

A Design Research: The creative cognitive approach in the processes of shaping and making of a place

Gokce Ketizmen Onal,
Istanbul Technical
University

Abstract:

Creativity is a capability dominated by all humans, and is a natural part of the thinking process. Creative ideas are often generated during conceptual design which is the first step in the design process. Designers think about new concepts and develop them into design options. The creative cognition view of creativity provides a strong foundation for analyzing the conceptual design process because it utilizes basic cognitive mechanisms to explain how individuals create. One basic goal of the creative cognition approach is to improve understanding of creative process by using the methods and concepts of cognitive science. The present research aims at examining the creative cognitive process of an architect during the act of designing a house for her/himself. In order to investigate the contents of a thought process, protocol analysis method will be adapted to this experimental study. The evaluation will be structured on the action categories defined in cognitive research in design that covers physical, functional, perceptual and conceptual manners. This research lies within the scope of examinations of cognitive process of an architect for crystallizing design ideas in early design processes.

Keywords: creativity, cognitive process, protocol analysis, creative cognitive approach

Introduction

Creativity can be characterized as a complex activity, consisting of a special form of problem solving (Newell et al., 1962). The designers' mental representation evolves as the problem solving progresses. Therefore, each designer constructs his or her own representation of the design problem and deals with a problem that has become specific to him or her (Simon 1995). In practice, different designers, supposedly solving the same design problem, reach different solutions (Bonnardel and Marmeche 2005).

Attempts to understand and promote creative thinking have focused on a number of descriptive models. Rosenman and Gero (1993), for example, classified the

procedures that might occur in creative design models into four groups: combination, mutation, analogy, and first principles. Gero (1994) added emergence to these groups. Hennessey (1994) focused on the assessment of creativity by examining the relationship between ratings of product and process creativity. Dorst and Cross (2001) also studied this relationship, and using protocol analysis in their empirical study, evaluated the observations in a model of creative design as the co-evolution of the problem and solutions spaces. They claimed that the process of evolution, as driven by a reaction to surprise, could be considered as creativity in the design process. In architectural design processes, Akin and Akin (1998) analyzed the discovery of a creative solution that corresponds to the sudden attainment of an insight in the sketch of a design problem that was structured with several restricting frames of reference. Akin and Akin (1998) later suggested that *"the cognitive processes observed in these design fields closely resemble processes that play a role in a number of the traditional art fields such as music, writing, painting and sculpture"* (pp. 129-130).

Cognitive Stages of Creative Problem-Solving

Design, a field that inherently involves a creative problem-solving activity, necessitates the making of decisions in order to fulfill certain objectives. Over the years, several different models have been proposed to explain the process of creative problem solving. In fact, these models are not extremely different from each other and have quite a lot in common. The first of these models was originated by Wallas and consists of four stages: preparation, incubation, illumination, and verification (Hasirci and Demirkan 2007). Plsek (1997) claimed that, in establishing the stages of creative process, many models use the common theme (such as Bandrowski's, 1985, Model for Creative Strategic Planning; Barron's, 1988, Psychic Creation Model; Fritz's, 1991, Process for Creation; Treffinger and Isaksen's, 2008, Creative Problem-Solving Model; Koberg & Bagnall's, 1981, Universal Traveler Model; Osborn's, 1953, Seven Step Model for Creative Thinking; Rossman's, 1931, Creativity Model). On the other hand, Finke et al.(1992) propose Geneplora, a general model of creative cognition that can be applied to the conceptual design of products. The model consists of preinventive structures, generative processes and exploratory processes. This approach is based on the experimental methods of cognitive science. The aim of this approach is identifying the specific cognitive processes and structuring that contribute to creative acts and products and to develop novel techniques for studying creativity within the context of controlled scientific experiments. A central feature of the

creative cognition approach is that it ties in with current research in traditional areas of human cognition and cognitive psychology (Finke et al., 1992). That findings of creative cognition research can have important implications for both advancing our understanding of creativity and for extending current methods and ideas in these traditional areas. In fact research in some of these areas, such as imagery, categorization, and problem solving, has already begun to move in the direction of exploring creative cognitive processes (Smoliar 1995).

Creative ideas are often generated conceptual design- the first stage in the design process. Designers think about new concepts and develop them into design options. The creative cognition view of creativity provides strong foundation for analyzing the conceptual design process because it utilizes basic cognitive mechanisms. Different designers have different creative abilities, but all designers use the same cognitive process (Benami 2002). Based on all these information, it can be admitted that creativity is about the designer cognitive mechanism. In order to reveal the data that affects the design process and measure the creativity, cognitive actions are needed to be investigated. As set out here, cognitive actions needed to be defined by a logical research method.

Cognitive Actions

For to identify the cognitive actions of a designer, coding scheme is used that enables to systematically code cognitive actions of designers from video/audio protocols. The coding scheme has produced relatively similar results, even when used by different analyzers (Gero and McNeill 1998).

The purpose of the analysis was not to directly obtain results with full generality but to assess whether this type of approach could produce useful results. The results of protocol analysis studies and coding of designers' cognitive actions led us to evaluate sketching using concepts from mental imagery processing.

Based on literature analyses four types of actions has been developed for the case study: physical, perceptual, functional and conceptual. This classification was obtained by revising Suwa and Tversky's (1997) information categories in such a way that the four categories correspond to the levels at which incoming information is thought to be processed in human cognition. Past literature in cognitive science supports the proposition that information coming into human cognitive processes is processed first sensorily, then perceptually and semantically. Physical actions correspond to sensory level, perceptual actions to perceptual, and both functional and conceptual to semantic (Suwa, et al. 1998; Ketizmen 2010). All action categories can be seen at table 1.

Physical Actions

As Suwa, et al.(1998) states that the first category, physical, refers to actions that have direct relevance to physical depictions on paper. There are three types of actions. Physical actions are divided into three categories, which are 'draw', 'modify' and 'copy' actions (see Table 1). These actions have been referred to as "P"-actions (as it is the capital letter of "physical"). They had also 'look' actions and actions that were related to motion of pen or hands, but the present experiment did not employ those subcategories of actions.

Perceptual Actions

This action category is divided into three, which are named as features, relations and implicit subcategories. As described in Suwa et al. (1998) features refer to visual and spatial attributes of depicted elements such as their shape, size or texture. The second class defines spatial relations among elements such as connectedness, alignment, and remoteness. There is also an actions related to implicit space. These actions have been referred to as "Pe"-actions (as it is the capital letter of "perceptual").The subcategories and the corresponding cognitive actions can be seen in Table 1. These sub-categories were selected from Suwa et al. (1998) and Bilda (2001), and were revised and new subcategories added in meaning identification to fit this study's situation.

Functional Actions

This category is divided into two subcategories named as 'implement', and 'thought' functions. 'Implement' refers to the functions related to implementation of functional criteria that the designer makes up in his/her strategies. The subcategory thought functions, is related to the functions, which the designer thinks of during the design process. The functions (Table 1) were selected from Suwa et al. (1998) and Ketizmen (2010) were revised in meaning identification to fit this study's situation.

Conceptual Actions

The fourth category, conceptual, refers to cognitive actions that are not directly suggested by physical depictions or visuo-spatial features of elements (Suwa et al. ,1998). The first three categories are taken from the research made by Suwa et al.(1998) and Ketizmen (2010) were revised in meaning identification to fit this study's situation. The C4 category has added to this action in order to fulfill the all the conceptual action of a designer.

Category	Sub-category	Codes	Description
Physical Actions	Draw	Pa	Making new depictions (drawing lines, walls, things which are object, furniture, etc.)
		Pb	Depicting a symbol that represents a relation.
	Modify	Pc	Writing words for describing the thoughts.
		Pd	Revising the shape, size, or texture of a depiction.
	Copy	Pe	Erasing a depiction / delete a wall or object.
		Pf	Tracing over a depiction on a new sheet of paper
		Pg	Description of an object in a space.
Perceptual Actions	Features	Pea	Attending to the feature of a new depiction (shape, angle, size, texture)
		Peb	Attending to the new feature of an exist depiction
	Relations	Pec	Creating or attending to a spatial relation between two space components or area
		Ped	Creating or attending to a spatial relation between the present and past.
		Pee	Attending to the location of an object in a space component.
		Pef	Discovering an organizational relation between things/objects
	implicit	Peg	Impose the meaning on the formerly described relations.
		Peh	Emphasize the feelings about a space.
		Pei	Emphasize the features about a space.
		Functional Actions	Implement
Fub	Associating a new depiction, feature or relation with a specific function that was previously thought or newly discovered.		
Fuc	Re-interpretation of a function		
Fud	Permanence of a function		
Thoughts and functions	Fue		Thinking of a function independently of depictions.
	Fuf		Remembering a function
	Fug		Describe a new function.
Conceptual Actions	Self evaluations	C1	Set up goals
		C2	Retrieve knowledge
		C3	Make preferential and aesthetic evaluations
		C4	Make socio-cultural evaluations

Table 1: Cognitive Actions

The experiment

The design task of the experiment was “designing of a house” that reflects the designers herself. The experiment conducted around a table. During design process the one year experienced architect express her ideas loudly and all the process recorded. After finishing

the sketch problem, the participant was asked to explain her design decisions and preferences. The process went on like an interview to let the designer evaluate her design and at the same time to gain a previous insight on the designer’s view.

Protocol analysis results

In order to investigate the contents of a thought process, protocol analysis method is adapted to this experimental study. The evaluation is structured on the action categories defined in cognitive research in design that covers physical, functional, perceptual and conceptual manners.

The frequency with which functional, perceptual, physical and conceptual actions occurred throughout the design process of the architect was examined. She produced six pages of sketches. The rectangular closed shape in Figure 1 is the property line of the site given to her. She was asked to arrange a home for herself. Also given was a pair of parallel lines representing a public road that runs from the south of the site to the west. She stated in the report that each Figure presented a distinct design phase in the process. Figures 1 and 2 involved analyzing both the site and the design requirements. Figure 2 was the phase to roughly arrange things on the site. This arrangement became the basis of all the subsequent pages. In Figure 3, she explored one possible design based on the arrangement. In Figure 4, she tested another way. In Figure 5, she worked on an accurate building plan based on Figure 4. In Figure 6, she worked on a building plan based on Figure 3. For each page, the sum total of occurrences of physical, perceptual, functional and conceptual actions are determined. The cognitive actions used during the design phases with their explanations can be seen in table 2. Table 3 shows, for each page, the ratio of occurrences of each type of action to the total number of occurrences.

In figures 1 and 2, physical actions were dominant while functional actions were less frequent. In Figure 3, functional actions occurred more frequently than in the first two pages, and physical actions were less dominant. In Pages 4, 5 and 6, this pattern was more relevant. In Figure 6, functional actions and physical actions increased. Also perceptual and conceptual actions are dominant. This tendency is more than Figure 3. Actually, in the first half of Figure 6, she emphasized some of the basic arrangement she had made in Figure 3 and tried a new arrangement with which to explore a detailed building plan.

within all these actions and this can be admitted as the concrete indication of the creativity. And all these findings show that, creative cognition approach is the specificity with which it characterizes both the nature of basic cognitive processes and how they operate on knowledge structures to produce original and task-appropriate ideas.

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