interventions scaffold the learner's shift towards a more academic register by paraphrasing students' ideas and making available more formal explanations in alternative linguistic codes.

### **Cultural capital**

Currently, we appear to be in a state of flux. There is at present no dominant or explicit concept of ability as we float between notions of hard work, genetic capacity, and socialisation. The accountability culture may

be leading us back to a simpler moral emphasis on the value of persistent effort. A by-product of this is that many children may internalise their lack of success as a sense of personal inadequacy.

Throughout all these shifts, the common-sense notion of intelligence or ability is resolutely individualised: it sounds odd to speak about a collective intelligence, i.e. the acquired ability of a group of people to solve a problem.

We urgently need to retheorise ability in the context of a divided society and for the age in which we live. Bourdieu's theory of *cultural capital* provides an important clue. He argues that the principle cause of educational disadvantage is not linguistic weakness but a clash of cultures. The children of professional parents with a university education unconsciously pass on to their children extensive cultural knowledge and habits which are positively received in school (Bourdieu and Passeron 1970). The different cultural knowledge of children from marginalised communities, on the other hand, does not function as capital because its value goes unrecognised by teachers and there is a mismatch with the discourse of schools.

This moves the argument from an individualistic understanding of intelligence towards a socio-cultural one. The ability of more privileged children to succeed in formal educational settings is not a greater intelligence inherited from parents, but a social habitus which derives from a cultural environment. In considering ways of making valued cultural capital available to working-class and ethnic minority children, we need to avoid simplistic solutions such as teaching a collection of cultural facts, or the danger of conveying a sense that working class children's cultural frameworks are inferior.

### **Multiple intelligences**

Howard Gardner characterises school learning as predominantly *decontextualized* and *notational*.

We now place a great premium on amassing 20-50 students together in a classroom for 6-8 hours a day over many years, disallowing most kinds of physical activity or contact, discouraging socializing, and saving rewards for those who can pore over books or papers, make small squiggles on lined pieces of paper, repeat back what has been told to them, and on occasional 'high-stake' tests, provide precise forms of information on demand. (Gardner et al 1996: 252)

Such practices lead to circular thinking about intelligence.

Our definitions... of intelligence have been based in significant measure on what individuals are expected to do in school. If, for example, school is the site par excellence for notational work in a decontextualized setting, and if tests of intelligence require the manipulation of symbols in a decontextualized setting, then it is scarcely surprising when individuals who score well on an intelligence test do well in school, or vice versa. (ibid: 254)

Gardner proposes a different model - *multiple intelligences*, as opposed to a single general intelligence. He derives his model of distinct abilities from evidence such as child prodigies and studies of brain-damage, as well as uneven development in education and everyday life. For example, we may find little correlation between bodily-kinaesthetic intelligence in footballers and the skills they require in school – or, as we often see, for television interviews. Gardner's first model has seven intelligences, though he has since suggested revising the number:

- linguistic
- musical
- logical-mathematical
- spatial
- bodily-kinaesthetic
- intrapersonal
- interpersonal.

Gardner has warned against his theory leading to new forms of discrimination, such as the idea that black teenagers have an hereditary ability at sport but not at maths. He opposes the suggestion that schools should simply concentrate on areas of strength. While insisting that intelligences represent potential for learning or problem solving, rather than an acquired skill, he recognises that they can only materialise in particular cultural situations: thus, Mozart and Robbie Williams both have musical intelligence but could not compose each others' songs. (Perhaps the difficulties around this point should lead us to move further away from the genetic explanations which seem to persist in Gardner's theory and towards a more environmental model of *acquired* multiple intelligences.)

The concept of multiple intelligences is liberating in a number of ways. It makes it more difficult to place children in rank order. It prevents us devaluing those children who are less successful in decontextualised

notational learning. It has also stimulated practical experimentation in using a wider sensory range to access difficult ideas.

*Multiple intelligence theory in practice:*

- A class of nine-year-olds miming different adverbs in a game of charades, as a step towards consolidating the concept of parts of speech: ‘She said it ... joyfully / cautiously / boldly’
- A weekend workshop on MacBeth where each scene is developed according to one of the multiple intelligences: musical, intrapersonal, spatial
- A school in Copenhagen built on a design which provides particular spaces where the different intelligences can be developed.

We also need to be wary of the dangers. In England, the government are rapidly increasing the number of specialist schools which will select a proportion of pupils at age 11 on the basis of ability in specific fields, from mathematics to languages, from sport to business. This may seem to be an advance on the idea of a fixed general intelligence, but since there are no credible mechanisms for identifying potential in these fields, the system can only prove to be a new form of social discrimination. It will serve to select those children whose backgrounds have given them greater opportunities to experience these fields, or whose parents can argue most articulately for their admission.

### **Distributed intelligence**

We normally think of ‘intelligence’ in resolutely individualistic terms - the idea of a ‘collective intelligence’ sounds like science fiction - yet there are many instances when it becomes apparent that this is not the only way of thinking about potential and ability.

- Wandering round a Renaissance art gallery, it is striking how much Italian 15<sup>th</sup> Century paintings have in common: apart from a few remnants of an earlier Gothic style or the odd El Greco, it takes truly expert knowledge to distinguish between individual artists without the labels
- Writing or playing music within a particular genre or period means partaking of the shared intelligence of those who have gone before
- Bourdieu’s ‘cultural capital’ might be seen as the *collective* intelligence of a privileged social class

- Similarly, groups of adolescents with their own sub-culture(s) share knowledge and patterns of behaviour, and their ways of working and habits of interaction represent a capacity for solving particular types of problem and skilfully undertaking certain forms of action
- When we watch a group of mechanics standing round a car engine trying to diagnose a difficult fault by listening, experimenting, adjusting, we see a shared activity whose success depends on combined intelligence

In all these examples, the sum is greater than the parts. It is remarkable, then, that so much emphasis is placed in schools on children working in isolation; even when children sit around a table and are said to be working in groups, close observation generally reveals them to be working on separate tasks while occasionally helping one another.

A Harvard-based research team including David Perkins, Gavriel Salomon, Roy Pea, Howard Gardner and others, has been working since the late 1980s on alternative concepts of intelligence. The Project Zero website shows numerous projects for raising achievement in schools.

One key idea is the concept of *distributed intelligence*. Perkins (1995:322) suggests that intelligence can be distributed in three ways:

- *Physical*: We rely on physical artifacts as simple as note pads and as complex as computer-aided design systems and beyond to do various kinds of remembering and computing for us
- *Social*: We do not typically think solo but in teams where different people bring different abilities to the mix, and collaboration moves the general enterprise along
- *Symbolic*: We do not think in bare thoughts but thoughts clothed in symbol systems, including natural languages with their rich vocabulary of thinking-oriented terms and a variety of notional and graphic symbol systems.

This exploration of intelligence builds upon Engels' understanding that individual skills depend upon socially-developed tools, and Vygotsky's subsequent conception of language as the social tool which enables individual cognition (see also Cole and Engeström 1993).

A few familiar examples might illustrate this way of thinking:

- To prevent overload, we sometimes use reminders (alarms, lists, post-it notes, other people) to help us sequence an activity

- Writing frames can provide children with a structural map and a reminder of some typical starter phrases so that they can concentrate on expressing their personal content
- As I am writing this book, and struggling to concentrate on an impossibly wide range of ideas and sources, the task is eased by my computer's error checker, a list of chapter headings, an earlier text written for other purposes which I can copy and paste, and, on the floor around me, a circle of key books needed to reference the present chapter
- In mathematics we draw graphical models or use graphic calculators to provide a visual reference, and often to mediate between verbal ideas and physical experiences
- Architects working in different locations might share their ideas for a new building electronically, using the software to sketch arches or display from different angles (from Perkins 1995).

Roy Pea (1993:70) provides a metaphor for distributed intelligence by inventing a special tape-measure for foresters. This device would incorporate a conversion formula and a value for  $\pi$ , such that the forester can measure a tree of 2.5m circumference and read off 0.4m (the radius) from the tape measure.

The distribution of intelligence is not a replacement for the individual, but recognises that, in real life, our ability to solve problems and deal with new situations often derives from the 'person-plus' not the 'person-solo' (Perkins 1993:88). Schools, however, often regard this as suspect, preferring situations in which an individual works with nothing but a pen, and even this is mainly used to record answers rather than to sketch strategies and solutions. We have seen much of this tendency recently in the emphasis on mental calculations and the suspicion of calculators – an attitude which would have eliminated slide-rules and logarithm books for my generation!

Clarity about this issue is important for school improvement. When some children repeatedly fail with detailed calculations, we need to consider the wisdom of compelling them to do more and more, against the possibility of distributing part of the thinking to a calculator so that the learner can engage in more interesting ventures.

Children whose different talents are developing at different speeds need experiences which will boost their confidence and give them a taste of success – rather than seeing themselves labelled as comparative failures in the 3 Rs. (Tim Brighouse, 2002)

Individuals obviously need to move between situations, and take with them knowledge, skills and the memory of previous solutions. One way of looking at this is as a residue of those other occasions when we have worked with tools, colleagues and sets of notes. We obviously cannot rely totally on the right cultural tools being available, and schools need to plan for capacity to adapt to new situations and transfer understanding and strategies. Perkins reminds us, however, that working with other people and with tools isn't an avoidance of personal learning: it is often the best route to it. By distributing lower-level aspects of a task, we can focus on the higher-level ones. He uses the example of the Geometric Supposer, a computer program 'designed to restore exploration and discovery to the teaching of Euclidean geometry'. (For further examples, see Gavriel Salomon ed. 1993, *Distributed Cognitions*, and David Perkins 1992, *Smart Schools*, two books which are rich with theory and practical ideas for schools.)

*The Geometric Supposer provides a 'constructive arena':*

- It makes geometric construction easy: a user can request that a triangle be drawn, an altitude dropped, and so on.
- It makes measuring such constructions to check conjectures very easy: for example a student can request a measurement of two sides of a triangle to see if they are equal.
- It makes retesting a conjecture on different versions of the same process extremely easy: the student can repeat the operation with a new randomly-sized triangle to explore an hypothesis. (Perkins 1993: 102)

### **Rethinking intelligence - rethinking learning**

This is an exciting period in terms of new social models of learning. School improvement needs to share in the theory as well as disseminating the practice.

This chapter has only skimmed the surface of a growing list: the implications of emotional intelligence (Goleman), the many variants of thinking skills, children's philosophy (Lipman and others) and so on. Perkins uses the concept 'metacurriculum' (1992:99-130), proposing that students simultaneously learn ways of thinking and areas of content. His analysis of forms of learning which fail to raise achievement is illuminating: fragile knowledge, inert knowledge, naïve knowledge and ritual knowledge (ibid: 20-27). His argument that intelligence is *learnable* is the best antidote to the pessimistic concept of innate intelligence: it raises more

hopeful possibilities of raising achievement than the constant pressure for intensification.

We need more than a bag of tricks: we need different theoretical models with the potential to generate new learning activities. We also need to think of the complexity of young people's learning in the world today, wonderfully illustrated in Nick Hornby's novel *About a boy* with its complex illustrations of social and cultural learning and emotional intelligence.

Bentley argues that our information age requires forms of ability or *creativity*, involving:

- the ability to formulate new problems, rather than depending on others to define them
- the ability to transfer what one learns across different contexts
- the ability to recognise that learning is incremental and involves making mistakes
- the capacity to focus one's attention in pursuit of a goal
- secure trusting relationships and environments in which people are prepared to take risks and learn from failure
- freedom of action, so that people can make real choices over what they do and how they try to do it
- variations of context, so that learners can transfer and make connections
- the right balance between skills acquisition and challenging new activities
- interactive exchange of knowledge and ideas
- real world outcomes, so that creativity and motivation are reinforced by the experience of making an impact and giving benefit to others. (Bentley 2001:136-137)

He suggests that the 'scope for continuous improvement in output and productivity within the present infrastructure is limited. Some serious rethinking is required, as schools are increasingly at odds with the more challenging environments which learners will later encounter. Schools need to be restructured as learning communities, as stimulating and cooperative environments on a human scale, which can connect with the wider problem-rich communities in which innovation flourishes.