By measure: creativity in design

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Abstract: Specific training may be required to develop creativity in design students. At the very least, training is valuable in developing creativity in first-year students. Creativity is a skill that can be examined, used and taught – and it is one that is central to designing. This paper presents the results of empirical research from a class in creative problem solving for design students. The nature of creativity and the structure of the class are described, and this is followed by an outline of the research methodology and the use of the verbal Torrance Test of Creative Thinking. Creativity, as measured through the test, significantly increased.

Keywords: creativity; design education; innovation; thinking, standardized testing

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Creativity – how we generate new ideas – is a critical skill in any field, and particularly in the field of design. It is a skill that can be employed in small tasks or large projects, but it is one that must be nurtured, developed and practised. In teaching a skill, the emphasis should be on active learning and extensive practice, and this applies equally to creativity.

There are various techniques for improving creativity, and there are many pragmatic and incidental ‘creative’ techniques that are part of the larger field. However, creativity as a human trait cannot be distilled into a quick trick, method or process: it is a complex skill comparable to research or writing. While there are intermediate activities, the development of one’s creative skills is a long-term endeavour and requires specific attention.

Within the creative fields, such as graphic design or architecture, the topic of creativity is revered, but the skill is rarely taught outside the traditional studio classroom. Design educators apparently tend to assume that work in the studio will develop the learner’s creativity. Thinking skills are often not taught directly, in the way that pragmatic and procedural topics are taught. In contrast, courses are commonly offered for other skill-based aspects of a university education, such as writing, drawing, computer use or research methods.

This study begins with an examination of definitions of creativity, differentiating it from ‘innovation’ and ‘intelligence’. The main aspect of creativity, the ability to develop divergent and applicable ideas rapidly, is central to the use of the Torrance Test of Creative Thinking, a widely adopted standardized exam. The demographics of the study participants, the methods of creative instruction and a pilot test are discussed before the results are examined. The study implications include the need to recognize the value of specific instruction in creativity in the design curriculum.

Creativity, innovation and intelligence

Creativity can be and has been described and defined in many ways. In general, it is seen as a cognitive and generative ability. ‘Creativity is the generation of new ideas – either new ways of looking at existing problems or of seeing new opportunities. . .’ (Cox, 2005, p 8).

‘The creative process . . . refers to the sequence of
thoughts and actions that lead to novel, adaptive productions’ (Lubart, 2001).
Creativity may be evident in the recognized genius (such as Beethoven or Einstein), but it is also evident in most people – and that observation is the focus of this study.
Creativity is important in many fields. ‘Creativity is a topic of wide scope that is important at both the individual and societal levels for a wide range of task domains’ (Sternberg and Lubart, 1999, p 3). Recent popular books, such as *The World Is Flat* (Friedman, 2005) and *The Rise of the Creative Class* (Florida, 2004), have illustrated the broad value of creativity. Corporations and governments on a variety of levels frequently look to support and encourage the development of creativity, particularly in the context of innovation, as a means of maintaining or improving economic status. For example, in Denmark Lego concentrates its efforts on the development of new and highly innovative toys as a means of retaining national economic health (Nielsen, 2004). The UK, as exemplified by the Cox Report (2005), and the government of the People’s Republic of China actively support the development of creativity (see, for example, Tischler, 2006).
Innovation, which is similar to creativity, deals with the novel or new but is more concerned with the adoption and acceptance of new or different ideas. Cox (2005, p 8) holds that ‘‘Innovation’’ is the successful exploitation of new ideas. It is the process that carries them through to new products, new services, new ways of running the business or even new ways of doing business’. Innovation is concerned with societal change or acceptance (Rogers, 1995), whereas creativity can be described as the individual sparks that precede innovation.
Creativity is also distinct from intelligence, to which it is often compared. Intelligence, raw cognitive ability, is the ability to remember and know – the ability to recall and use ideas from learning and experience. While there is some connection between remembering information and new ideas, they are independent aspects of cognition (Runco and Chand, 1995).
Some researchers consider creativity to be an aspect of an inclusive definition of intelligence: smart people are more creative. However, most in the field separate creativity from intelligence and recognize that retained knowledge (that is, intelligence) does not fully correlate with creativity:

‘Many studies recognize creativity as a cognitive ability separate from other mental functions and particularly independent from the complex of abilities grouped under the word “intelligence”’. Although intelligence – the ability to deal with or process large amounts of data – favours creative potential, it is not synonymous with creativity.’ (Preti and Miotto, 1997, p 2.)
Creativity is an ability – and an aptitude – to generate the new.

Teaching creativity
Efforts to increase creativity are widespread in education and are common in industry. While such efforts are not limited to training and educational activities, this direction has proved effective in increasing creative output, and is a preferred means (Montouri, 1992).
There is a wide range of methods within educational contexts to increase creativity. These include cognitive, personal, motivational and social interactive approaches (Bull et al, 1995). Addressing different types of learners and the different social/cognitive preferences of learners may also encourage the use of varied methods within the structure of a single class. Scott et al (2004) reported that encouraging and developing ‘divergent thinking’ was a consistent element in most efforts to increase creativity. Divergent thinking can be described as the development of multiple answers to stimuli, the capacity to think beyond one single answer to a question or problem.
In a meta-analysis involving 70 studies of evaluating creativity training, Scott et al (2004) observed a number of differentiating factors in creativity training. Time on task and extensive work were generally needed to develop skills in creativity. Courses that stressed structured techniques, such as formal brainstorming, were more effective than those that used unconstrained exploration or creative expression as a means to develop creative skills. The largest gains in measured creativity occurred through structured techniques such as critical thinking, convergent thinking and constraint identification.

The research venue
This research focuses on an existing course on creative problem solving (CPS). The course is a blend of theoretical instruction, practical application and rapid idea generation, and is taught by the author.
The nature of the course is consistent with recommendations inherent in Fasko (2001) and the findings of Scott et al (2004). The class is structured around organization, idea generation, collaborative activity, student-directed learning and the application of ideas. It has four principle aspects: repeated practice in
rapidly generating multiple and numerous ideas; coursework (lectures, readings, exercises) on methods and theories of creativity; weekly student-directed personal activities grounded in the learner’s environment (that is, each student publicly engages in unorthodox creative behaviour on a regular basis); and a series of collaborative activities. While specific activities vary from year to year, the basic structure of the course has remained consistent.

Anecdotal evidence from students completing the course has indicated a strong development of creative abilities.

**Torrance Tests of Creative Thinking and other methods**

As there is a wide range of definitions of creativity, and as evidence of creativity is extremely varied, there also is a broad range of methods to evaluate and study it. Plucker and Renzulli (1999) note a variety of current research directions, but point out that most research on creativity is based on psychometric methods – the ‘direct measurement of creativity and/or its perceived correlates in individuals’ (p 35). Both Guilford and Torrance viewed the idea of diversification as central to creativity and examined it principally through psychometric methods.

As noted earlier, creativity can be recognized as the ability to generate a wide number of ideas addressing a given problem or stimulus. It implies the ability to develop different types of ideas for any given instance, and also the ability to generate unexpected ideas. These are the three main aspects taken into account by the standardized tests of creativity developed by Dr Paul Torrance, and are categorized as fluency, flexibility and originality. The Torrance Tests of Creative Thinking (1974a) are the most widely used standardized tests of creativity: ‘...by far the most commonly used test of divergent thinking and [which] continues to enjoy widespread international use’ (Plucker and Renzulli, 1999, p 39).

This testing method is but one measure within a broad spectrum, but it does provide insight into certain aspects of creative abilities. It measures one aspect of creativity as it appears in the general population. Pragmatically, it is moderately easy and quick to administer, and tests can be scored by the researcher or the test publisher.

**Elements of the Torrance Tests**

The Torrance Tests of Creative Thinking (TTCT) are available in written and visual form; the written form was used in this study. The written version has six sections that ask for written responses to illustrations and verbal prompts. Each section is timed and responses are recorded for five minutes; one section of the test lasts for ten minutes. The written test has two versions, and is designed to be used before and after treatment. The versions have been designed to be comparable to each other and can be administered in any order or singly.

Creative people are expected to develop a large number of new ideas. Fluency, the first metric, is the ability to develop a large number of relevant responses to a given stimulus; that is, how many different ideas can a participant develop to address the question at hand? The tests pose a series of hypothetical questions and participants are evaluated in part by volume of response. For example, one could be asked to eat something different and possibilities such as apples, pizza, hot dogs and cheese would be expected. Each of these answers would count as applicable to the question.

Flexibility measures the ability to develop a wide range of differing answers. Creativity is expected to encourage answers that will go beyond slight differences and produce responses that are quite distinct from those previously developed. Creative people, as demonstrated by their flexibility, thus develop different types of answers. For example, when asked what they could eat, participants could respond with answers such as the food of a different culture or something not normally considered as food but still edible, such as leaves from a tree. These answers are categorically different from each other.

Originality evaluates participants’ answers against a list of common responses to the same problem. Creativity is often understood to provide answers that are outside common societal experience. For example, to eat something different could also include eating one’s own words or foot. Such answers are unexpected responses and are often described as novel or new.

**The pilot test**

A pilot test was completed in the autumn of 2004 using the verbal Torrance Test of Creative Thinking with one section of a creative problem solving course. Seventeen first-year students participated in the testing as part of their regular class work, and all took the test in the first and last weeks of class. Sixteen were women, and six had earned sufficient credits through advanced placement or previous college experience to be considered second-term students. All the students were in the college honours programme.

Scholastic Testing Service, the publisher of the test, independently scored the results. Creativity was found to have increased across all three metrics. A paired t-test was performed for each metric and all changes were
found to be statistically significant (t-test < 0.05). Fluency, the generation of ideas, increased by a mean of 34.5%. Flexibility, the diversity of ideas, increased by 22.8%, and originality, the generation of unexpected ideas, increased by 34.0%. See Tables 1–3 for additional information. (For administrative reasons the tests of two students were not scored.)

Given these strong results from the pilot test, it was hypothesized that some of the increase in creativity was due to the new experiences of first-year college students, or to the studio experiences of entering design students. A quasi-experiment was therefore designed to examine the class as compared to the larger population of first-year design students.

The study
The Torrance Test was again administered to the creative problem solving (CPS) class in the following year, with some differences in administration. The test was not administered within the CPS class but within the context of a larger class. Nine students from the CPS class were enrolled in an ‘Introduction to Design’ lecture class, and the other members of the large lecture class were also tested and would serve as a control group for the research.

The large lecture course is mandatory for all entering design students at the university and consists of a series of lectures, presentations and readings about design. The class included students from clothing design, interior design and graphic design. All students in the course also take at least one other studio class from a common design curriculum that includes basic drawing and an introduction to colour. All also take an introductory studio class in their discipline. The course is open to the rest of the university population.

Ninety-five students took both versions of the TTCT. To provide a more accurate evaluation of the effects of treatment, only freshmen/first-year students were scored as part of this study. Thus those who were scored included 47 first-year students and 13 first-year students with sufficient credits to be classified as second-term (meaning they had earned, through means such as advanced placement, a modest amount of college credit). Fifty-three were female and seven were male. Within this group, nine students were also registered for the CPS class and were evaluated as the ‘treatment’ group; six of these were freshmen and three had sufficient credits to be considered second-term. All were women, and all were in the college honours programme.

Results
The members of the CPS class experienced significant gains in the measured aspects of creativity in all the areas tested. The larger control group experienced slight gains in two measures, but neither was statistically significant. The gains for originality for the control group were significant.

Fluency
All members of the treatment group (those enrolled in the CPS class) experienced increases in measured fluency, with an average raw score change of 34.4%. These changes were significant at 0.05 (see Table 1). The fluency score for students in the control group increased by 2.5% over the course of the term, but this change was not significant.

The results from the testing were compared with a meta-analysis of creativity training programmes published by Scott et al (2004). In that study, 70 results of creativity training and testing were evaluated, and the effect size was calculated by the Glass Delta method. Glass’s Delta was calculated for each area of the Torrance Test.

Scott et al (2004) list a mean effect size of 0.70 for all combined instruction methodologies and a mean of 0.75 for divergent thinking methods, with a standard deviation of 0.67. The effect size for this class was calculated at 1.06 for fluency, which is higher than but comparable to the mean. It is approximately 0.42 SD

| Table 1. Fluency scores and comparisons: effect size. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Group            | Fluency RS – A mean | Fluency RS – B mean | Difference | t-test A:B |
| Pilot 2004 CPS (n=15) | 89-13 (19-24) | 117-25 (20-72) | 134-52% | 0-0000037* |
| Treatment 2005 (n=9)   | 94-67 (26-81) | 125-44 (33-73) | 134-41% | 0-00047* |
| Control 2005 (n=51)       | 88-40 (27-08) | 90-56 (33-04) | 102-45% | 0-49 |
| Treatment versus control, t-test | 0-42 | 0-0020* |
| Glass’s Delta, treatment | 1-056 | |
| Glass’s Delta, control   | 0-065 | |

Notes: The figures in parentheses are the standard deviations. RS=raw score. * Significant at 0.05.
above the mean, well within an expected distribution of results.

Flexibility
In both tested classes, scores on flexibility (the measure of divergent responses to questions) were found to have improved significantly. The mean of the combined groups increased by 22·8%, and the 2005 group alone increased by 35·3%. The increase was significant (at 0·05) for each group and for the combined CPS groups. In contrast, the control group score for flexibility increased by 2·9%, but the change was not significant (see Table 2 for further information).

Originality
The 2005 group experienced a 55·2% increase in the measure of originality (the generation of ideas that are new and uncommon in society at large) – indicating a strong and significant increase in this area. The control group increased by 16·3%, and this was statistically significant (see Table 3 for further information).

Glass’s Delta as calculated for originality for the treatment group was 1·21, and for the control group it was 0·262. This appears to indicate that about 25% of the increase in originality was due to the common activities of the larger class.

The treatment group was compared to the control group for both versions of the test. While there was no significant difference prior to treatment, there was a significant difference after treatment, in spite of significant gains by the control group.

Both sections of creative problem solving (2004 and 2005) were also compared with each other. In all six values – that is, fluency, flexibility and originality measured before and after the class – the two sections were not statistically different from each other.

Discussion
Creativity can be taught, or at least the ability to diversify thinking can be developed in students: the findings of this study are consistent with a number of others (see Scott et al, 2004) in terms of both scale and detail.

The findings support the idea that creativity is a trait which can be developed through specific course work. Results from both the pilot and control groups indicate substantial gains in measured aspects of creativity. The nature of the course, with a range of teaching methods and a long-term approach to developing creativity, appears to encourage the development of creativity beyond what is expected in a standard course. Creativity is, of course, context-bound, and the investigation of

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Notes: The figures in parentheses are the standard deviations. RS=raw score. * Significant at 0·05.
creativity as such must understand the full environment surrounding the teaching of it. The academic standing of those on the CPS course (all were honours students), other classes (all took design courses) and the new college environment could have affected the students’ development of creativity.

Given that the findings do not indicate a gain in most measures of creativity among members of the control group, design classes and the novelty of the college experience do not appear in themselves to encourage the development of creativity. The lack of significant improvement compared to strong gains for the control group suggests that there is value in specific instruction in creativity. The control group did show significant improvement for the originality metric, despite insignificant changes in fluency and flexibility scores. This may mean that, while the participants did not have a greater number of new ideas, the ideas that they did have were more divergent as compared to society as a whole. In other words, the students did not have more new ideas but those they had were more diverse after their initial college and design experience.

**Implications for design education**

It would appear that, even within a design curriculum, there is value in specific courses for developing creativity. The study indicates that teaching creativity in a separate course is effective in developing the ability in design students. It also indicates that design students in a comparable context do not develop their creative skills independently to the same degree as students in a specific course on creativity. If creativity is valued in design, curricula should therefore include specific training or education in creativity.

Within design curricula, or within the curriculum of any creative field, separate courses may be necessary for the full development of creative skills. While many techniques of creativity are commonly used in design courses (such as thumbnail sketches), these may not be sufficient to change creative behaviour. Secondly, domain knowledge itself is not sufficient to increase creativity. A specific concentration on creativity may thus need to be formally identified, so that it is taught as a distinct skill.

**Directions for further research**

The findings of this study raise a number of questions. Do students in the creative fields without specific creativity training develop their own creative capability at a slower pace than those who take a class in creativity? Do they ever catch up? Given a baseline of information on creativity in first-year design students, what improvement in creativity is observable in such students years later?

Research is needed into the retention of creative skills, and comparisons should be made between design students who participate in creativity training and those who do not as they progress through the curriculum.

Further, can the teaching of creativity be integrated into a large class or does it require the time and resources of a small class structure? Can creativity training be built into regular design and/or lecture courses? The formula of small classes with highly motivated students may have been an important component in achieving the measured creativity gains in this study. Interventions that are scalable (that is, applicable in larger classes and to a broader range of learners), however, will be more beneficial and financially viable.

One question that was not adequately answered by this study is whether or not the students in the creative problem solving courses were inherently different from those in the larger group; they were compared using the TTCT and were not significantly different before treatment. (While the initial mean scores of the CPS group were higher than those of the control group, they were not significantly different.) However, the CPS students had self-selected the course and may have had a higher propensity towards creativity. As honours students, and therefore as higher achieving students, they may also have had an advantage. Torrance (1972) indicates that there is some correlation between creativity and intelligence.

As this study focused on first-year students, it would be interesting to compare the results with a study of advanced students in design, as creativity may develop as the student progresses through the design curriculum. Longitudinal studies of students as they continue their design education should also be undertaken: as they complete their studies, does their skill in creativity develop more than that of their peers? Or do design students develop creativity as an attribute as part of their regular design education?

Finally, there may also be a distinction in the development of creativity in different fields of design – for example in graphic design as opposed to interior design. This may be present at the beginning of the student’s education, or it may develop as the student develops specific domain knowledge. Learning styles may vary between graphic and other design students, and the requirements for creativity may vary according to the particular field.

Developing an understanding of how creativity is developed and learned in design education is important. Design inherently values creativity, but seldom directly
addresses the subject in educational programmes. This study encourages the specific inclusion of creativity in the design curriculum.

Conclusion

The research summarized in this paper used the Torrance Test of Creative Thinking, verbal version. It involved design students at an American university in their first year of a four-year programme of study and compared the development of creative abilities in those students who attended a specific class on creativity (the treatment group) and those students who did not (control group). Significant differences were found between the treatment and the control groups.

It can be argued that creativity increased in the study group. At the least, a greater level of divergent thinking was observed – this is one measure of creativity but, according to Torrance (1974), does not ensure increased creative behaviour. As Kim (2006, p 3) explains, ‘...creative motivation and skills as well as creative abilities are necessary for adult creative achievement to occur’.

Extending the observation of design students to learners in other fields is speculative, but it may be valuable. Students in design fields are expected to be creative, but this research indicates that within creative fields only specific attention to the development of creativity can produce changes in the level of diverse thinking. Other learners in other, ostensibly less creative fields could also be expected to benefit from such training.

References:


