# IN SEARCH FOR UNITY
## FINDING A DISCIPLINARY APPROACH TO DESIGN CREATIVITY

**Anthony Williams, Hedda Haugen Askland, Michael Ostwald**
School of Architecture & Built Environment
University of Newcastle
NSW, Aust., 2308.
tony.williams@newcastle.edu.au

## ABSTRACT

This paper considers the concept of creativity as it relates to design and, more particularly, design education. Underpinned by the observation that there are multiple definitions and theories of creativity, the paper explores the possibility of finding a disciplinary approach to the concept. It is suggested that the multiplicity of definitions of the concept and the subsequent ambiguity that exist cause frustration and stress amongst student and staff, and that the lack of an overarching disciplinary framework hinder pedagogical development and generation of appropriate assessment strategies. Through an extensive literature review and analysis of primary data, the paper addresses these problems. It argues that behind the diversity of opinions, theories and definitions there is a sense of consensus, and that by adopting a multifaceted model of creativity and educating students about the complexity of the concept some of the ambiguity impeding teaching and assessment practices may be resolved.

**Keywords: Creativity, design education, multifaceted approach.**

## INTRODUCTION

Although there are multiple definitions and theories of the concept of design creativity (Christiaans 2002; Coyne 1997; Cross 1997; Dorst & Cross 2001; Gero & Maher 1993; Howard et al. 2008; Lindström 2006), confusion exists as to exactly what 'design creativity' means. Is it, for example, the quality of aspired design outcomes or is it a characteristic of the design process? Is it the result of individual inspiration and talent or of team work and prolonged effort? Is it spontaneous, unconscious and inert, or is it conscious, rational and strategic? Is it linear or dynamic? Is it the result of monologue or dialogue, of personal agency or social dynamics? Is it something objective or is it subject to interpretation? The list of questions continues and, depending on whom you ask and the context in which the question is posed, you may receive different answers to the same question.

The conceptual ambiguity surrounding the concept of creativity has serious implications for design education and training. Firstly, as found by Bachman and Bachman (2006) and Ostwald and Williams (2008), the lack of an unambiguous disciplinary definition of creativity leads to stress and confusion amongst both staff and students. Secondly, without an overriding disciplinary framework for how to understand design creativity, identifying its pedagogical dimensions is problematic, as is developing appropriate strategies to understand where different levels of creativity occur and how they should be assessed. This paper addresses these problems through an exploration of the concept of design creativity, as it is articulated in the literature and by leading design scholars. Through an extensive literature review and analysis of design practitioners' and academics' perceptions of creativity, the paper considers what creativity means in the context of design. The paper is divided into four main parts: first, it briefly outlines the methodology supporting the project of which this paper forms part; second, it briefly describes the existing scholarship on design creativity, providing a brief overview of key definitions and approaches to design creativity as it is found in the literature; third, it explores the diversity of opinions, theories and positions held by a number of design scholars; and, forth, it searches for

a sense of unity across the complex and diverse approaches.

## METHODOLOGY

This paper forms part of an ongoing Australian Learning and Teaching Council funded project, entitled Assessing Creativity: Strategies and Tools to support Teaching and Learning in Architecture and Design.[1] The project has two main goals: firstly, it aims to develop a conceptual framework for understanding creativity in design, and, secondly, it endeavours to develop a general model for assessment and a set of 'best practice' models for assessing creativity in the design disciplines (architecture, design, interior and landscape). The paper addresses the first goal, which was achieved in December 2010 with the publication of Creativity, Design and Education. Theories, Positions and Challenges (Williams, et. al., 2010). It is based on face-to-face, semi-structured interviews with 30 design academics at 7 Australian universities, written submissions from 39 leading design scholars from Australia and internationally, and a symposium with 22 senior Australian design academics and practitioners. Whereas the interviewees were randomly selected, the design scholars who contributed in writing and who participated at the symposium were purposefully selected due to their position in the field. Interviewees were asked questions related to three main topics: teaching creativity; assessment, feedback and reflection; and, quality assurance. They were not asked directly about their understanding of creativity, though reflection and discussion about teaching and assessment practices brought light to this. In contrast, those who contributed to the project in writing and who participated at the symposium were asked to consider five questions about creativity and design, which went to the core of the conceptual discussion. The five questions were:

- What is 'creativity'?
- How does creativity present itself in your discipline?
- What role does creativity play in design?
- What makes a person's actions or the products of their actions creative?
- Can creativity be assessed and, if so, how?

The interview questions and the questions for the symposium and the written submissions were deliberately open-ended. This allowed the interviewees and the contributors to approach and interpret the questions in their own way, subsequently providing further information about the diversity of approaches to creativity that underpin design education.

## CREATIVITY RESEARCH AND DESIGN

The project of which this paper forms part was initiated by the observation that there is no apparent consensus amongst design academics as to what creativity means in relation to design. Despite the central position of creativity to design (Casakin 2007; Taura & Nagai 2010b) and the importance of creativity as a driver for technological and societal change (Hennessey & Amabile 2010), creativity as a phenomenon remains relatively under-researched in the design domain. The 'study of design creativity', which explores the particularities of creativity as it relates to design, is quite recent (Nagai & Gero 2012; Taura & Nagai 2010a), and creativity has typically been explored in-directly through an analysis of design problems, the design process or the design product. It has been considered in relation to concepts such as routine and nonroutine design processes (Gero & Maher 1993); linear, descriptive processes (Archer 1965; French 1985; Howard et al. 2008), co-evolution and integrative processes (Akin & Akin 1996; Cross 2000; Korth 2000), prototype design (Rosenman & Gero 1993), problem-solving and concept-generation (Logan & Smithers 1993); novelty and appropriateness, transformation and concentration, surprise and value (Gero & Maher 1993; Maher 2010; McLaughlin 1993). Creativity has been portrayed as an absolute resulting from particular processes and as a relative quality dependent on context (Logan & Smithers 1993: 40),

[1] Support for this research and paper has been provided by the Australian Learning and Teaching Council Ltd, an initiative of the Australian Government Department of Education, Employment and Workplace Relations. The views expressed in this paper do not necessarily reflect the views of the Australian Learning and Teaching Council.

and it has been described as a rational problem solving process (Simon 1992 [1967]) and as reflective practice (Schön 1983, 1987). Some authors, such as Cross (2000), Milton and Hughes (2005), Mitchell (1993) and Yamacli, Ozen and Tokman (2006), focus on the personal, inert and/or learnt skills of the designer, whilst yet others consider environmental factors providing opportunity and constraints (Heath 1993; Onarheim & Wiltschnig 2010).

Despite this multiplicity of approaches, design creativity has traditionally been considered as a unitary concept related to the process of design and the products resulting from design processes (Taura & Nagai 2010b). However, as the above summary suggests, creativity is more than an element of the design process or a quality of the end-product of design processes. It is, as identified by Gero (2010) in his recent discussion of future directions for design creativity research, a multidimensional entity that can be found in the design, in the design process, in the designer, in the assessment of design, in the meeting between the users and the design, in the society in which design sits, and in the interaction of all of the above (Gero 2010: 15).

Gero's identification of 'where creativity may lie in the overall enterprise of designing' (Gero 2010: 15) resembles what is known as the 'contextualist' or 'confluence' approach to creativity. Over the past 50 years, there has been a widespread move towards a confluence approach within disciplines such as psychology, pedagogy, anthropology and sociology. Theories that combine cognitive, personal, motivational and socio-cultural elements have become well-established (e.g. Amabile 1983, 1996; Csikszentmihalyi 1988, 1996, 1999; Sternber & Lubart 1991, 1992, 1995, 1996), and creativity is increasingly perceived as 'a system of interrelated forces operating at multiple levels, often requiring interdisciplinary investigation' (Hennessey & Amabile 2010: 517). Design research has, however, remained relatively unaware of both theoretical and methodological advances in alternative fields, retaining a solitary focus on the discourse of design (an exception is: Cropely & Cropley 2010). This may be seen as one of the underpinning causes of confusion and ambiguity as there is a distinction between the theoretical discourse of design research and the more conventional discourse of design creativity. Whereas design research holds a particular focus on design processes and products, design practitioners, academics and students often embrace conventional stereotypes and aspects of theories from other fields, such as psychology, in their conceptualisations of creativity. This will be explored in the subsequent section.

## CREATIVITY IN PRACTICE – DIVERSITY OF APPROACHES

The primary data collected for the project suggest that design practitioners and academics hold a number of different approaches to creativity, which, to a varying degree, reflect historical and theoretical conceptualisations of the term. Firstly, there is a distinction between those who embrace the rationalist approach and those who maintain elements of romanticism within their otherwise rational approach. Secondly, there is a distinction between those who adopt a largely pragmatic approach and those who attain a theoretical approach to the concept. Thirdly, it is possible to separate between those who emphasise the creative process and the idea of a Eureka moment and those who place the creative design process directly in relation to social and environmental factors.

### *ROMANTICISM VERSUS RATIONALISM*

Confluence theories and the increased emphasis on context have seen contemporary theories of creativity move away from the ancient romantic discourse that has framed the historical debate of creativity (Williams, Ostwald & Askland 2010: 20). Romanticism refers to the idea that creativity is the result of divine inspiration and a reflection of innate (or divine) forces that cannot be promoted and fostered. Within the romantic paradigm, creativity is perceived as a process of unconscious and spontaneous, unfettered and undisciplined searching. It can be traced back to ancient Greece, though it has manifested itself throughout history in various models, including Freud's psychoanalytical approach to creativity as the result of unconscious, primary processes. Romanticism bestows creative agency on something beyond—or unconscious to—the individual. This is challenged by the rationalist paradigm, which is based on the idea that creative agency, talent and potential is an attribute of the individual; rather

than having a genius, as suggested by romanticism, the individual is perceived as being the genius. The rationalist paradigm emphasises creativity as the result of conscious work, rationality and deliberation, and it is attained that creativity can be promoted, fostered and assessed.

The theoretical and practical approaches to creativity in design have always, to some extent, been removed from the romantic paradigm. This can be seen as a result of the particular nature of design problems and the conflicting requirements of function and form; design has to balance the ideal of so-called creative solutions with the constraints posed by the particular contexts in which the design activity takes place. However, despite the requirement of function and the subsequent relativeness of design solutions, elements of romanticism inflict designers' approaches to creativity. In the written responses received for the project, as many as 15 contributions contained romantic elements. Romanticism weaved itself into the responses through words such as 'conscious and unconscious insights', 'magic', 'intuition, sensation and emotion', 'creative energy' and 'creative spirit'. By identifying creativity as something magical or exceptional, creativity is removed from the sphere of personal expression or expressive productivity. Creativity becomes reduced to the ability to 'tap into' the creative energy or connect with the creative spirit, subsequently removing personal agency. This is problematic within a teaching and learning environment and it is therefore not surprising to find that the participants whose responses entail romantic elements will place these within a broader rationalist framework. Hence, in most instances, 'the romantic legacy refers to the acknowledgement of the individual actor—the person—and the way their personality, innate motivation and inert traits, can influence the creative process' (reference to be inserted: 27). In fact, all the contributors emphasise creativity as something that can be promoted, fostered and developed. Creativity is referred to as the result of discipline and practice, as a rational and practical phenomenon, as social validation, and as a reflection of particular environments, fields and domains. This will be furthered discussed in the section about creativity as social process.

*PRAGMATISM VERSUS THEORY*

There is a clear distinction between participants who adopt a largely pragmatic stance on the topic and those who adopt a theoretical approach. The majority of the written responses (66%) reflect the contributors' experience as designers and/or teachers. These responses relate directly to students' creative abilities and they are framed by questions such as: what is creativity; how is it presented; can it be fostered and, if so, how; and how can it be assessed? Theoretical responses, on the other hand, are based on cognitive and psychological theories of creativity instead of the practical aspects of teaching creative courses. The difference between the two approaches is illustrated in the two following quotes, the first being an example of a pragmatic response and the second being an example of a theoretical response:

'…creativity is fairly complex, but I think it starts with, in terms of architectural design, the identification of the necessities or constraints of the problem […] creativity for me is the recognition of the opportunities that lie between those necessities and constraints.'

'[creativity is] the result of interaction/s of various parts of the brain resulting in a productive type of thinking.'

The last quote provides a definition of creativity as a cognitive ability, which is largely founded upon neuroscientific research. Though this research provides valuable insights in the phenomenon of creativity, it becomes problematic within the context of design as it places the phenomenon beyond the practical activities of architecture and design. Subsequently, although the respondent acknowledges the central position of creativity to design, she rejects it as a discipline agenda because: '[w]e don't know the cause of creativity; we don't know what "makes" a person creativity. [Therefore] it [is] to not worry about the creativity thing, but to worry about the artefacts and the contribution of the knowledge to the discipline.'

The implied rejection of creativity is evident in a number of other responses. It is argued that the term creativity has been 'hijacked' and 'pressed into the service of reductive thinking'. Subsequently, there is a need to withdraw back to the discipline and create an understanding of the disciplinary foundations of

the concept. It is suggested that, within the design teaching and learning environment, creativity could be replaced with alternative concepts, such as (wicked) problem-solving, reinvention, reinterpretation, lateral thinking, divergent thinking, flexible thinking, fluid intelligence, conceptual blending, hybrid thinking, and innovation. These alternative words draw the concept of creativity back to cognitive theory, placing the individual at the centre of the creative process.

*EUREKA VERSUS SOCIAL PROCESS*

The idea of process is emphasised by a number of the contributors. Process is, however, not straightforward and it is possible to discern those who consider the creative process as a staged—linear or dynamic—process towards an outcome, and those who emphasise the creative process through consideration of the context in which the design activity takes place and by which the design outcome is judged.

The former—the creative process as staged progression—emphasises the notion of Eureka or 'Aha' moments that happen through 'really intense immersion and reflection' around a problem. As one of the participants explained:

'[c]reativity is a two staged process; it's first production and second development of ideas, where production is the initiating activities a designer undertakes to inform or inspire ideas. The differentiation of design from creativity is not straightforward, a simplification can be discussed in the following terms: cognitive psychology has defined design activities as problem-solving, where the problem is ill-defined and open-ended. Creativity in this design process is often characterised by the occurrence of a significant event, a creative leap, [a] Eureka moment. So the most challenging, it is often only in retrospect that the designer is able to identify a creative leap, and that identification is often unreliable.'

This quote illustrates the blending of rational and romantic elements discussed earlier: on the one hand, it suggests creativity as a rational problem-solving process consisting of the mutually dependent processes of production and development, whilst it on the other hand suggests an abstract, unconscious process or event (Eureka moment). This sense of the inexplicable is removed in other responses, which emphasise the idea of 'recreation' or 'reordering'. These responses also emphasise process, though they pose a more relative stance by which the creative act is overtly placed in the context of present realities. In these responses, creativity is embedded in difference and can be measured through the distance between what has been created/produced and what already exists. The relational or contingent perspective focuses on the contextual nature of creative processes, these being as 'continuous experimentation with the world of things'. Hence, understanding creativity—as a process and a product—requires consideration of the social, cultural and physical milieu in which the creative acts take place.

The contextual factors and the role of the social milieu is also emphasised in relation to judgement and evaluation of creative products and processes. Reflecting the contextualist approach, one of the participants defines creativity as 'the act to create a novel, a new idea or a product that's deemed a valuable contribution within the intended field, and judged so by its peers.' This definition emphasises the role of the social and cultural context and of peer evaluation or judgement of creative outputs (ideas or products). Similarly, another participant argued that creativity is embedded in 'the social validation of imagination':

'[t]o be creative is not only to imagine, describe or fabricate something new or unprecedented. Creativity implies that a social good attaches to the new thing, so that its qualities are recognised in relation to their uniqueness as well as their utility, insight, aesthetic value etc. Thus to be creative is to show a capacity that is socially admired or respected.'

It is important to acknowledge that the notion of peer judgement will not only affect the evaluation of the final product, but also the production of the idea or artefact through the (perceived) boundaries, rules and values of the field; a set of prerequisites will guide the creative act as well as the judgement of its creative output. There is thus a need to understand the social, political, cultural and economic fields in which one acts, and to have an awareness of the audience, rules and boundaries of a given field. By bending these rules and boundaries, whilst at the

same time retaining a connection to the field and maintaining a balance between convergence and divergence, what is perceived as creativity may occur. This idea brings the notion of creativity back to the most common definition of creativity in the design literature; namely, creativity as the production of artefacts and/or ideas that are novel, yet appropriate, and that has value. At the same time, it moves the definition away from the conventional emphasis on the design product and the design process, and includes consideration of the person driving the creative act, the creative process, and the environment in which creativity occurs. These different aspects of creativity were clearly identified by one of the participants, who argued that:

'the act of creating can refer to product, person, process and situation […] The creative person involves a state of mind, the creative process involves play, exploration, openness […] The creative situation, [requires being] relaxed but purposeful, it needs both of those to be creative, I don't think anywone's creative under too much pressure […] [Creativity relates to] this notion of being aware of the rules, being aware of specific patterns, but not following them.'

The emphasis on context allows engagement with one of the challenges of creativity; namely, the lack of a uniform standard and a simple classification of what constitute a creative product. It allows for variation according to expertise and discipline. In the words of one of the participants:

'[w]hat you see is that [creativity] plays out differently on different levels of expertise […] We also see that between the disciplines of design and architecture, it's professionalised differently, it takes different shapes, people do different things.'

The acknowledgement of variation according to discipline and expertise has vast implications for education and learning; it suggests the possibility of growth, development and learning. It suggests that creativity is not a uniform phenomenon, trait or quality, but rather that it is characterised by levels of attainment whereby a creative work—in terms of process and product—will vary according to educational levels, experience and exposure.

## IN SEARCH FOR UNITY

The list of words, theories and concepts suggested by the study participants in relation to the question 'what is creativity' is long and complex. As illustrated in the previous sections, some answers are underpinned by romantic ideas, whilst others are supported by a strongly pragmatic and rational framework. Definitions of the term range from it being a practical ability with which designers face problems to a cognitive activity that lies beyond the reach of the conscious mind. Creativity is portrayed as a process, as a trait of individuals, as an acquired skill, as something that is external to the individual, as inert ability, and as social construct. The variation in responses is clearly illustrated in the use of key words in the written responses, which is summarised in Table 1.

| **Key word** | **Total number of responses (n=39)** |
|---|---|
| Approach | 5% |
| Ability | 54% |
| Intelligence | 13% |
| Mastery | 41% |
| Problem solving | 15% |
| Opportunity seizing | 13% |
| Imagination | 31% |
| Originality | 15% |
| Novelty, freshness | 54% |
| Difference, relative | 31% |
| Value | 46% |
| Surprise | 26% |
| Risk | 23% |
| Play, curiosity | 26% |
| Future-orientation | 21% |
| Boundaries, context | 46% |
| Re-create | 26% |

*Table 1. Number of written responses that included keywords*

Behind this veil of diversity there is, however, a sense of consensus. As illustrated in Table 2, the majority of the written contributions make reference to creativity in relation to person, process, product and press (contextual factors), also known as the 4Ps.

| Person | Product | Process | Press |
|---|---|---|---|
| 31 | 25 | 30 | 34 |

*Table 2. Number of written responses that make reference to person, product, process or press*

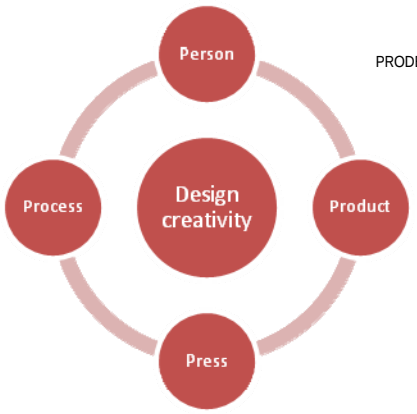
These four strands can be traced back to an analytical scheme proposed already in 1961 by educationalist Mel Rhodes (1961), who identified the four strands as:

- person – personal characteristics, such as personality variables, intelligence, values, personal attributes, experience, skills and intrinsic motivation;
- product – the outcome of the creative process, which may be classified according to a list of properties indicating their creative value;
- process – behavioural aspects, including empirical and sub-empirical referents such as ideas (initial, critical, composite), idea generation, creative leap, use of technology, combining and restructuring, and social and physical environment;
- press – contextual factors reflecting the relationship between the human beings and their environment, general influences that operate through implicit valuation and tradition and more specific influences.

The four strands are evident in the various contributors' emphasis on:

- personality variables, such as mastery, skill, experience, competence, motivation, ability and approach;
- production and development of design outcomes through risk taking, curiosity and exploration;
- problem solving and opportunity seizing, as well as preparation, illumination, inspiration, incubation, verification and evaluation; and,
- contextual and environmental factors.

The identification of these four strands brings us back to Gero's (2010: 15) argument that creativity is a multidimensional entity. Creativity is not unitary or singular concept or phenomenon, but rather a multidimensional construct within which the four strands overlap and intertwine. It is through the unity of the person, product, process and press that 'creative processes', 'creative problem solving' or




'creative place' take place; that is, as illustrated in Figure 1, through their interconnection, design creativity may emerge.

It is important to note that none of the four Ps are more important than the others; they are all needed for creativity to transpire and they influence and are influenced by each other. For example, the creative agent's (individual or group) cognitive characteristics will guide the creative process through his/her/their aesthetic taste, imagination, intellectuality, integration, flexibility, decision skills and

*Figure 1. A multifaceted approach to design creativity.*

divergent/convergent thinking. The creative product will reflect the creative agent's orientation, knowledge and technical ability, and it will be a direct outcome of the creative process. Creative press will inform the agent's personality and approach through longitudinal socialization and engagement with particular fields and disciplines, it will guide the creative process through the establishment of the premise for creative agency, the boundaries, rules and restrictions, and it will influence the creative product through domain validation, evaluation and judgment.

This model proposes a solution to the question of design creativity that acknowledges and values its complexity. Subsequently, it provides an understanding of design creativity that allows for disciplinary variation and diversity, whilst at the same time avoiding reducing it to the outcome of rational or relative problem-solving processes or the characteristics of particular products. It provides an overarching framework within which the various aspects that form part of creative design processes and influence (the evaluation of) creative products can be explored, consequently potentially enhancing the creative agency of the individual designer and the quality of design products.

## CONCLUSION: IMPLICATIONS FOR PEDAGOGY AND ASSESSMENT

There is no simple answer to the question of design creativity. Design creativity is a complex, multifaceted phenomenon that includes aspects of person, process, product and press. However, though any definition of creativity will be complex and encapsulate multiple variables, it does not have to be ambiguous and vague. The ambiguity surrounding the term is largely a reflection of a linguistic diversity that results from detail requirements and historical discourses. Through analysis of written and verbal responses to the questions 'what is creativity' and 'how does it present itself in your discipline', it is evident that at a more abstract level there is a sense of consensus that removes this ambiguity. There is agreement amongst design academics and practitioners that creativity is a rational phenomenon that encapsulates a range of factors, including some romantic ideals, related to person, process, product and press.

The multifaceted approach and the observation that there is, indeed, a sense of disciplinary agreement with regards to creativity have significant implications for design education and training. If employed with critical engagement and discussion of the concept the multifaceted model may go some way to resolve the ambiguity that exists in relation to creativity and design. The model provides a framework within which discussion and debate can take place, and through critical engagement, students can be encourage to reflect on the concept of creativity—as a phenomenon and as practice—and to understand and develop their own creative abilities. Creativity has to be placed on the agenda of design education, not only as an inert part of design, but as a theoretical, methodological and practical tool that can support students in their learning process and their future work. By adopting a holistic approach to teaching design, which reflects the multifaceted conceptualisation of design creativity, students will be introduced to and learn about the complexities of creativity, about the role of context and audience, boundaries and rules, about the balance of form and function, and, not least, about their role as both participants in the creative process and as judges of creative work.

## REFERENCES


Akin Ö, Akin C. (1996). Frames of reference in architectural design: analysing the hyperacclamation (A-h-a-!). *Design Studies* Vol. 17, No. 4, 341-361.

Amabile T.M. (1983). *The Social Psychology of Creativity*. New York, NY: Springer-Verlag.

Amabile T.M. (1996). *Creativity in Context*. Boulder, Colo.: Westview Press.

Archer L.B. (1965). *Systematic Method for Designers.* London: The Design Council.

Bachman L. and Bachman C. (2006). Student perceptions of academic workload in architectural education. *Journal of Architectural and Planning* Research, Vol. 23, No. 4, 271-304.

Casakin H. (2007). Metaphors in design problem solving: implications for creativity. *International Journal of Design,* Vol. 1, No.2, 21-33.

Christiaans H.H.C.M. (2002). Creativity as a design criterion. *Creativity Research Journal*, Vol. 14, No. 1, 41-54.

Coyne R. (1997). Creativity as commonplace. *Design Studies ,* Vol. 18, No. 2, 135-41.

Cropley D.H., Cropley A.J. (2010). Recognizing and fostering creativity in design education. *International Journal of Technology & Design Education*, Vol. 20, 345-358.

Cross N. (1997). Creativity in Design: Analyzing and Modeling the Creative Leap. *Leonardo*, Vol. 30, No. 4, 311-317.

Cross N. (2000). *Engineering Design Methods: Strategies for Product Design*. Chishester, NY: Wiley.

Csikszentmihalyi M. (1988). Society, culture and person: A systems view of creativity. In: R. Sternberg (Ed.), *The Nature of Creativity: Contemporary Psychological Perspectives*. Cambridge: Cambridge University Press, 325-339.

Csikszentmihalyi M. (1996). *Creativity. Glow and the Psychology of Discovery and Invention*. New York, NY: HarperPerennial.

Csikszentmihalyi M. (1999). Implications of a systems perspective for the study of creativity. In: R. Sternberg (Ed.), *Handbook of creativity*. Cambridge, NY: Cambridge University Press, 313-335.

Dorst K, Cross N. (2001). Creativity in the design process: co-evolution of problem-solution. *Design Studies,* Vol. 22, No. 5, 425-437.

French M.J. (1985). *Conceptual Design for Engineers*. London: Design Council.

Gero J.S. (2010). Future directions for design creativity research. In: T Taura, Y Nagai (Eds.) *Design Creativity 2010.* London: Springer, 15-22.

Gero J.S., Maher M.L. (1993). Introduction. In: J.S. Gero, M.L. Maher (Eds.) *Modeling Creativity and Knowledge-based Creative Design*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1-6.

Heath T. (1993). Social aspects of creativity and their impact on creativity modeling. In: J.S. Gero, M. L. Maher (Eds.) *Modeling Creativity and Knowledge-based Creative Design*. Hillsdale, NJ: Lawrence Erlbaum Associates, 9-23.

Hennessey B.A., Amabile T.M. (2010). Creativity. *Annual Review of Psychology,* Vol. 61, 569-598.

Howard T.J., Culleya S.J., Dekonick E. (2008). Describing the creative design process by the integration of engineering design and cognitive psychology literature. *Design Studies*, Vol. 29, No. 2, 160-180.

Kim M.H., Kim M.H., Lee H.S., Park J.A. (2007). An underlying cognitive aspect of design creativity: Limited Commitment Mode control strategy. *Design Studies,* Vol. 28, No. 6, 585-604.

Korth S.J. (2000). Creativity and the design process. *Performance Improvement Quarterly,* Vol. 13, No. 1, 30-45.

Lindström L. (2006). Creativity: What is it? Can you assess it? Can it be taught? *International Journal of Art & Design Education*, Vol. 25, No. 1, 53-66.

Logan B, Smithers T. (1993). Creativity and design as exploration. In: J.S. Gero, M.L. Maher (Eds.) *Modeling Creativity and Knowledge-based Creative Design*. Hillsdale, NJ: Lawrence Erlbaum Associates, 139-175.

Maher M.L.(2010). Evaluating creativityin humans, computers, and collectively intelligent systems. *DESIRE'10 Conference: Creativity and Innovation in Design*. Aarhus: Desire Network, 22-28.

McLaughlin S. (1993). Emergent value in creative products: some implications for creative processes. In: J.S. Gero, M.L. Maher (Eds.) *Modeling Creativity and Knowledge-based Creative Design.* Hillsdale, NJ: Lawrence Erlbaum Associates, 43-89.

Milton A., Hughes B. (2005). Claystation - design modelling and creativity. In: P. Rodgers (Ed.) *Crossing Design Boundaries*. Hoboken: Taylor & Francis, 437-443.

Mitchell W.J. (1993). A computational view of design creativity. In: J.S. Gero, M.L. Maher (Eds.) *Modeling Creativity and Knowledge-based Creative Design*.Hillsdale, NJ: Lawrence Erlbaum Associates, 25-42.

Nagai Y., Gero J.S. (2012). Special Issue on Design Creativity. *Journal of Engineering Design*, Vol. 23.

Onarheim B., Wiltschnig S. (2010). Opening and constraining: constraints and their role in creative processes. *DESIRE'10 Conference: Creativity and Innovation in Design*. Aarhus: Desire Network, 83-89.

Ostwald M.J. and Williams A. (2008). *Understanding Architectural Education in Australasia. Volume 1: An Analysis of Architecture Schools, Programs, Academics and Students*. Sydney: ALTC.

Rhodes M. (1961). An Analysis of Creativity. *The Phi Delta Kappan*, Vol. 42, No. 7, 305-310.

Rosenman M.A., Gero J.S. (1993). Creativity in design using a design prototype approach. In: J.S. Gero, M.L. Maher (Eds.) *Modeling Creativity and Knowledge-based Creative Design*. Hillsdale, NJ: Lawrence Erlbaum Associates, 111-138.

Schön D.A. (1983). *The Reflective Practitioner*. New York, NY: Basic Books.

Schön D.A. (1987). *Educating the Reflective Practitioner*. San Francisco: Jossey-Brass.

Simon H.A. (1992 [1967]). *The Science of the Artificial*. Cambridge, MA: The MIT Press.

Sternberg R., Lubart T. (1991). An investment theory of creativity and its development. *Human Development* Vol. 34, 1-32.

Sternberg R, Lubart T. (1992). Buy low and sell high: an investment approach to creativity. *Current Directions in Psychological Science* Vol. 1, No. 1, 1-5.

Sternberg R., Lubart T. (1995). *Defying the Crowd: Cultivating Creativity in a Culture of Conformity*. New York, NY: Free Press.

Sternberg R., Lubart T. (1996). Investing in creativity. *American Psychologist*, Vol. 51,677-688.

Taura T., Nagai Y., eds. (2010a). *Design Creativity 2010*. London: Springer.

Taura T., Nagai Y. (2010b). Discussion on direction of design creativity research (part 1) - new definitions of design and creativity: beyond the problem-solving paradigm. In: T. Taura, Y. Nagai (Eds.) *Design Creativity 2010*. London: Springer, 3-8.

Williams A., Ostwald M.J., Askland H.H. (2010). *Creativity, Design and Education. Theories, Positions and Challenges*. Sydney: ALTC.

Yamacli R., Ozen A., Tokman L.Y. (2006). An experimental study in an architectural design studio: the search for three-dimensional form and aesthetics through clay. *The International Journal of Art & Design Education*, Vol. 24, 308-314.