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Modelling and creativity in design and technology

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Abstract

Recent OFSTED reviews of inspection findings emphasise that whilst pupils at all key stages are enthusiastic and well - motivated when engaged in design and technology, confidence and competence vary with the effectiveness of teaching, the degree of challenge of the task and the opportunities given to be creative and to work independently.

This paper will present the work done in the early stages of development of a PhD research programme concerned with examining the role of creativity in the teaching and learning of design and technology.

Design activity generally is characterised by attempts to solve ill-defined problems based on an understanding of the present world, not the one for which the solution to the problem is expected to meet. Consequently, some form of 'creative leap' on the part of the designer is required to produce solutions that are never right or wrong, only better or worse. In the classroom, the careful framing of problems and the persuasiveness and positive leadership offered by the teacher can promote growth in the sophistication of pupils' models and responses to situations encountered. The paper will explore the range of factors likely to influence the achievement of success:

a) by designers

b) by teachers and learners working on design problems through the construction of, and interplay, between expressed and mental models.

Educating in design and technology - balancing content and process

OFSTED main inspection findings for 1993/94 indicate that in primary schools, pupils failure to make progress with capability is partly caused by teachers lack of subject knowledge and practical expertise necessary to give pupils a broad experience. Bowen concludes that it is not just because teachers do not have the knowledge or skill but that they see design and technology in terms of an end product rather than a process (Bowen, 1996). With 'real world' design problems the end result for a client is all that matters but in education, there is also concern with the development of pupils' knowledge, skills and understanding. OFSTED's main findings also conclude that for pupils at all key stages.

Their confidence and competence varies with the effectiveness of the teaching, the degree of challenge of the task, and the opportunities given to be creative and to work independently (OFSTED, 1995).

Tom Karen, a product designer of Ogle Design Limited comments on the need

to select students for employment with a big spark of imagination and inventiveness... we must then encourage original and expansive thinking. We must be careful about bringing students down to earth by making them work out practical solutions too early. I am a bit concerned that young people at that stage in their development are not capable of thinking divergently and convergently at the same time. It is unrealistic to expect them to produce good, original ideas and at the same time to think about questions of tooling, manufacturing limitations and so on. (Karen, 1979).

Frequently in education, the role that the 'learner designer' can play is limited and superficial resulting in a dulled sense of purpose with little meaningful action resulting. The comments by Karen as with the findings from OFSTED point towards the need for

sensitive, competent mentors to work with learners in the design field. These concerns give rise to this programme of research which is concerned with the following question:

How creativity and creative acts are discerned, valued and promoted in design and technology education and how these relate to design and technology in practice?

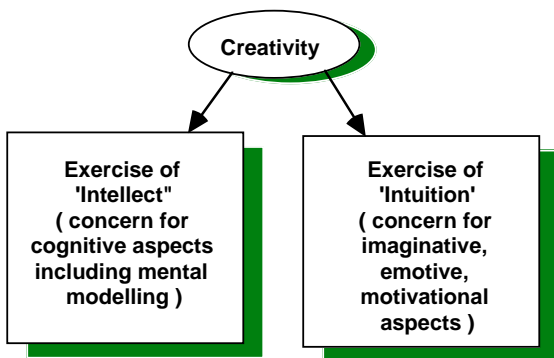
I am interested in:

- What views exist about the nature of creativity in design and technology education?
- What role does creativity have in a balanced experience of design and technology education?
- Under what conditions does creativity best flourish in school-based design and technology

Creativity in Education

There are two inter-related human capabilities that need consideration in order to understand creativity and creative acts. These are as follows:

There are mixed values, meanings and



interpretations concerning the place of creativity in schools. On the one hand it is recognised that when learners undertake creative work it pre-supposes worth as it:

- is a powerful motivating force for teachers and learners,
- celebrates achievement.

On the other hand it is frequently of low priority as:

- there are so many things to be learnt in classrooms,

- it makes for disruptive classrooms,
- it requires 'high risk' teaching strategies.

Teaching is about maximising success rates with sometimes large numbers of learners and therefore creativity is one virtue amongst many which have to be balanced reflecting the wide range of accountabilities that teachers are required to endure.

Creativity in Design and Technology Education

Design activity is characterised by ill-defined problems based on understanding the present world, not the one for which the solution to the problem is expected to meet, hence there is an expectation of a creative leap to produce a solution for the future. Solutions are never right or wrong, only better or worse. Where value judgements of this nature are not central, the problems are likely to be solved by other means such as those available through science.

The work of the Assessment of Performance Unit (APU) undoubtedly influences much current thinking in education that design and technology can be represented by a "model of interaction between mind and hand" (APU, 1990) which in turn implies a holistic process involving developing solutions to design problems by linking mental (cognitive) and expressed (2-D or 3-D representations) activity.

Expressed models are representations or manifestations of ideas and can either be developed in 2-D or 3-D form. Concrete models are a type of expressed model produced by shaping and fashioning materials and are used extensively in designing.

Using models and modelling processes to design

Responding to design problems involves thinking about and modelling ideas in order to build up understanding about the range of solutions that might be available. Prior experience and understanding of materials and techniques is likely to form the bedrock from which development can take place.

Modelling can be predictive and can also reveal previously unknown and un-conceived ideas, hence is a 'tool' for creativity and invention. It is particularly valuable as an aid to the birth and realisation of shared ideas where the evolution, implementation and evaluation of decisions are a joint responsibility. Modelling ideas in mental and expressed forms helps to progressively clarify concepts related to design problems and the links between them.

Designing requires the formulation of images in the mind's eye which implies a capacity for mental modelling. There is a need to consider "the function and role that imagery plays in thinking; and on whether it is a symbol system that can mediate thought as language does" (Cohen, 1977). It is generally thought that visual imagery has a special role in designerly creativity.

Any feature or combination of features concerning the form of a product, its function or aspects of the relationship between form and function can be imaged in ways which are relevant to the growth and development of ideas/solutions. These are independent of universal language or symbol systems even though there is always a pressing need to communicate and convince others of the worth of the solution(s) to the problem using words, symbols and, or, realisations through concrete models.

The nature of models in design and technology

Concrete models

Concrete models are a type of 3-D expressed model developed and used to 'give shape to' ideas and materials for:

- visualisation of whole or component parts of the product for the purposes of conveying information;
- helping the developer to frame ideas;
- contextualising and explaining concepts to clients and all interested parties;
- working out and developing ideas to 'fix' dimensions and form;
- testing performance, ergonomics, dimensions, processes relationships of components;
- leisure through the application and development of craft skills;

- identifying the properties and working constraints of chosen materials;
- developing historical records of other cultures and societies through working with artefacts which reflect practices, styles, techniques, use of materials and values.

Whilst recognising the important role that concrete modelling plays in developing solutions to design problems, this paper is more concerned with mental modelling and how we construct thinking patterns, build images and develop emotional behaviour patterns and tendencies. I am interested in exploring through fieldwork the factors that influence styles of teaching and responses from learners in design and technology that results in creative acts.

Mental modelling in design and technology

Mental modelling converts the perception of reality into the framework of human consciousness. To be creative, all capacities of the mind from the conscious and unconscious levels may be called upon to promote the reflection, decision-making and judgement of the creator. Personal attributes of: intelligence, emotional intelligence and imagination are likely to influence the response to a problem.

In creative activity, the gaps are being filled in between what is known and understood by the creator using familiar textual and symbolic representations in the thought processes and the circumstances of a design problem itself which can contain elements previously not considered in symbolic form.

Intelligence

The quality of any creation will reflect the judgements made, information utilised, values of the creator and influences brought to bear in producing the resulting product which directly implicates the intelligence of the creator(s). There are important links between intelligence, creativity and other faculties of mind for which the connections are beginning to be unfolded as a result of the work by Gardner amongst others. Gardner introduces the notions of 'contextualisation' and 'distribution' of intelligence's which are both

efforts to extend intelligence beyond the skin of the individual, and to show the ways in which our intellectual capacities are inextricably bound with the contexts in which we live and the human and artefactual resources at our disposal (Gardner, 1993).

Emotional intelligence

Resisting impulse is the cornerstone of self-control which in turn can give the emotional strength and drive required to be creative. The role of emotions in the achievement of success in any field is currently being explored by Daniel Goleman who proposes that we must harmonise head and heart and use emotions intelligently in order to succeed in our chosen projects and destinies (Goleman, 1995).

Imagination

Information is available from primary and secondary perceptions which are considered to be a particular feature behind original, creative thought products. Imagination is accumulative and becomes a growing store of fused and diffused perceptions based on real and distorted perceptions of the world. McKellar argues that modelling allows concretisation and realisation of elements of the imagination which are sometimes abstract and vague but can be thought of as original and creative even though unconscious plagiarism might be responsible for the novel ideas (McKellar, 1957).

Modelling in Design and Technology Education

Learning through design is important in schools as a vehicle for conceptualising and developing the made world, however, the central model at the heart of the National Curriculum Order is inadequate in its generality if taken too literally. A designer in reality is able to test and evaluate the effectiveness of a solution to a problem by obtaining feedback from the client or source of specified need. A learner in education must also have the opportunity to test solutions against specified needs or the problem-solving process is educationally invalid (Baynes, 1969).

It is likely that some forms of modelling encourage creativity, whilst others inhibit. Christopher Cockerell utilised a biscuit tin and

vacuum cleaner to illustrate the principle of the hover craft and as Evans notes

this could have been represented in a two-dimensional form or more thoroughly engineered representation, but during the early stages of concept development it is more appropriate to create something that actually works (Evans, 1993).

How often in schools are pupils instructed to proceed in certain ways which are alien to their natural ways of working?

The guiding principle for the use of modelling in design and technology is that techniques used should help learners progressively to confront the reality of their ideas (Assessment of Performance Unit, 1990),

This recognises that modelling is the cornerstone of capability. It is therefore important to identify: How learners construct mental models? How mental frameworks are developed for locating knowledge and skill? How conceptual understanding is achieved? in order to develop programmes of learning that are appropriate.

Teaching and learning approaches

Typically when teaching, behavioural and descriptive language is used to define product outcomes. Little emphasis is placed on helping a learner to make links between their existing mind-set and the circumstances of the new problems faced. Developing the following abilities can help to empower learners and inform their decision-making:

- presenting information in 2 - D and 3 - D forms;
- selecting symbol systems, language and styles to suit problem contexts, and audiences;
- using the mind and the hand in an integrated way to achieve desired products.

Frequently, following a simple routine procedure manufacturing a well-finished prototype model can appear to be worthwhile, but have achieved little learning. It is a common self-justification amongst teachers of design and technology in secondary schools, endorsed by OFSTED, that pupils enjoy their work and experience which offers evidence

of good relationships between teachers and pupils. Cochrane believes that in school practical subjects there is a need to beware of “education degenerating into therapy” (Cochrane 1975). It is important to make such a distinction.

Role of the teacher

In any classroom or workshop, mental modelling is a vehicle by which progress is made. It occurs with individual learners, and with the Teacher. Boulter and Gilbert propose that:

There needs to be a problem or task which can be debated and clear leadership from the teacher on what is expected in terms of interaction and the framing of the content. For children to deliberate their own models in response to a task they must both participate in the talk and in deciding what domain is to be talked about (Boulter and Gilbert, 1995).

The appropriate framing of the problems and the persuasiveness and leadership given by the teacher promote growth in the sophistication of the children’s models. It also creates common reference nodes within the culture of the classroom that allows the sharing of ideas to become the stimulus for individual development.

Group work

Martin, a Wellcome researcher at the University of Manchester places great emphasis on the difference between the kinds of artefacts which can be designed and made by a single clever individual, and those which can only be created by a team (Gouk, 1995). In schools, there is a marked lack of value placed on collaborative endeavour, individual effort is rewarded, short term success is valued and failure (sometimes very public) punished. Failure should be a motivator through offering feedback on the purposes and operation of a product. All learning should be developmental.

Values and classroom culture

Within design and technology education, there is little attempt to use cognitive

psychology to influence development, rather, teaching and learning methods and techniques are often selected on the basis of precedence, instruction and indoctrination. In historical terms, the strong craft traditions and beliefs act as blockages to the development of a more coherent knowledge base and language consistent with ‘change’. Whilst accepting the validity of certain long held tenets of handicraft that learners should develop value in craftsmanship, skill and sound construction, they should as Baynes believes “think radically and not accept the standard solution to a problem” (Baynes, 1969).

In education, design activity can neither be value free or value neutral and the choice and specification of tasks, materials, knowledge and skill promotes pre-dispositions by learners to the development of products and use of processes which can be based on openness, enquiry and exploration or narrow, closed, negative, rejective stances. When designers create ideas and develop concepts, they are continuously borrowing and modifying already established work.

Conclusion

Through fieldwork, I will be seeking to examine the work of teachers and learners in design and technology:

- the motivational factors behind approaches and outcomes;
- the tensions in the expectations and relationships;
- the nature and effects of primary and secondary constraints influencing the ways in which teachers set up learning opportunities and the ways in which pupils can respond.

Through adopting a case study approach to the research, I hope to delve more deeply into how children are empowered to learn utilising their creative potential. In addition, establishing ways in which teachers can best promote learning which has a sound creative base balanced against the need for them to meet the range of other educational demands placed upon them.

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