The Design Aim in Education

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IN 1979 Archer published with Roberts a classic article in this journal[1] setting out clear ideas of the nature of design in education. It must be read, but as a temporary precis his aim seems to be the ability to carry out cognitive modelling, necessarily commutative, with or without the aid of physical models, and aimed at solving problems and attaining desires which may be initially unclear. Archer deliberately excludes the search for generalisations as in science. These ideas have provided a clear rallying cry for those advocating design in schools.[9] I hope to extend one aspect of this conception and to point out some practicalities which may require a shift of focus. More detailed accounts of some aspects will be found elsewhere.[2]

Archer is well aware of the need to relate educational theory to current educational psychology and theory of brain psychology, so I will start there. Changeux[3] has described perception as the firing of a pattern of neurones (nerve cells) in relation to the various analyses which the brain makes of any sensory input. He sees thinking as 'calling up' such perceptions and mentally trying them out against each other. He sees a concept as a region of overlap of percepts which can develop its own stability and be 'called up', too, while each new mental 'tryout' can be checked against reality etc. before acceptance or rejection. The act of attention can control the overall type of activity (e.g. reverie v checking) and the aim of the thinking (e.g. scientific v 'design') by selective input. We seem to have here at last a physiological picture of brain function which fits our experience of the nature of 'creative reverie' and of the mental checking of ideas as they occur. Many people will recognise this double process as 'rational thinking', and its relation to Archer's Design is clear.

Piaget[4] also observed children's problem-solving behaviour among a welter of other studies. He discussed separately the logical commutative aspect which he called operational thinking, and showed how such abilities develop gradually, in a recognisable sequence of stages. This work has been extensively checked and developed for practical application by Shayer.[5] It now seems likely that the children's progress noted by Piaget depends partly on extra outgrowths and connections of neurones at key ages in development, but partly on the use that is made of these new possibilities by forming, utilising and retaining new complex concepts which allow new ways of analysis.

Munn,[6] making practical use of Hirsts analyses for the school curriculum, uses the notion of different 'ways of thinking' that are supplied by different subject-areas of the curriculum such as maths, science, language and the arts. These 'ways of thinking', interpreted as above, can be considered as frameworks of concepts that allow us to apply specialised ways of analysing problems.

Wider application of design-thinking

The similarity of all these views to Archers Design is inescapable, as is the importance of the activity Archer is stressing. However, his conception can be widened. This type of directed thinking, involving creativity and logical check, has been shown to be the basis of successful grasp of mathematics.[7] Just to tell children how to add and subtract is not effective. They do better if they see the basic properties of numbers (e.g. which ones, put together, make ten) and then invent for themselves varied ways of adding and subtracting, which of course they check. This creativity seems to be a requirement for real interest in mathematics and real mathematical ability. A similar argument can be made for language. Chomsky describes ways in which children create sentences for themselves, applying and checking simple concepts of sentence construction which may be to some extent innate. Archer would call Design a third essential aspect of the curriculum alongside maths and language, in education. But if we see design-thinking as also pervading these two school subjects, and of course others like music, dance, games and history, then design-thinking can be developed to some extent in and by all these areas.

Science

As Archer explains, the final aims of Design and science differ. Design deals with one problem, local in time and space. Science searches for wide and usually very abstract generalisations, concepts and 'patterns' and for ways of testing them out by specially devised experiments. However, design-thinking *is* important for science: clarifying a brief is rather like looking for the pattern, and the patterns have to be 'created' and mentally checked, the experiments designed. Nevertheless the distinction Archer has made between these two aims is currently worth stressing because it is often unclear to science educators. Adding 'application of ideas' to the 'science process' in ways currently published does not change this into a design process, nor into technology in the widest sense of that variable word. If we tell pupils about the way *other people* used scientific methods to make pencillin which may save *their* lives they are not themselves making use of scientific concepts and skills *to solve personal problems.* They are merely watching what others have done and their motivation coming from a sense of expertise and power can be low. Similarly if pupils make inedible bread in the science lab. or solve specially designed puzzles at the end of the chapter (or even play games or roles) science is being applied but the level of reality is low. These are specially designed uncluttered problems allowing pupils to focus on one issue, but our real life problems, including the making of good bread, force us to integrate several different concepts, values, skills and many facts all at the same time, as does any piece of practical Design work. Uncluttered puzzles are important in the early stages of teaching difficult concepts and design skills, and they are difficult to devise, but they are a different animal. Nuffield Home Economics for example is in basically applied science, not Design in this sense, and it does not teach the range of design skills needed for 'design-process' home economics.

End versus means

Archers approach has proved very welcome as a banner behind which to rally because it is simple. There is a slight danger that if the target is as wide as rational thinking itself, then teachers may evade the issue by saying they are doing it already. Another danger is what I have called curriculum developers disease.[8] Researches from many sources have recently shown[9] how curriculum developments fail if disseminators extol the advance rather than explaining to

teachers exactly how it can be carried out, in the everyday real life situation, when a new, risky and frightening change is being tried out by a teacher with no experience.

In promoting a new idea we must show its value (the end or aim) clearly and simply, but we must make the *means* and pathway equally clear and simple for new teachers. This may alter the picture considerably. We do not teach swimming effectively by giving pupils practice (throwing in at the deep end): we teach breathing and floating. We now teach multiplication not by multiplication sums to copy but by a real understanding of number and successive addition. We teach chopping onions not by demonstrating this skill for copying but by getting pupils to analyse vegetable structure and to grasp general rules for learning new manual skills.[10] Similarly, for design-thinking, pupils may need an approach that is not immediately apparent, especially if they have not been successful before, being too young or having missed educational opportunities. In the end we shall need to promote a message about *means* that is as clear as Archers message about *ends*. But this will not be achieved, in my view, unless we approach this whole situation as a design problem and use suitable design skills and tactics, with a sound, organised, overall strategy. Currently there is much trial and error, and we may do better to use Alexanders principle rather than fixing initial overall solutions.[11] In home economics several projects attracted funding by their attractive grand plans but in the end just died out.[12] Perhaps also we should follow the design principle that Feuerstein teaches to beginners,[13] not to panic when things do not work out, but to take time and approach the problems again in a new way. We might even extend this to 'Be willing to bear the pain of the untidy hopeless stages of design which all practical designers learn to face, which may in this case include apparently divisive disagreements and criticisms and tough clarifications, as well as having to spend time on minor aspects that appear beneath the dignity of curriculum developers. Face the nitty-gritty difficult practicalities with detailed and honest criticisms among co-workers who aim to help'. If we also look for 'Feuersteins 'new way' the basic strategy appears to be to promote Archers view among teachers of different subject areas, (which is a very pleasant positive task, without the pains described above) and then let the teachers discuss in groups and work out how to bring it about. But do they have the pre-requisites for this, e.g. the experience, the knowledge? Some current approaches to pupils need not be 'the only way', either (e.g. starting young pupils off with an enervating slab of theory before they do any design, or evading the whole issue of efficiently and enjoyably passing on organised experience and generalisations, and relying on pupils 'absorbing' important ideas).

J. Christopher Jones has descriptions of many helpful design skills[13] and devotes a large section of his famous book to getting ideas from inside the heads of other people by systematic search. This approach has precedents in

education.[14] Such a search might reveal among others, the work of the Aquarian self-help group of teachers who have been at it for twenty years. We find for example, that our strategy for approaching teachers has become quite different from that outlined above. We:

1. Show teachers in detail how to try out, without upsetting their lessons, little bits of work in the new style and let them experience the really quite extraordinary effects on pupils behaviour, for themselves.
2. Then if they are temperamentally attuned and welcome it, they can proceed, but if not they can withdraw.
3. We provide detailed help and discussion with experienced teachers, gradually, enabling teachers to take what they want for their own schemes.
4. Other teachers may take the risk later when they visit local schools where this is going on or talk to teachers who are finding it works.

For pupils, too, we have changed our *initial* focus of attention away from the aim of pupil thinking and teaching method. We now see our aim as providing *help and opportunity* for thinking. One help is concept-frameworks, taught clearly by special sequences or catenas, and which really enable pupils to think out problems for themselves: their welcome shows this. A range of important design skills in the widest sense[15] and value-meanings are taught by similar methods. *Content has in fact become central, a complete reversal.* For teachers also we found that the right content made it possible to attain the free design methods for which they had unsuccessfully tried for years.

The other essential initial requirement for pupils is the provision of graded, motivating problems, making things to the pupils desires, and where cognitive success in the actual design-thinking is really possible for all, using the pupils own ideas and choice of ideas. These problems are integrated into the teaching-catenas, which requires a great deal of pre-planning. Production is of course carried right through to a finish, which helps motivation and demands perseverence. In summary, our *aim is good general concepts and design skills and the chance to practice using them* on good problems. Then the design-thinking develops in normal children. At later stages we require more discrimination, and build in more skills and concepts and more complex situations. In particular, class and group discussion, directed to clear ends, serves as a model for thinking as well as a source and check of ideas, and we develop the concept of critiera for clarifying a brief and for evaluation, starting *necessarily* with clear, concrete, *testable* examples of criteria. This involves developing pupils ability to face evaluation of their own products and of their own actions, an important skill for learning. Clarifying a brief and selecting or inventing an overall strategy are more difficult skills, coming later, while cognitive modelling in the complex, abstract and mathematical area of food studies needs special aids.

If design-thinking can be developed in *any* subject area and if it is regarded as crucial, we should be looking for areas of the curriculum which have special value for any aspect of this pathway, in addition to Munns 'ways'. On that basis we can point to the values of revitalised, reoriented 'craft' subjects, now design based, and each offering *different* help.

Notes and References

1. B. Archer and P. Roberts, Design and Technical Awareness in Education, in Studies in Craft Education Design and Technology, Vol. 12, Winter 1979, p.55.
2. Aquarian materials list from I.E. Finch, 67a Wallwood Rd., London E11 1AY.
3. J.P. Changeux, *Neuronal Man,* Pantheon, New York, 1985.
4. J. Piaget, Growth of Logical Thinking, Longman, and several other books.
5. M. Shayer and P. Adey, *Towards a Science of science teaching,* Heinemann.
6. 'The Munn Report', Scottish Education Department 1977, is properly *The structure of the curriculum in the third and fourth years of the Scottish secondary school,* HMSO.
7. BBC TV Horizon Programme 1986 on maths teaching.
8. *Beware the dreaded CDD,* in *Aquarian Newsletter,* July 1985, and an example of the research: J. Ruddock, *Curriculum Research and Development projects. Barriers to success,* in B.J. Ed. Psychol, Vol. 41, 1971.
9. Needed because eg the Schools Council completely omitted craft and design work for its publication discussing essentials of the middle schools curriculum at their inception.
10. Edition 7 of Aquarian scheme, see 2.
11. J. Christopher Jones, Design Methods, Wiley, describes and gives references.
12. Home and Family publ. Forbes and Schools Council Home Economics Bulletin on aims and objectives.
13. What can Feuerstein teach us? in Aquarian newsletter, 1984.
14. Teaching CDT in schools, HMSO.
15. These can be regarded as 'tricks' or skills for approaching parts of problems of the relevant kind, e.g. discussion skills as a means of getting and checking ideas, advanced reading skills, brainstorming, time ordering with flowcharts, see 2.