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(In the course of work in the Royal College of Art's Design Education Unit, there has been considerable discussion on the relation of 'technological awareness' to design activity. The following paper represents part of that discussion).

Design and Technological Awareness in Education

Design, like science or scholarship, is the product of a distinctive kind of activity and is governed by a distinctive capacity of mind.

Designing and the development of technological awareness, as educative activity, consists in relating and drawing attention to purpose, the self, and the means and significance of Man's intervention in his habitat. Design activity, when distinguished from design-educational activity, is directed towards the manipulation of things and systems so as to achieve the most acceptable and practicable fit between a particular set of desires and needs, on the one hand, and a particular means for fulfilling them, on the other.

But the development of things and systems is not necessarily sufficient as the purpose of design activity in general education. The things and systems devised or commented upon by a child are indicators of the development of the cognitive modelling capacity which is the core of learning-through-designing. That is to say, the educational ends of design activity are, primarily, the development of the cognitive modelling capacity of the pupils. This capacity is manifested and developed in intentional activity, of which design is a sub-class. Design activity is concerned more with the attainment of a result than with the acquisition of knowledge. Design educational activity is concerned not only with achieving an effective result, it is also concerned with the development of the pupils' knowledge and understanding. This knowledge and understanding is to do with self, self in relation to man-made things and systems, and the appreciation of the effect of his or her own, and other people's, activity in and on the world.

Design activity is always a grappling with the unknown. Whilst design activity in a particular instance will demand knowledge and understanding of particular kinds, some of this demand may be met after the need for it has been appreciated rather than before the task is started. Indeed, some phenomena may be legitimately treated with, in an empirical way, without their ever becoming truly understood. The legitimacy and efficacy of a design result resides in the demonstrability and appreciation of its appropriateness to purposes rather than in the clarity of understanding of the principles governing the production of the result.

Design activity is characterised by being specific, that is, by being concerned with the attainment of a particular effect rather than with the drawing of generalisable conclusions; by being holistic, that is, by being concerned with the integration of variables rather than with the isolation of them; and by being commutative, that is, by being concerned as much with the fitting of ends to means as it is with fitting means to ends.

It is a problem-centred activity, but it is distinguishable from some other sorts of problem-solving activity by the fact that it is chiefly concerned with 'ill-defined problems'. In this context, the term 'problem' refers to the presently-existing state of affairs; it does NOT refer to the statement of requirements which a (possible) thing or system is expected to meet. Nor does the term 'solution' refer to the design arrived at, that is, to the resulting tangible thing or system. The design act is one of discovering and elaborating and adapting requirements and provisions to match one another. The problem is obscurity about what the requirements might be, ignorance as to what sorts of provisions might be suitable and uncertainty as to how well the one might fit the other. The solution is the achievement of a requirement/provision match that is both sufficiently described and demonstrably a good enough fit.

Design problems are described as 'ill-defined' because there is no way of arriving at a provision description merely by the reduction, transformation or optimisation of the data in the requirement specification. By the same token, it is rarely possible to determine whether or not the finished design is 'the correct', 'the only' or 'a necessary' answer to the requirements. It must usually be possible, of course, to establish whether or not the design is 'a proper' or 'an acceptable' answer to the requirements. It may or may not always be possible to judge whether or not one 'proper' answer to the requirements is better or worse than some other 'proper' answer. Where such doubts do NOT exist, the problem is not 'ill-defined' and might therefore have been resolvable by scientific or mathematical methods rather than designerly methods. Most real-world problems encountered by most people are 'ill-defined'.

The conduct of design activity is made possible by the existence in man of a distinctive capacity of mind, analagous with the language capacity and the mathematical capacity. This is the capacity for cognitive modelling. A person acting in the role of designer or appraiser of designs forms images 'in the mind's eye' of things and systems as they are, or as they might be, and evaluates them and transforms them so as to gain insights into their structure and into the likely quality of fit between alternative conceivable configurations and the interaction of perceivable requirements. Its strength is that light can be shed on intractable problems by transforming them into terms of all sorts of schemata drawn from the agent's experience no matter how logically improbable. Cognitive modelling is not limited to

spatial configurations. Aspects such as colour, texture, sound, flavour and anything else relevant to the system can be imaged and manipulated. Cognitive modelling is independent of language or symbol systems, but when appropriate, the concepts modelled can be translated into or supplemented by language or notational terms. The image is usually externalised through models and simulations, such as drawings, diagrams, mock-ups, prototypes and, of course, where appropriate, language and notation, or it can be embodied in the construction or enactment of the emerging responses. These externalisations capture and make communicable the concepts modelled.

All design activity involves continual appraisal and reappraisal of the meritoriousness of existing realities and alternative propositions being handled. There is also a transitive form of the same activity which is wholly or largely concerned with the appreciation of states of affairs and with choosing and deciding, rather than with the creation of things and systems. All human beings rely heavily on cognitive modelling in both these forms for the pursuit of their everyday activity. Most pursue at least occasional explicitly designerly activity when they are appraising, using or devising things or systems. Technological awareness is the ability to bring knowledge and skill to bear in the pursuit of intentional activity.

In schools, whilst the application of designerly and technological awareness cuts across the whole curriculum, there are some curriculum areas that embrace explicitly design-related activity, in whole or in part. These include art, craft, dance, drama, environmental studies, home economics and technology. Such areas can be described as comprising the design dimension of the curriculum. Each and any of the subjects in the design areas, when well taught, can develop the capacity for cognitive modelling and skill in the handling of ill-defined problems, and can transmit the values underlying the essential design concepts of specificity, holism and comutativity in dealing with the practical world. Each has its particular sorts of knowledge and skill but all contribute to the general development of technological awareness.