

Creativity in design & technology

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Introduction

Creativity in our pupils' work is never an easy issue to address. Teachers will have different ideas on what they think is creative as it is a very subjective concept and they may even question the importance of creativity in their pupils' work. Many teachers you have met may think that it is much more important for the pupils to get the best marks they can by following examination boards' guidance rather than trying to be creative.

The focus of this chapter is to encourage you to think about your pupils' creativity. Do you think that creativity is important? And if so why, and how can you support and guide the pupils? Questions we want you to think about are:

- Are you a creative teacher?
- Are your pupils' creative?
- Does your teaching encourage creativity?
- Do your pupils' products show a creative response?
- How do you know?



Some design & technology teachers question the importance of creativity. They argue that their task is to teach pupils to learn 'skills' and make well. What do you think?

The need to foster pupils' creativity has become an important issue in recent years in the UK. It was Ken Robinson's Report "All Our Futures: Creativity, Culture and Education" (1999) that first raised the issue of the lack of creativity in education. The report proposed a national strategy and made recommendations of how to foster pupils' creativity across the curriculum. Similarly, educational writers such as David Hargreaves (2000) have highlighted the importance of creativity in education, as have Richard Kimbell (2000) and David Barlex (2003a) in design & technology. This has been followed by government initiatives such as the "Key Stage 3 National Strategy (Designing); Foundation subjects: design & technology" (Department for Education and Skills, 2004).

The Design and Technology Strategy Group, supported by the Department for Education and Skills (Barlex, 2003b), recognised that there was a need to examine the approach to pupil

01		
02	03	04

01 Is this work
- creative?
04 How do you
decide?



assessment in design & technology responding to Richard Kimbell's comment that assessment was 'widely regarded as having become formulaic, routinised and predictable' (Kimbell, 2004, p. 100).

The Innovating Assessment research project was a response to the view that 'it has become increasingly evident over the last few years that a number of pressures have combined to reduce learners' innovative performance at GCSE in design & technology. "Playing safe" with highly teacher managed projects has been seen to be the formula for schools guaranteed A-C pass rate' (Kimbell 2006). The project explored and developed approaches to assessment that enabled pupils to discuss, record and critique their 'designerliness' as they moved through a design task structured in a way to provoke and reveal their creativity.

See http://www.nuffieldcurriculumcentre.org/go/CurriculumIssues/Issue_292.html



What do you think?
In your experience do
examining bodies credit pupils'
creativity and if so how?

The early "National Curriculum Design and Technology Orders" (Department for Education, 1995) did not mention creativity. This was rectified through the 'importance of design and technology' statement in the 1999 Orders. Design & technology was the only subject where creativity was mentioned twice.

Pupils are expected to 'learn to think and intervene creatively...become autonomous and creative problem solvers' (Department for Education and Employment and Qualifications and Curriculum Authority, 1999, p. 15). Recent pressures in education, such as rigid national examination systems, the introduction of national 'league tables' and regular school inspections from the Office for Standards in Education have, as noted by Richard Kimbell (2000, p. 211), 'contributed to the damping down of creative fire in design & technology'. Ken Robinson's Report (1999) argues that there is a shortage of teachers who aim to foster pupils' creativity, as there is excessive risk in being such a teacher for it involves discovery, risking, pushing limits and taking steps into the unknown. Ellis Paul Torrance supports this with the claim 'this is serious business - dangerous business and when you challenge students (or pupils) to be creative, you lose control' (1995, p. 107).

The rest of this chapter will discuss definitions of creativity; explore strategies to foster creativity and teach pupils to be creative. It will describe examples of pupils' work that are creative and present a model for developing creativity in the design & technology classroom. It will also provide suggestions for further study.

Defining creativity

Defining creativity in general terms has not proved an easy task, giving rise to a wide range of suggestions. At a simple level John Dacey and Kathleen Lennon (1998) see creativity as the ability to produce new knowledge. Margaret Boden (1994, p. 75) adopts a more complex view, seeing creativity as 'a puzzle, a paradox, some say a mystery' but essentially a novel combination of ideas that should include value. Edward de Bono (1992, p. 4) sees creativity as 'a messy and confusing subject, bringing something to life that was not there before'. David Feldman, Mihaly Csikszentmihályi and Howard Gardner (1994) consider 'big creativity' to be something that is of enduring value, contributing to an existing field of knowledge and transforming it. Whereas, 'small creativity' is more humble, though equally valuable, as it is an activity that gives a fresh and lively interpretation to any endeavour. Richard Mayer (1999, pp. 450-451) suggests, 'there appears to be a consensus that the two defining characteristics of creativity are originality and usefulness'. Teresa Amabile (1983, 1996) highlights the importance of a supportive social environment for creativity to occur. This has particular implications for the classroom in which the teacher is trying to teach pupils to be creative.



Many teachers believe that 'small' creativity is something we see in the design &

technology classroom.
Try to give some examples
from your experience.

However, a literature review indicates that there is still generally a lack of consensus over the meaning of the word 'creative'. In some cases the word is used to describe a product, in others a process, sometimes a personal quality and at other times a social quality. For some creativity is seen as rare, possessed by only a few, while for others it is a quality possessed in some measure by all. In the context of education the Robinson Report (1999) sees creativity as a universal quality that can be enhanced by teaching. The report defines creative activities in education as 'imaginative activities fashioned so as to produce outcomes that are original and of value' (1999, p. 29).

Designing and creativity

Jacob Bronowski in 1973 described designing as the creative process that visualises the future, plans and represents it as images that are projected and move about inside the head. In education designing is referred to by Bruce Archer, Ken Baynes and Richard Langdon (1976) as cognitive modelling and described by Ken Baynes (1989, p. 2) as 'the task of creating the form of something unknown, the ability to image, to see in the mind's eye'. Educational writers such as Richard Kimbell and David Perry (2001) and Bryan Mawson (2003) agree that this process underpins and lies at the

heart of design & technology so highlighting its potential for pupils to be creative. David Barlex (2003a) notes that design & technology does not have a high priority in the Robinson Report (Department for Education and Employment, 1999), although there is recognition of the potential for creativity in 'designing'.

Designing in the context of design & technology is a verb or a 'process' as it involves pupils carrying out a range of activities in order to find a solution to a brief or problem and meeting the needs of people. Designing is seen as a creative activity as it involves pupils carrying out a range of activities to bring ideas from the mind's eye into reality in response to peoples' needs and wants. The level of pupils' creativity will depend on the extent to which they have control of the ideas they eventually turn into products.

Teaching for creativity

The Robinson Report (1999, p. 89) considers creative teaching in two ways: first 'teaching creatively' and second 'teaching for creativity'. Teaching creatively is interpreted as teachers using imaginative approaches to make learning more interesting, exciting and effective. This could be described as 'good practice' where teachers themselves are highly creative and develop materials and approaches that interest and motivate pupils. In teaching for

creativity, the focus is on forms of teaching that are specifically aimed to foster or enhance pupils' own creative thinking or behaviour. Teaching creatively and teaching for creativity are both considered to include all the characteristics of good teaching including 'strong motivation, high expectations, the ability to communicate and listen and the ability to interest and inspire' (Robinson, p. 95). Additional criteria needed to teach for creativity are techniques to stimulate curiosity and raise self-esteem and confidence in pupils. The report notes that teachers need to recognise when these techniques are required and balance structured individual learning with opportunities for self-motivation and group work. The report suggests that when teaching for creativity teachers should:

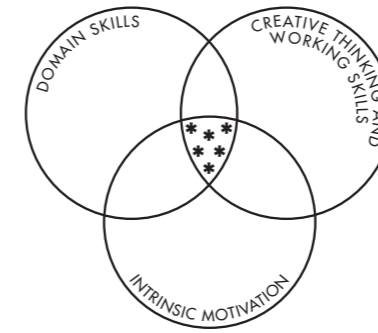
- Include broad and narrow experimental activities;
- Encourage a positive attitude to imaginative activity and self-expression;
- Provide space for generative thought that is free from immediate criticism and discouragement;
- Encourage self-expression;
- Understand the phases of creative activity;
- Be aware of the differing contexts for the development of ideas, the role of intuition, unconscious mental processes and non-directive creative thinking;
- Encourage and stimulate free play with ideas, the use of imagination, originality, curiosity and questioning and free choice.

05

05 The Creativity Intersection.

(Adapted from Amabile, Teresa M. (1989). "Growing Up Creative". New York: The Creative Education Foundation.)

THE CREATIVITY INTERSECTION



Can you give examples of these sorts of activities for the design & technology classroom?

Fostering creativity in design & technology

Facets of creativity

Traditionally, achieving functionality has been the main criteria for products designed and made in the design & technology classroom. However when teaching for creativity a wider perspective is required and other criteria become equally important. Creativity in design & technology requires a combination of clearly identifiable criteria where pupils make creative design decisions, including the overall concept plus its aesthetic, technical and constructional features. Marion Rutland (2005) has described these as:

- **Concept:** which requires the pupil to consider originality; novelty; feasibility, usefulness and function;
- **Aesthetic creativity:** which requires the pupil to consider 'ways in which the product will appeal to the senses' - sight, hearing, touch, taste and smell;
- **Technical creativity:** which requires the pupil to consider 'how the product will work' and the nature of the components and materials required to achieve this;
- **Constructional creativity:** which requires the pupil to consider 'how the product will

be made' and the tools and processes needed to achieve this.



In what ways do you think these headings could help you and the pupils identify creativity?

The environment for creativity

Teresa Amabile (1983, 1989, 1996), an American social psychologist, introduced two important factors to be considered when teaching pupils to be creative when she highlighted the impact of specific social factors and intrinsic motivation on creativity. She describes creativity as the confluence of intrinsic, or self, motivation, domain-relevant knowledge and abilities and creativity-relevant skills. The creativity-relevant skills relate to strategies and approaches that the teacher teaches pupils so that they have some tools for being creative. Teresa Amabile argues that our culture places great emphasis on talent, skill and hard work yet they make up only two-thirds of the creativity formula with intrinsic motivation as the remaining third. Thus, when helping pupils to become their most creative selves, it is not enough to train them in skills, give them opportunities to develop their talents or develop good work habits. There is a need to help them identify the place where their interests and skills overlap, which she calls the 'Creativity Intersection' and illustrates as shown above.

06 | 07

06 A Key Stage 3 example of playfulness in creativity: 'Walk on the wild side'.

07 Friendly melon bench.
(Produced by Richard Toxam.)

	1	2	3	4	5	6	7	8	9
Feelings	Lazy	Scary	Happy	Loving	Friendly	Chirpy	Grumpy	Energetic	Sad
Things you like to sit on	Tall box	Kerb	Bench	Horse	Chair	Sofa	Cushion	Rocking chair	Piano



	10	11	12	13	14	15	16	17	18
Feelings	Melancholic	Cheerful	Depressed	Lively	Blue	Peaceful	Angry	Spiteful	Resentful
Things you like to sit on	Suitcase	Railings	Rope	Fit ball	Bicycle seat	Table	Floor	Car seat	Carpet

Teresa Amabile argues that it is at the intersection that pupils' domain skills and creative-thinking skills overlap with his or her intrinsic interests and it is here that the pupil is most likely to be creative. Her focus on social factors as well as motivation is of great relevance for design & technology in that it emphasises the importance of the classroom or learning environment and the role of the teacher in ensuring an environment conducive to pupil creativity.

Artefacts to support pupil-pupil and teacher-pupil dialogue

Malcolm Welch and David Barlex (2004) interviewed several professional designers to find out what they used to support and enhance their own creativity. They revealed that they used sketchbooks (a personal record of generic research, with sketches, notes, doodles, not focused towards any particular end product, looking at surroundings and soaking up information) and ideas boxes (collections of items the designer finds intriguing, novel, appealing). To maintain a record of their designing as it occurred, the designers used job bags which contained everything to do with a specific project (every scrap of paper, sketches, and drawings, simple rigs, models, photographs, digital images of models etc.). Such artefacts are likely to be useful for pupils because (a) they support the 'internalised dialogue' that takes place in designing, (talking to yourself, inside your head, about your ideas as they are developing) and (b) they provide an arena for

conversations between pupils and teachers. This often undervalued opportunity to talk and to explore ideas is an essential pre-requisite to the development and evaluation of new and novel solutions to problems. It helps pupils take risks in handling new ideas, deal with uncertainty, and develop and articulate reasoned arguments to support their thinking.

For further guidance on the use of sketchbooks visit the address below where you can download a guide to using sketchbooks in design & technology:
http://www.nuffieldcurriculumcentre.org/go/CurriculumIssues/Issue_93.html

Q What are your views on the present GCSE and 'A' level portfolios?
To what extent do they encourage pupils to be creative?

Playfulness in creativity

When encouraging children to be creative it is essential to provide the time and appropriate classroom environment to allow them to 'play around' with their ideas. It is inevitable that some ideas will have less potential than others. It is only by 'playing' with their ideas and speculating about their usefulness and feasibility that pupils will be able to identify those ideas that are worth pursuing and those which should be discarded.

Unfortunately some methods used within design & technology advocate efficiency to creative idea generation using the minimal number of iterations to come up with an embellished rather than divergent and novel response. Although this 'playfulness' is time-consuming and can appear as idle chatter, in reality this iterative process is an essential ingredient for creativity. This does not mean that the 'playing with ideas' should be unstructured - quite the reverse. Structure is essential for novice designers as they are unlikely to have strategies for playfulness. The materials from the Key Stage 3 National Strategy give a range of useful activities that provide a framework for structured playfulness and encourage children along 'unconventional' thinking paths. "Walk on the wild" side is an interesting example. This technique is a way of using unusual word associations to generate novel and divergent ideas from random words and is a way of de-structuring thinking whilst facilitating idea generation. Themes have words randomly associated to them and then a random linkage is made between the two discrete themes to come up with unusual associations, which form the basis of the next design iteration. The table above shows two lists of words. The first list is associated with the theme 'feelings'. The second list is associated with the theme 'objects to sit on'.

Some random associations for designing seating are an angry chair, a friendly bench,

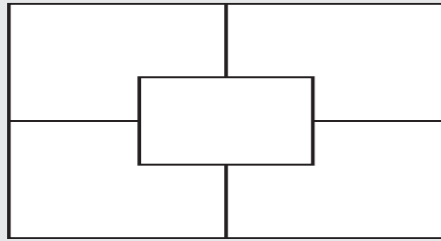
a resentful rocking chair. Some of these associations will be unfruitful but some will lead to interesting and unusual ideas. To increase the fun element spinners or dice can be used to generate genuinely random associations between the different categories. When using the dice the word lists can be numbered 1-6 (or any multiple of 6 e.g., 12, 18, 24 etc.) with pupils taking turns to throw the dice to see which random association they have to work upon. Note there is no shortage of combinations in the above example. There are 18 possible types of seat for each of 18 feelings giving $18 \times 18 = 324$ possible combinations.

If a pupil threw the dice and got a five (friendly) and a 3 (bench) then the question is what would a friendly bench be like? Who would the bench be friendly towards? Would it be in a friendly location? Or would it be environmentally friendly? Above is an example of a friendly bench based upon square melons. Why? Well why not? It is essential not to reject anything at the early stage and to see the associations as opportunities for creativity.

Q Using up to three dice and the lists above, have a go at generating your own random associations between feelings and something you sit on.

08 09

08 The layout of the Four by Four creating ideas sheet.
09 A morphology table for hand held products.



Colours	Style	Construction	Cost
Blue	Funky	Vacuum-formed	£1 - 3
Red	Futuristic	Injection-moulded	£3 - 5
Spotted pink	Retro	Blow-moulded	£5 - 7
Combination	Pop	Cast	£7 - 10

10 11 12 13

10 Product ideas - from pupils.
13



Here are three other examples from the National Strategy for design & technology.

Four by Four

Divide a large piece of paper into four with an additional large square in the centre as shown above. As individuals (or in a small group) you have four minutes to come up with a creative solution to a problem in one of the squares on the paper, e.g. Alternative uses for used CD's. After four minutes, you pass on your idea and receive another person's sheet containing their initial idea. You then have four minutes to work on the idea that you have received (whilst the other person works on your idea) in the next square. After four minutes, you pass on again and finally repeat for a fourth time. When you eventually receive your ideas sheet back, you can then review and synthesise the range of ideas in the final centre square.

Morphology

This is a way of generating large numbers of combinations by breaking down a product design into different features. If a group of pupils is designing a handheld product they can break down the design into headings related to colour, style, materials, cost, construction and so on. The table above shows an example. By combining features from each column the pupils can generate descriptions of new products. One possible set of combinations is a spotted pink, futuristic, vacuum-formed design costing £7-10. As there are 4 features in each of four

columns the total number of combinations is $4 \times 4 \times 4 \times 4 = 256$ combination. This is the perfect antidote to pupils who say they only have one idea!

An alternative to this is attribute analysis. You can find an example at this address: http://www.secondarydandt.org/resources/ks3/frk3_000000013.asp

SCAMPER

This is a technique that encourages divergent thinking when pupils use the SCAMPER analysis tool to think about an object from different perspectives. Doing this allows pupils to think about redesigning an object from multiple perspectives. Therefore if redesigning a fork using SCAMPER headings pupils might think about it as follows:

- **S - Substitute** - We could use chopsticks, fingers;
- **C - Combine** - We could use fork and knife and spoon;
- **A - Adapt** - We could create a tuning fork;
- **M - Modify** - We could produce a baby fork, garden fork;
- **P - Put to other uses** - We could use it for planting seeds;
- **E - Eliminate** - We could pre-shred all food, use adapted spoon;
- **R - Reverse/Rearrange** - We could think of alternatives to a fork (as if it had never been invented).

Scamper does not provide answers but provides a re-conceptualisation opportunity

that may spark idea generation. Note that Moshe Barak discusses SCAMPER and other problem-solving approaches to designing in his chapter.



Think about how you might use these strategies in your own teaching.

Product parade 1

Look at the products shown above. They were all produced by pupils as minor projects.



Before you read ahead, write down what you think each product might be and why you think this. A clue is that the products are all related so you can begin by asking yourself how products might be related.

The project that the pupils attempted embodies the principles outlined above in that the pupils had to work in an uncertain and risky way as they were operating outside of their existing knowledge base. The teacher did not pre-determine the outcomes. Clearly they are diverse in appearance and that alone suggests creativity.

In fact all the outcomes were produced in a medical product design project. This can be attempted with any age group in secondary school although the examples here are from pupils aged 14 and 16 years. These pupils were tasked with designing a product to be used in response to a specific medical condition. Such a task is immediately non-trivial and provokes genuine engagement unlike so many design tasks that pupils tackle. Not only did they need to consider the significance of the product, they also needed to consider the hidden (emotional) messages that the designs would create such as being reassuring, healthy and uplifting.

At the design stage, the pupils were very much encouraged to play with ideas. This was particularly evident with design 3 (image 12) where the student was playing with a 'Tixex' mouse by drawing out the white tape across the back of his hand. As he was playing he realised that this could be a way of applying medication across the skin without the need for injections (which was his original brief). Product responses 1 (image 11) and 4 (image 13) are redesigns of asthma inhalers with design 4 being aimed at the sports market and taking a stimulus from sports drinks plus making the product bigger than the usual inhaler for easier finding in a sports bag. Product response 2 (image 10) takes its stimulus from a wasp's tail as it stings and was a means of providing insulin for someone in early pregnancy.

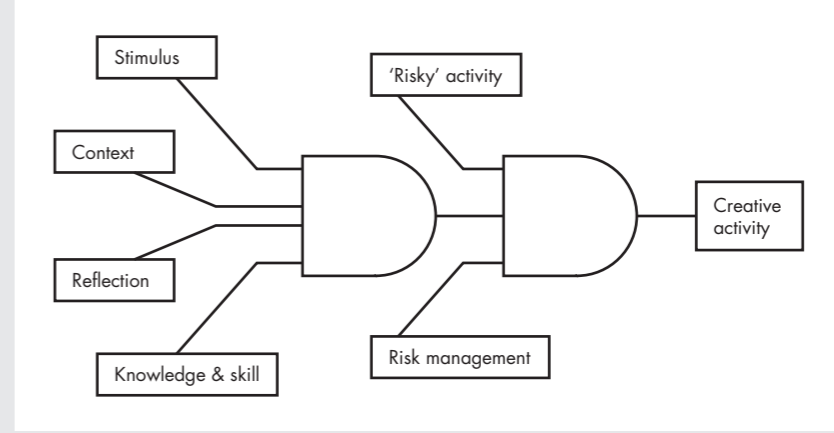
14	15
16	17

14 Wrapped-filled
- food products
17 designed by
pupils aged 15.



18

18 The inputs that
need managing
for creative
activity.



The development of each product was fraught with uncertainty. Pupils were given license to be risky and make mistakes from which they were able to recover. Achieving technical functionality was not an initial priority and did not drive the process. Playfulness was encouraged at the early stages, which translated into technical detail in the later stages. The results in terms of creativity speak for themselves.

Q How might this approach be used in one of the projects you teach?
In what ways would you have to change the project?

Product parade 2

Look at the food products shown above. They were made when Year 10 pupils working in small groups were encouraged to design and make products with a 'wow' factor. The approach allowed the pupils to design more freely rather than addressing a very specific brief, for example design and make a '...' from the beginning. It could be described as the 'Ready Steady Cook' approach, with an open range of ingredients available where the pupils could draw on their previously learnt 'knowledge and skills' base to develop their own range of ideas for a named target market.

Their first task was a product analysis of existing products to rank order existing wrapped-filled products against a set of criteria for design decisions.

The criteria were:

- Desirable nutritional content;
- Flavour and odour;
- Colour;
- Cost;
- Effective use.

The results from the product analysis task were analysed and ranked using a series of star diagrams for their potential as a handheld product by a 'taste testing panel' consisting of the whole class. This activity enabled the pupils to identify key criteria for a 'handheld' product.

The pupils then experimented in groups with a range of fillings and wrapping to explore the development of flavour, odour and taste. They chose two fillings to develop with different wrapping into a food product for a specific market. It was at this stage that each pair of pupils wrote their own design brief for a range of 'handheld' products. Their ideas they came up with were wide-ranging and varied, including:

- a range of handheld pastry snacks for a new fast food franchise;
- a range of handheld snacks for a school trip;
- a sweet and savoury product for a children's packed lunch box;
- healthy, deli-based food products for a champagne picnic for two;

- savoury handheld wrapped foods for an adult summer picnic;
- handheld wrapped picnic foods aimed at improving fruit consumption.

Q This work involved pupils writing their own brief around a theme. Could this work in your classroom? What difficulties might your pupils experience? How would you overcome these?

A model for developing creativity in the design & technology classroom

The Nuffield Design & Technology Project and the Qualifications and Curriculum Authority responded to the Robinson Report by inviting 20 teachers to attend a full-day meeting. The teachers presented pupils' work in art & design and design & technology that they considered creative. This was followed by visits to a selection of schools to watch lessons in progress and a further full-day meeting in which teachers presented and discussed pupils' work. From this overview it was possible to identify four features that had to be in place for pupils to act creatively in either subject:

- The activity had to be presented in a context to which the pupils could relate;

- The activity had to be supported by a significant stimulus which was often, but not exclusively, intensely visual;
- Focused teaching was necessary to provide knowledge, understanding and skills;
- An attitude of continuous reflection needed to be encouraged.

But these four features alone do not ensure creative activity. The deciding factor is the way they are managed. This must be done so that pupils can *handle uncertainty in exploring and developing outcomes*. There must be some risk associated with the endeavour in terms of the 'originality' of the activity as far as the individual pupil is concerned. If the outcome is certain to be successful, all possibility of 'failure' is eliminated, if there are no 'butterflies in the tummy' at some stage in the endeavour then the outcome will be mundane. This is illustrated above. These findings indicate clearly that the nature of the activity and the way in which the teacher manages the classroom are two factors that need to occur simultaneously when teaching for creativity.

Q Try to suggest means by which these inputs can take place in the way design & technology is taught.

Teaching *for* creativity is a complex and demanding activity in which the role of the teacher is crucial in creating a calm, supportive environment where pupils feel motivated, secure and confident to take risks. Teaching *for* creativity and fostering creativity is dependent largely on the teacher's professional ability to manage his or her classroom environment to meet these requirements. We believe that providing an appropriate environment and expecting pupils to be creative within that environment is at least as important, if not more so, than developing exercises to assess their creativity.

Further reading

This chapter has merely scratched the surface of what is an enormous topic which is increasing in significance. The issue of the relationship between creativity and intelligence has not been explored, but if this is of interest to you read the work of Robert Sternberg listed below. If you wish to develop your understanding further then the publications below will give you a good starting point as well as providing you with further references.

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