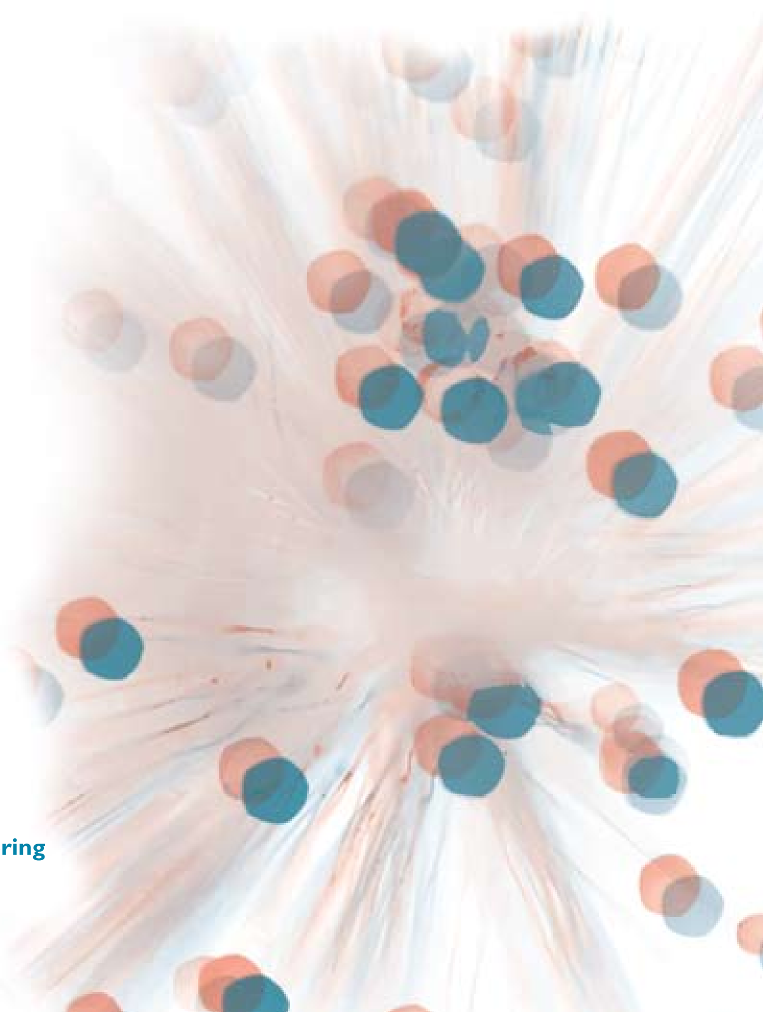
Assessing Creativity in Design: Emerging Themes for Engineering

an **Engineering Subject Centre** guide edited by
Peter Ball



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Assessing Creativity in Design: Emerging Themes for Engineering

Foreword

Dr Marianne Guldbrandsen,
Head of Design Strategy, Design Council

This guide focuses on the important but challenging subject of creativity and its assessment in education. Creativity is the generation of new ideas either by new ways of looking at existing problems or seeing new opportunities. Design is what links creativity and innovation. It shapes ideas to become practical, attractive propositions for people.

When creativity is properly employed, carefully evaluated, skilfully managed and soundly implemented it is a key to business success. This guide reminds us that it is not just in the output that creativity should be assessed but also the input, the process and perspectives that are brought to unravel creative thinking and execution. This is no easy task and the guide provides insight as much as it provides solutions, aided by a wide set of examples that allow the reader to draw out their own lessons.

It is important to foster creativity and risk taking in an educational environment. Creative thinking can best be developed through a nurturing and non-judgmental learning environment with a tolerance for ambiguity. Such an environment is crucial in an educational context that is fostering the creative skills and tangible solutions that our designers, engineers and marketers are developing. The best ideas are often developed in interdisciplinary environments. That is why creativity not only sits in R&D but exists throughout every step of product creation as well as across the organisation.

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Overview

A lot of attention is being given to creativity in both education and engineering related practice. It is a feature of all courses irrespective of the language used. Academics develop the creative thinking and skills of students and often use creativity as part of the assessment criteria.

But how do we assess this concept of creativity that we refer to? First we need to define what we really mean by it and appreciate the different perspectives from people to process to product. Is it something that people are born with or can it be taught? Is it about the flair and elegance of the journey that the student demonstrates or it is it purely about the destination they arrive at? Does creativity apply only to the appearance of a product or does it extend to the simplicity of unseen internal components?

It is necessary to consider the diversity in practice across the disciplines ranging from art to industrial design to engineering design. How do values differ and therefore how do we view the assessment differently? For example, how can we encourage risk taking and assess the outcome. The breadth of our examination of this area should include ethics and employability. UK-SPEC includes creative aptitudes for competence at all levels of professional registration and particularly for CEng level (Engineering Council, 2010). QAA benchmark statements for engineering refer to creativity in the opening statement on the characteristics of an engineering graduate (QAA, 2006). The Design Council activity seeks to foster creativity to support the UK design sector (www.designcouncil.org.uk). Against this backdrop how do we have engineering, technology or design in their titles? What are the metrics we use and to what extent do we encourage risk? How do we engender ethical behaviour and prepare our graduates for employment?

This resource is intended to provide a short introduction to the assessment of creativity in the design process. Those who are knowledgeable in the field may recognise and value the variety of perspectives it contains and appreciate the difficulties inherent in assessing creativity. Those who are new to the area may view the resource as a starting point – an introduction to an ongoing and stimulating discourse.

The debate on how to assess creativity in engineering teaching led to a workshop in December 2008. Academics active in the field and keen on progressing the debate contributed to the workshop and many in turn have contributed to this resource that captures strands of the debate as well as gives depth to them, using examples of current practice as well as considering areas that need further development.

Peter Ball

Context

Jon Adams, Northampton University

Creativity within the sciences and engineering is variously highlighted in current benchmark, review and policy statements as an essential capacity. What these statements fail to do, however, is to offer guidance on how creativity might be fostered and taught, let alone how it might be assessed.

UK-SPEC (2010) characterises Chartered Engineers as individuals who are able to develop solutions to engineering problems through “creativity, innovation and change”. Incorporated Engineers are characterised by an ability to “act as exponents of today’s technology through creativity and innovation.”

Similarly in Europe the requirements for registration as a European Engineer (Eur. Ing.) are specified as being able to demonstrate, through professional competence, “an awareness of continuous technical change and the cultivation of an attitude to seek innovation and creativity within the engineering profession” (FEANI, 2000).

Within UK higher education, the subject benchmark statement for engineering from the Quality and Curriculum Agency (QAA, 2006), in its opening definition of the characteristics of engineering graduates, links creativity with innovation, design and flexibility in manner. Debatably, it even proposes that creativity is a generic capacity across disciplines: “The creative way of approaching all engineering challenges is being seen increasingly as a ‘way of thinking’ which is generic across all disciplines.”

Even recent UK reviews and policy statements are not immune from recognising the value of creativity within the science, engineering and mathematics (STEM) subjects. Sainsbury's (2007) review of the Government's science and innovation policies identifies the demand for STEM skills as an important driver for economic prosperity by saying: "Policy-making in many areas of government also requires a supply of creative young scientists and engineers." Whilst Leitch's (2006) review of skills does not explicitly identify creativity, it does suggest five key drivers which are related to creative ability: competition, enterprise, innovation, investment and skills.

It is against this backdrop of benchmark statements and policies that educators must devise and implement strategies for developing, enhancing and assessing creativity within the sciences and engineering. Whilst tried and tested strategies for teaching and enhancing creative thinking within science-based subjects can be found in many texts and research publications (Woods, 1977; Felder, 1987; Wankat and Oreovicz, 1992; Felder, 1998; Dewulf and Baillie, 1999) we are all tasked to be mindful of the need to offer our students creative experiences and environments which are fit-for-purpose for the 21st century (Felder, 2006).

Opening up the teaching and learning debate

Mike Goatman, Coventry University

Can you confine 'creativity' to one agenda and one model?

Is the application of creative method in one context the same as in another? To what extent is creative method transferable? Are engineers applying creativity to find solutions for their constituency carrying out a similar activity to designers in the 'creative' sector? How do the brief parameters compare, the input criteria and the measures of success? There are a wide variety of models of creative practice involving method and evaluation. Does each method expand possibilities in one area and close down in another? Does a particular method focus particular qualities and in what ways can methods be tested by comparing results?

How is intuitive evaluation by creative designers to be correlated with analytical methods of evaluation?

Designers in the 'creative sector', the art school generated designers, make constant apparently intuitive judgments about design. This is based on a subconscious vocabulary of visual and material relationships and, perhaps, natural ability which does not always find synergy with the metric evaluative methods employed in other sectors (TRIG, etc.) and doesn't allow quantitative evaluation in a robustly comparable way. It is, however, respected as basic to the 'art'. How are these methods to be correlated?

Creativity is driven by expanding and constraining methods.

Creativity can be engendered by the expansion or 'divergent' method, for example the Design Council's 'Double Diamond', which expands the envelope of possibilities before the convergent analysis of evaluation and decision (Design Council, 2007). It can also be engendered by constraint, requiring new ideas and approaches in order to solve a problem and meet given target expectations. How do these two methods relate? Do they have different applications? Can they be applied to the same need or circumstance?

Is creativity best identified by method or results?

The 'creative design' sector is usually employed to produce solutions and the outcomes are considered to be the measure of success. This is due partly to the art/craft heritage from which it comes, and partly to the consultancy nature of most of its application. However, creativity in the engineering environment is more often evaluated by the definition of methods that are transferable and where application is not necessarily defined. How is creativity therefore to be defined?

Is creativity genetic?

Are some personalities more naturally creative than others, whatever application they are given? If so, to what extent is creativity personality based rather than method based? Jung's definition of the brain operating from the 'left side' (broadly calculating) and 'right side' (broadly intuitive), with each person having an inclination to varying extent one way or the other, has been made the basis of tests such as the 'Myers Briggs Type Indicator' (www.myersbriggs.org). These can be used to classify the aptitudes of a personality into ways of thinking and suggest that some people are naturally more creative than others.

Vignette I. Structured creativity techniques (Loughborough University)

Structured creativity techniques are introduced to 2nd year undergraduate Industrial Design/Product Design students in the Department of Design and Technology at Loughborough University to encourage ideation in support of Sustainable Design oriented project briefs set by industrial partners.

In a three hour practical session, which sees the students working in project groups, they are first introduced to a little theory on creativity, illustrated by examples of creative thinking. They are then introduced to the 'rules' of creativity: do not criticise other peoples ideas; do not criticise your own ideas, and are told that the 'judgement phase' comes later. We then get them started. The warm-up exercise gets them active by engaging them in a short paper-ripping exercise which makes them laugh and gets them talking. After this they engage in a series of creativity techniques with the intention of developing ideas around their chosen project brief.

Prior to the application of the first technique, students are asked to look beyond the product and reframe their brief into something which is less product focused (e.g. thermal comfort for the home, food delivery etc.) to encourage them to consider different ways of fulfilling the required function through mechanisms such as systems and services. Traditional creativity techniques such as 'What if…?' (Allan et al., 1999), Random links (Cave, 2005), and the 'Make me wheel' (Daniel, 2008) are combined with material generated during research projects, such as 'Excite me - surprise me - amuse me – satisfy me' (Lofthouse, 2007) which was developed by combining the template approach used by The Grove Consultants International (2003) and the 'emotion based' questions used in the Compass Ideation technique developed by Creative Advantage Inc. (2006). The aim of using these techniques is to encourage the students to think about their projects from different perspectives in order to stimulate new ideas. At the end of the session the students choose their favourite ideas to present back to the larger group. Following on from the session they undertake a feasibility assessment where they judge the ideas against a set of criteria in order to identify which one to take forward.

The approaches to fostering creativity in our teaching and learning content lead to a very broad range of possibilities. The following sections examine the different classes of using metrics before examining the differences in disciplines and how we encourage risk.

People metrics

Peter Childs, Imperial College London

The assessment of creativity is undertaken in education in order to provide an indication of an important human attribute and to motivate certain behaviour. The subject is an ongoing research topic. Several metrics for creativity have been developed, with some focussed on the person and others on the product, artefact or system concerned. If a measure is to be made it is important to have a definition of the quantity being measured. Creativity can be defined as the ability to imagine or invent something new of value. There are many alternative definitions for creativity, but most include attributions of novelty and value (e.g. Ghiselin, 1952; Mednick, 1962; Vernon, 1989; Herrmann, 1996; Bogen and Bogen, 2003).

Psychometric methods are predominant in the assessment of creativity and have been applied to creative processes, personality and behavioural correlates of creativity, characteristics of creative products and attributes of creativity fostering environments. Barron and Harrington (1981) concluded that the most robust correlates of creative achievement were: aesthetic sensitivity; broad interests; attraction to complexity; independence of judgment; intuition; high energy level; self-confidence and creative self-concept. Torrence's (1962, 1974) tests of creative thinking, TTCT, are frequently adopted to assess divergent thinking, although widely used criticism of such tests abounds, for example Kim (2006), who indicates that high scores on TTCT scales are not a guarantee of a person's chances of behaving creatively. Adjective check lists (Domino, 1970, 1994; Gough and Heilbrun, 1983) are widely used to identify an individual's creative aptitude: if a person can be described using a large number of the fifty-nine adjectives on the list, then he or she can be thought of as a creative person.

The Creative Product Semantic Scale (CPSS) (Besemer and O'Quin,1986; O'Quin and Besemer, 1989) measures product creativity by scoring novelty, resolution and style. The Consensual Assessment Technique (CAT) (Amabile, 1983) is a subjective assessment of product creativity where judges are asked to individually select and score criteria to determine the product creativity. Both CAT and CPSS are limited in application and utility for determining product creativity. The overall arguments against the CAT include time-demand impracticalities, lack of appropriateness for individual differences or cutting edge technology and high correlation with other factors. The principal weaknesses of CPSS are found in its vague definition of creativity and the lack of criteria to assess creativity, as well as questionable validation techniques. The assessment of the creativity that is innate and added to a product as a result of human intervention is a critical issue. Redelinghuys (1997) proposed an equation for the explicit quantification of product creativity. In their study, Horn and Salvendy (2006) identified the relative attributes of product creativity: resolution (27%); emotion (9%); centrality (8%); importance (8%); desire (7%) and novelty (6%). The assessment of creativity is reviewed by Treffinger et al. (2002).

Caskin and Kreitler (2008) report the use of the following criteria for evaluating creativity in design:

- fluency (quantity of filled pages)
- fluency (quantity of distinct units of information)
- flexibility (number of alternative solutions)
- elaboration (number of features included in the design)
- usefulness, functionality A (clarity of function of each component in a design)
- usefulness, functionality B (efficiency of functioning of a design)
- usefulness, functionality C (availability of all the drawing plans)
- usefulness, functionality D (degree to which the design may be realised)
- innovation value
- fulfilment of the specified design requirements.

The unintended influence of assessment on students' studying behaviour is sometimes referred to as the hidden curriculum (Snyder, 1971). The hidden curriculum can be interpreted as a set of unspoken rules, a hidden agenda which the student must follow in order to get a good grade, thus some students can find their motivation when preparing themselves for assessment (Hansen, 2004). It is therefore important to ensure that any explicit or implicit assessment of creativity is carefully designed and implemented in order to ensure appropriate behaviours in students and that it facilitates the intended competencies that are required and not just the competencies that are necessary for passing the assessment.

Comment

- Guiding characteristics of creativity have been identified.
- Metrics have been developed for creative processes, personality and behavioural correlates of creativity, characteristics of creative products and attributes of creativity fostering environments.
- For any assessment to be acceptable it has to be reliable, coherent (aspects must be mutually rational) and relate to the real world. The measures that have been developed so far do not cope well with all three. One of the major challenges is that the real world test is subject specific.
- The existing metrics, given the complexity of the subject, have inevitably identified flaws and statements such as *'I know creativity when I see it'* remain common in assessment, indicating an ongoing need for research and development of fundamental insight into this issue and, as a result, robust metrics in order to ensure appropriate and fair assessment in education.

Vignette II. Studies on creativity (Imperial College London)

Studies on creativity processes can be broadly classified into five categories (Plucker and Renzulli, 1999): psychometric; experimental; biographical; historiometric; biometric.

Psychometric methods involve the direct measurement of creativity and/or its perceived correlates/effects in individuals, relying extensively on self-report mechanisms (see, for example, Torrence, 1979 and Amabile, 1983).
Experimental methods involve the use of quasi-experimental and causal comparative designs (see, for example, Amabile, 1979).

The biographical or case study approach involves the construction of a case study of an eminent individual using quantitative research methodology based, for instance, on indisputable instances of creativity (Wallace and Gruber, 1989) and in this way the methodology avoids criticism on quality and excellence criteria.

The historiometric approach involves the measurement of creativity by means of an assessment of quantitative data from historical documentation (Ludvig,1992; Root Bernstein et al., 1995).

Biometric approaches involve the use of measures such as glucose metabolism while the subject performs a cognitive activity (see, for example, Haier et al., 1992).

Product and quality metrics

Chris Evans and Dave Smith, Aston University

The Engineering Subject Benchmark Statement (QAA, 2006) states that engineering relies on the three core elements of scientific principles, mathematics and 'realisation'. The realisation aspect includes the whole range of creative abilities and is an essential and distinguishing characteristic of engineering.

The competence requirement specified by UK-SPEC (Engineering Council, 2010) shows the general and specific learning outcomes that all graduates should have achieved during an accredited engineering degree programme. An element of the general learning outcomes is that students must be able to demonstrate 'creative and innovative ability in the synthesis of solutions and in formulating designs.' In terms of design specific learning outcomes, the students must also 'have the knowledge, understanding and skills to use creativity to establish innovative engineering design solutions, justifying the selection of ideas.' Here knowledge, understanding and skills have specific meanings:

- Understanding – capacity to use concepts creatively
- Knowledge – information that can be recalled
- Skills – acquired and learned attributes which can be applied almost automatically.

These learning outcomes are set at different levels of attainment for the year stages within the programme so that students can demonstrate (in order): consolidation, development, authority and (for the enhanced MEng level) mastery.

The institutional requirements of the IED (accredited to MIED) also essentially follow the UK-SPEC specific 'design' requirements.

It is therefore necessary to be able to set and assess student activities so that the students can reliably demonstrate that they have attained the threshold level of competence for these learning outcomes and also to be able to discriminate grades above and below the threshold. Indeed, it is good practice to give students the opportunity to demonstrate each learning outcome twice at both programme and module levels (Engineering Subject Centre, 2008).

This is where the problem lies. Reliable assessment implies an accurate and confirmable judgement and it is extremely difficult to even define 'creativity', let alone to produce an acceptable metric and reliably assess it. Creativity, in isolation, is essentially a very subjective issue.

In design the creative process is never stand-alone. It is always part of the total design process which incorporates multiple elements and requires iteration to successfully complete. Even in its most basic state the creativity process always involves aspects of creativity, analysis and evaluation (divergence followed by convergence).

Engineering and design programmes have always incorporated 'creativity' assessments in a number of ways and with different emphasis for different programmes, but mostly as an element within the design process of a project assessment (especially so in the later summative assessments). When assessed in this way it is relatively easy to 'test' a design by

its functionality – does it do what it was meant to do (pass/fail)? It is also usually possible to measure a design's performance against others by using weighted performance criteria to arrive at a quantifiable 'value' (e.g. cost, weight, speed). However, it is often quite difficult to judge the 'creativity and innovation' that might have gone into the solution. The problem may be to refine a product or part within a product, (e.g. with a brief to reduce weight by 5% whilst not increasing cost) and the creativity and innovation required may be subtle and not obvious but nonetheless taxing. In an extreme case it may be that the original design is the best (e.g. performance cannot reasonably be improved without incurring unacceptable cost increases) and the creativity and innovation is actually in recognising that fact by going through concept generation and evaluation processes without actually coming up with a distinct and obviously assessable innovative final outcome.
In this way the outcome metrics of product and quality are not independent of the process metric. In order to be able to make the distinction between output and the process metrics (so that specific learning outcomes can be demonstrated at different levels) it is necessary to devise multiple exercises with different objectives. This has the advantage of allowing ample opportunity for the student to demonstrate the learning outcomes and for the assessor to gain confidence in their subjective assessment of a student's learning and grade.

Vignette III. Learning outcomes (Aston University)

The engineering and design programmes at Aston University are currently being extensively revised to incorporate the CDIO™ (conceive, design, implement, operate) framework. Our 'best practice' has been identified to provide common teaching and assessments across commonly required learning outcomes for the different programmes. Amongst these common learning outcomes are the 'creativity and innovation' requirements.

At level 1 (consolidation) the design process methodologies are introduced through a series of short exercises. These are often without risk to the student (they cannot fail if they attempt the exercise) and so allow them to be less conservative in attitude and explore limits and constraints from both sides (success and failure). Learning by doing and making mistakes is an important part of creating better designs in time. By setting multiple exercises with different objectives it is possible to give more appropriate feedback and gain confidence in the overall grade given.

At level 2 (development) the learning is developed by providing more realistic and holistic exercises but still with the emphasis on the process rather than the outcome. This is necessary to help the students practice the process, and its variations, in preparation for professional life.

At level 3 (authority) it is possible to concentrate on the professional objectives of design where it is the more measurable total outcome that is most important, not necessarily the judgement about how innovative a design might be. However, the student should be able to demonstrate the processes they went through (which would include creativity and innovation at some level) and the assessor would be satisfied in the knowledge that the student had already achieved the required specific learning outcomes and was demonstrating the general 'intellectual ability' learning outcomes at a professional level.

Process metrics

Avril Thomson, University of Strathclyde

Typically, design project submissions are presented and assessed in a number of formats allowing students the freedom to express their creative process for assessment. These formats may be one or a combination of folio, critique, conduct, report, presentation and poster.

Folios allow students to express their creative process which in turn facilitates its assessment. In later years students are given the freedom to submit folios in whichever size, format, structure or "look" they feel appropriate. This leads to a large variety of work, ranging from largely graphical folios through to mainly text based reports. Assessment of folios and reports is carried out using well structured marking schedules which assess each of the clearly defined stages of the design process together with methodology, rationale, presentation and quality of final output. It is important that each of these criteria is considered as students may carefully execute a well defined and documented process and yet produce a low quality output or vice versa. Similarly, methodology and rationale are significant assessment criteria which can be applied to reward well thought through approaches which in themselves may be creative.

Critiques and presentations supported by well structured and clearly defined criteria are an excellent way of assessing creative projects. Students can freely present the aspects of their work they deem to be important, often providing a key indication of creativity. Questioning during critique or following presentation allows rationale, reasoning and creative process to be explored in depth and assessed as appropriate. Posters can be used to support presentations, again allowing freedom to express creativity for assessment. Conduct assesses a range of elements, including professional approach, ownership, time management, decision making and effort throughout the duration of the project. Adopting different combinations of these approaches provides the flexibility to meet dynamic requirements.

Vignette IV. Using robots to develop creative thinking strategies (Northampton University)

A three-year (two-cycle) Action Research project with engineering undergraduates at the University of Northampton has been used to develop creative thinking and problem solving process skills.

In the project Lego RCX and, more recently, Lego Mindstorm NXT robots have been used as a means of providing motivation within a problem based learning (PBL) scenario.

Mediation of the creative problem solving process has been an important part of the project, enabled in the first cycle through classroom-based sessions and in the second cycle through the use of reusable learning objects within a Blackboard-based virtual learning environment (VLE). The use of robots has enabled problem ownership, motivation and visualisation through a student-generated challenge. The scenario also provided the opportunity for students to acquire and develop a number of further creative problem solving skills, including the need for visualisation techniques, the desire for realistic experiential learning activities, the value of developing critical and reflective thinking skills and the ability to work in teams.

This work has been informed by a parallel project involving over 50 interviews to identify how creative problem solving is perceived by engineering students, academics and practicing professional engineers. Analysis of the interviews has taken the form of a phenomenographic study.

Student feedback through online questionnaires, focus groups and interviews indicates that the module developed through the project, and its means of delivery, has been successful in improving their creative problem solving skills. It also highlights the value of developing process skills within a practical and motivational environment.

The work has been kindly supported by two mini-project awards from the HEA Engineering Subject Centre at Loughborough University and a Learning and Teaching Enhancement Award (Fellowship) from the University of Northampton. Further details about this research work along with the RLOs to download can be found at: *http://www2.northampton.ac.uk/appliedsciences/appliedscience/engineering/problem-solving*

Disciplinary differences, divergences

Vicky Lofthouse, Loughborough University

A collaborative workshop attended by representatives of product design engineering, industrial engineering, industrial design and art to investigate 'what aspects of creativity are discipline specific' generated a number of interesting discussions and identified a number of key 'aspects' as being common to all the disciplines. These can be divided into three categories: process, outputs and attributes. In terms of 'process', common approaches to achieving creativity included idea generation, lateral thinking, imagination, visualisation tools, exploration and prototyping. Common outputs included the need for relevant communication and the importance of protecting and recognising intellectual property and common attributes were identified as originality, novelty and value.

A key finding, and one which is important to recognise, was that there is a real need to exercise caution when taking about 'aspects' of creativity. Although there was a clear common language emerging – e.g. teamwork, communication, drawing, thinking about things differently, constraints – the meanings and significance of the language varied considerably for each discipline. For example, the term 'communication' meant very different things to each discipline (hence the need for the addition of the term 'relevant' in the previous paragraph). Communication may involve Excel spreadsheets, computer aided design drawings, block models, sketching, detailed drawings etc. In addition to this some phrases seemed to be strongly 'owned' by some disciplines and, as such, perceived misuse of these terms can propagate misalignments in understanding.

Vignette V. Multi-disciplinary team 'design and build' projects (Aston)

The Royal Academy of Engineering (RAE) Visiting Professors Scheme noted that 'design provides an integrating theme for the study of engineering' (Royal Academy of Engineering, 2005). They recommended that 'multi-disciplinary team projects are the best way to introduce students to the technical and organisational complexities of design.' Design as an integrating theme is also recognised in UK-SPEC (the standard for recognition for engineers in the UK) (Engineering Council, 2010).

The general requirements of UK-SPEC have been incorporated into specific learning outcomes by individual professional bodies and these outcomes are inspected during accreditation. Design, build and test projects are recognised as providing a richer experience but require far greater resources that other more traditional teaching methods (RAE, 2005). They also fulfil many of the required institutional learning outcomes that are more difficult to satisfy on traditional programmes (i.e. some elements of the 'design' and 'engineering practice' criteria).

The recent in-depth study carried out for the RAE in engineering education (RAE, 2006) recommended that 'more and better quality project work is needed, based around real life problems, ideally delivered in collaboration with industry.' Team based hands-on projects will 'not only improve graduate performance in companies but can also improve recruitment into engineering courses and student motivation.'

A number of multi disciplinary team design and build projects are undertaken at Aston. Amongst these are the Formula Student and Shell Eco-marathon projects which are high profile, international competition based, design and build projects.

Successful projects depend, in part, upon creating and maintaining an environment that promotes creativity, confidence and productivity. Consideration should be given to:

- setting up and maintaining essential administrative functions for the projects
- providing group accommodation, communications and IT requirements
- making available project specific technical resources
- promoting project planning and management
- promoting creativity and synergy
- promoting confidence to allow designs to develop through detail into manufacture
- levels of supervision and assessment of the project
- involving other disciplines and maintaining their input
- matching the project requirements to the available module criteria in different programmes
- promoting capture and hand-over of the learning gained from one year to the next.

Creativity and risk-taking

Paul Cosgrove, Justin Carter and Fiona Dean, Glasgow School of Art

Increased interest in creativity has given rise to a proliferation of reports and studies such as Creative Britain (DCMS, 2008), NESTA (2008) and the Roberts report (2006). Often set within a discourse of skills, such documents outline the importance of developing creativity across diverse sections of society in order to achieve attributes such as risk taking, collaboration and creative thinking; skills defined as necessary in responding to increasing societal change. However, there has been criticism of aspects of this policy development as a "terminological clutter", where creativity becomes interchangeable and synonymous with a plethora of other terms such as 'innovation' in a discourse of markets, economy and creative industries (Galloway and Dunlop, 2007). With the exception of earlier longitudinal studies such as Getzels and Czikszentmihaly's (1976) study of problem finding in art; Madge and Weinberg's (1973) observations of art students and Douglas and Fremantle's more recent work on creative leadership (2007), little research offers insight into and from artists' perspectives on what creativity is and in particular what kinds of spaces and approaches to learning and teaching might support risk-taking. How can we assess this approach to learning and collaboration – getting things wrong – with the students themselves? An example from the Fine Art Studio is provided.

Vignette VI. Keeping it real: a view from the Fine Art Studio (Glasgow School of Art)

The studio as a place for risk taking and problem-making as seen through the cause and effect project delivered in term one of first year fine art.

Aims: The cause and effect project offers insight into an approach taken within the School of Fine Art which emphasises the importance of the studio as central to encouraging creativity. The studio is described by the School as a space that is “central to the learning and teaching of our practice-based subject” and one that “functions as […] a contemplative and critical space where decisions are made and ideas tested and discussed.”

Getzels and Czikszentmihaly (1976) make the observation that artists present creativity as a process, not of ‘problem solving’, but of ‘problem finding.’ Creativity, they argue, is richest not when people are presented with a problem to solve – even if not offered the means of doing so – but when individuals have to seek out the problem themselves. In cause and effect this is taken further as students are asked to problem-make and, through the use of notebooks, reflective journals and weblogs, record and observe their means of finding a problem/s, as well as their methods of investigation and resolution. More than success and failure, it’s the record of the journey - the making of the problem, often a new problem or question - that is a key aim of the project.

Project example: Cause and effect: the studio as a stimulus for problem-making

Process: The cause and effect project is delivered in term one of first year fine art, when students have just arrived in the subject area. One underlying aim of the project (and thereby rationale for introducing it at stage 1) is to encourage the student to explore and create new questions that are not so much focussed on inviting solutions to a prescribed problem, but more of an open invitation to participate in problem-finding or problem-making, whereby the students define the nature of the problem through intuitive play and investigation and present the outcome of their research to a live audience.

Cause and effect takes place in a large open studio space, some 2,000 square feet in dimension, involving around 30 students in a communal making activity. Working in small groups of three to four, students are set the task of resourcing the project, initially through found materials and objects that they use to devise and create a chain of reactions, where each event is triggered by the previous and in turn generates the next. The project is discussed in the context of practitioners such as Fischli and Weiss (1987), where collaboration involves a number of groups investigating the development of a discrete event. As part of a chain, it requires that each group negotiates with those 'before' and 'after' in order to resolve how their distinct part in the action relates to the whole. The completed work is eventually 'performed' as a live, public event, with each sequence contributing to part of a more elaborate chain.

Getting things wrong: Questions of success and failure are brought into sharp focus by the need to perform the work live. As the process culminates in a live public event, success relies not only on the ingenuity of problem-making and the methods and approaches of addressing the problem individually and as a group, but also on communication – a lot can and does go wrong and the project is centred on this as part of the learning experience.

Outcomes evaluation: As well as the need for individuals within each small group to help one another identify and make new problems that require different types of resources and investigation, groups themselves have to negotiate more widely, listening, responding and adapting to the needs of others. While cause and effect allows students to foreground individual skills, it also enables them to share experience and support one another. In a project where so much can go wrong and where students' perception of risk is heightened, a student-centred approach to assessment is vital - one which promotes the creative and collaborative aims of the brief. In this instance collaboration (and 'getting things wrong') forms part of that learning experience and is assessed by the students themselves through personal journals, reflections, archiving and sharing of learning, which forms the basis of post-project peer critiques. The studio space provides the necessary openness in which to test ideas and new ways of working in an environment where practice is shared and made visible, building up what Sennett (2004) has described as the kinds of respect, trust and mutual connections necessary to support the taking of risks.

Ethics

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In dealing with ethics it is necessary to distinguish between personal ethics and professional ethics:

- Personal ethics refers to how we treat each other in our daily lives.
- Professional ethics refers to the choices made in decisions that impact on an organisational rather than personal level, such as between two corporations or between a business and government (Fleddermann, 2008).

Issues with respect to creativity and ethics include:

- suppression of creative behaviour
- intellectual property
- legal aspects/commercial law
- criminality.

An analogy can be made between Heisenberg's uncertainty principle and the assessment of ideas. Just as it is impossible to pinpoint the location of an electron by measurement, so ideas can be illusive under the spotlight of assessment. Indeed, the assessment of creativity is contrary to the principles of divergence, a fundamental necessity of creativity embodied in the double diamond of the design process (Design Council, 2007). In the divergent phase of creative thinking we are encouraged to suspend assessment and judgement of ideas in order to provide an environment conducive to the emergence of a wide range of ideas. Divergence requires us to expose that most intimate of moments, an idea, something from within our minds and an expression of our person. Criticism of ideas is well known to provoke coping and defensive strategies. We therefore need to develop appropriate behaviours if we are to avoid our assessment strategies harming the very outcome we are attempting to encourage.

Creative behaviour will result in ideas, some of which will have a defined value that can be traced back to them. Some ideas can be attributed to a particular individual, while others result from the interaction between several people or teams. It is important to establish what mechanisms will be implemented to deal with any potential intellectual property rights (IPR) and appropriate care needs to be taken regarding the assertion or claim of a company or organisation to ideas developed by the participants.

Engineering is governed by many national and international laws. Behaviour or a product that is legal can be considered unethical. For example a product that emits an unregulated toxin into the environment is likely to be unethical, even if it is legal. Decision making in engineering will involve choices and, by implication, ethics. Some organisations or professional bodies operate a code of ethics that provides a framework for ethical judgements (Harris et al., 2000; Fleddermann, 2008).

Creativity, like intelligence, can be viewed as being used for intrinsic good or otherwise (Nickerson,1999). Criminals, for example, can be intelligent and creative. Some investigators have suggested that ethical diversity is desirable for creativity (Mcleod and Cropley, 1989). Subversive behaviour and boundary challenging can be effective drivers in creativity.

Industry needs and employee potential

Rajkumar Roy, Cranfield University

The Cox Review (2005) identified the need to improve creativity at different stages of a product or service life cycle. Organisations have to develop an environment where creativity is valued throughout the organisation. Design led thinking could be one of the instruments to promote such creativity as it essentially involves multiple concepts such as creation and exploration, an element of risk taking and an holistic approach to decision making.

In order to promote design led thinking, industry needs to develop recruitment processes and approaches that recognise the creative ability of individuals. Current practice looks only for specific skills, but skill based recruitment does not value the creative potential of applicants. In order to promote an all round creative culture within an enterprise, it is necessary to alter the recruitment process to include the assessment of the creative ability of the applicants. It is more challenging to implement such change within large enterprises and mainstream engineering organisations could potentially learn from small and medium scale companies within the creative industry sector.

For those individuals that are recruited, engineering organisations are often driven by their efficiency and productivity. A narrow view of efficiency may lead to a 'risk averse' culture within the organisation. It is necessary that engineering organisations develop and manage a more flexible environment where employees can take measured risks and are encouraged to create alternative ideas. In turn, there should be clear recognition for innovative ideas coming from employees. Few organisations already encourage employees through award schemes and small group activities. Management needs to appreciate the need for such change and should lead development of any new initiative in collaboration with its employees.

Creativity and innovation are two key capabilities required to improve the competitiveness of engineering organisations. The creativity of employees and the environment can develop new ideas and achieve step changes in the value proposition of an organisation. Innovation as an organisational capability, requiring good understanding of the market needs, customer aspirations and the commercial environment to successfully implement the ideas, helps to commercialise ideas by taking them to the 'market'.

Summarising comments

Much attention is currently being given to creativity in both education and engineering related practice. It is a feature of all courses irrespective of the language used. Academics develop the skills and creative thinking of students and often use creativity as part of the assessment criteria. UK-SPEC includes creative aptitudes for competence at all levels of professional registration and particularly for CEng level (Engineering Council, 2010). In the opening statement, the QAA benchmark for engineering refers to creativity as one of the characteristics of an engineering graduate (QAA, 2006). Furthermore, the Design Council actively seeks to foster creativity to support the UK design sector (www.designcouncil.org.uk).

In attempting to provide a short introduction to the assessment of creativity in the design process, this resource has opened up the debate about some of the challenges inherent in assessing the concept of creativity; from defining what we mean by creativity and appreciating the different perspectives, from people to process to product. We have seen that it is necessary to consider the diversity in practice across the disciplines, ranging from art to industrial design to engineering design. It is apparent that values differ and, therefore, this affects how we view the assessment of creativity, regarding, for example, risk taking, ethics and employability.

Those who are knowledgeable in the field may recognise and value the variety of perspectives represented in this resource and those who are new will hopefully see it as an introduction to an ongoing and stimulating discourse. It is hoped that readers of the guide will in turn contribute their own findings and discussion to the web pages accompanying the online html version of this guide at http://www.engsc.ac.uk/guides

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