

# Hidden Dimensions of Creativity Elements in Design Process

Halime Demirkan

*Bilkent University*

Deniz Hasirci

*Izmir University of Economics*

The aim of the study was to determine the items that can be evaluated as the components of creativity in design process. Factor analysis was applied to determine how well the items corresponded with the explored creativity characteristics. An overall component analysis was conducted to achieve a holistic approach to creative design process. It is found that the primary dimension responsible of 46% of the total variance is only composed of product components. The second dimension responsible of 19.54%, and the third dimension responsible of 14.46% of the total variance are both composed of the interaction of person and process components. Therefore, it can be concluded that the product is the strongest factor in determining creativity in design process.

The architectural design process distinguishes itself from the other problem solving tasks by requiring internal as well as external information. The internal information is specific to the problem domain while the external information is related to values such as cultural norms or standards. Due to the nature of design process, designers solve problems that are not well defined and the methods that they use are not fully understood (Demirkan, 1998, 2005). Although creativity is considered as one of the key concepts of design process, designers neglected to make research on creativity for many years. Christiaans and Venselaar (2005) classified the difficulties of making research in design field in two categories. The first one is the interference of concurrent protocol analysis method on the cognitive processes of designers during a problem solving activity. The second is that there is no one specific way of assessing the performance of designers due to the nature of design activity.

Later on, some studies investigated the creative person, process and product as the essential elements of creativity in design context. The creative person studies mainly attempted to find out creative personal

traits of exceptional designers (Lawson, 1994; Candy & Edmonds, 1996; Cross, 2002). However, the studies that were related to identify creative processes had various approaches to the problem domain. Runco and Chand (1995) proposed a model of creative thinking with problem finding, ideation and judgemental processes as primary components; and knowledge and motivation as secondary components which are only contributing and not controlling the creative thinking process. They emphasised the importance of interaction among the primary and secondary components as well as in each component level on creativity. Analyzing the conditions of creative architectural design process, Akin and Akin (1996, 1998) concluded that the person should have certain skills in creative problem solving process as well as accumulated design knowledge. Goldschmidt (1991; Goldschmidt & Tatsa, 2005) made the analysis of design processes that focused on the links among design ideas or decisions and considered the ones that are richly interlinked with other ideas as creative ones. Amabile (1983) stated that creativity is a property of products and developed a tool for the assessment of product creativity. Finke, Ward and Smith (1992) conducted experiments where participants were provided with shapes and forms as lines, circles, triangles, letters and were instructed to create objects with functions, such as furniture or tools. Besemer (1998) proposed the three

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Correspondence should be sent to Halime Demirkan, Bilkent University, Faculty of Art, Design and Architecture, 06800 Bilkent, Ankara, Turkey. E-mail: demirkan@bilkent.edu.tr

factor-model that is composed of novelty, resolution and elaboration, and synthesis dimensions. She tested the three-factor model for understanding product creativity in three designed chairs.

Over the past years, mostly researchers have used creative products to investigate the process of creativity. Roy and Design Innovation Group (1993) developed case studies in order to understand creative process and determine its relationship with innovative product development. Hennessey (1994) explored the mechanisms underlying the consensual assessment procedure in the relationships between ratings of product and process creativity. Using the protocol data of nine experienced industrial designers, Dorst and Cross (2001) evaluated the designs on overall quality and creativity aspects. Hasirci and Demirkan (2003) conducted an empirical study in two art-classes of six graders and found that process and product occurring within the same environment were highly correlated with each other. Christiaans and Venselaar (2005) studied the amount and type of knowledge used in design process and found a close relationship between the amount of process knowledge and the creativity of the product. Casakin and Kreitler (2008) focused on the correspondences and divergences between teachers and students in assessing creativity in the design studio.

Simonton (2003) claimed that creativity “has three essential components: (a) the products that contain the creative ideas, (b) the persons who conceived those ideas, and (c) the processes those persons used to do so” (p. 490). Furthermore, he said that for a comprehensive scientific approach, all three components should be investigated. Runco (2004), reviewing creativity research in the past 20 years also concluded, “the creativity research is best understood by considering various perspectives (e.g., person, process, product, or press)” (p. 677). Also, he highlighted that creativity is expressed in different ways in different domains. At first, this study makes an analysis of design process considering the creativity elements as person, process and product. Then, it delves deeper into each element and tries to provide the components of creativity in design process. Finally, it focuses on the design domain with a specific emphasis on the interaction of hidden dimensions of creativity elements.

## METHODOLOGY

The interrelated items such as originality, flexibility and sensitivity in each creativity element can be reduced to a smaller number of latent or hidden dimensions in the design process. The goal of this study is to achieve parsimony by using the smallest number of explanatory concepts to explain the maximum number of variance

among the creativity elements. Therefore, each creativity element is analyzed to find the hypothetical constructs called factors that help to interpret its consistency. Therefore, the factor analysis technique provides a meaningful organization scheme that can be used to interpret the multitude of items analyzed with the greatest parsimony of factors.

The aim of the study is to determine the components of creativity dimensions that complies with the design process. In order to achieve this, a set of observation sheets and rating scales that were developed by Hasirci & Demirkan (2007) are used as the preliminary assessment tools. In Hasirci and Demirkan’s (2003) study, there were 15 participants who were selected by random sampling among 46 third year design students. They were assessed while designing a task within the design studio. The duration of the task was approximately a single studio day. Also, the process was videotaped and watched afterwards by the observer. These observation sheets for the assessment of creativity characteristics of a person and design process and rating scales to assess product were tested for internal consistency (Cronbach alpha values >0.80) in the previous two studies. The data obtained in the previous study are used to develop the new creativity dimensions.

### The Preliminary Observation Sheets

The preliminary person observation sheet consisted of originality, completion, self-courage, sensitivity, negativity, isolation, control and humor items. Each item was defined by three to seventeen particular behavioral characteristics. These behavioral characteristics that made up each of these items were derived from previous research and literature and set up as oppositional phrases (Hasirci & Demirkan, 2007). The process observation sheet consisted of originality, completion, self-courage, sensitivity, negativity, identification, and movement items. Each item was defined by two to ten particular behavioral characteristics.

### The Preliminary Rating Scales

The preliminary product rating scales consisted of the individual assessment of the items of product creativity, design elements, unifying principles and spatial qualities (Hasirci & Demirkan, 2007).

The assessment of the product was done according to the following issues:

1. Characteristics of creativity, which are value, appropriateness, flexibility, fluency, novelty, originality, elaboration, redefinition, ability to answer needs, and open-endedness (evolution).
2. Design elements, which are line, shape and form, space, texture, value, color, and light.

3. Unifying principles, which are repetition, variety, rhythm, balance, emphasis, unity, and harmony.
4. Spatial qualities, which are concept execution, atmosphere/ambience (material, color, texture, lighting), planning/layout, building system and components (HVAC-heating, ventilation and air-conditioning, sound system), ergonomics (health, safety, comfort), use of standards, furniture (choice, design, utilization), design details, material use, presentation, and craftsmanship.

Instead of oppositional phrases, the assessment was done on a five-point scale (poor, poor-average, average, average-excellent, excellent) as the product characteristics necessitate a more detailed categorization. The instructors and the observer assessed each student's work independently; thus, the possibility of affecting each other while grading the products were eliminated. The raw averages of the two scores were calculated for the final performance score, and a *paired sample t-test* was carried out to assess the difference between the instructors and the observer's rating on the product. In total, no significant difference was found between the assessments ( $t = -1.00$ ,  $df = 14$ ,  $p > 0.05$ ).

#### Development of Assessment Tools

The initial challenge was to determine the items that can be evaluated as the components of creativity in design process. The first step in simplifying the assessment tools was to find and exclude the items that were not depicting the actual variability of the behavioral characteristics in design process. Item means were evaluated to determine whether a large percentage of the items created a floor or ceiling effect. As Tabachnick and Fidell (1996) state, when the individual items are at one or both extreme ends of the scale, the actual variability in behavioral characteristics may not be captured, then the significance tests are inappropriate with low correlation values.

Factor analysis was then applied to recognize items measuring similar things and eliminate irrelevant items. Thus, it would be possible to determine how well the items corresponded with the creativity characteristics that they were exploring. Correlation matrix was inspected to determine if the strength of the correlations among the items were reliable for factor analysis, since when there is no correlation exceeding 0.30, use of factor analysis is questionable as there is probably nothing to factor analyze (Tabachnick & Fidell, 1996).

Then, the principle component analysis method for determining the number of factors which is extracting factors with eigenvalues greater than 1.00 was used in all of the analysis with SPSS. An orthogonal factor rotation was performed using Varimax with Kaiser

Normalization. Varimax rotation is used to simplify factors by maximising the variance of the loadings within factors across items (Tabachnick & Fidell, 1996). It allows easy interpretation of the items that have a unique relationship with a factor.

After orthogonal rotation, the rotated component matrix was analyzed and the items with higher loadings on the factor were eliminated. The item's pure measure of the factor increases with greater loadings (Tabachnick & Fidell, 1996). Items that had relationships 50% and above with the factor component were thought to describe the factor and its related scale the best thus those items would provide the best assessment for that particular scale. The final assessment tool included only these items with 0.50 or more loading weights.

#### Overall Creativity Elements in Design Process

After analyzing person, process and product as the independent elements of creativity, it is aimed to redefine the elements of creativity in design process within a new perspective. Therefore, the components of person, process and product are investigated overall in order to determine the hidden dimensions of creativity in design process. Finally, the overall creativity dimensions and the interactions among the elements are analyzed within the design domain.

## RESULTS

#### Related to Observation Sheets

The observation sheet items both belonging to person and process had no mean values either at the higher or lower 10% of their ranges. It is concluded that there was no ceiling or floor effect for each item in the observation sheets. Also, there was no item was found having correlations among scores below 0.30 in the correlation matrix in observation sheets.

#### *Person Characteristics*

Principle component analysis was conducted on the correlations of 8 items of the person characteristics. Three factors were extracted with eigenvalues greater than 1. The first factor that is composed of completion, sensitivity and originality accounted for 29.44% of the variance. The second factor that is composed of negativity, control and isolation accounted for 28.18% and the third factor that is composed of self-courage and humor accounted for 24.36% of the variance. These three factors were then orthogonally rotated. The loadings greater than 0.50 were chosen. The items were ranked according to their loading on the factor from those with the highest loadings to those with the lowest loadings in Table 1.

TABLE 1  
Person Observation Sheet Items Ranking From the Highest to Lowest Loading in Each Factor

Factor	Scale	Items (Loading)
1	Behavioral flexibility	Completion (0.907), sensitivity (0.905), originality (0.629)
2	Emotional variability	Negativity (0.871), control (-0.856), isolation (0.826)
3	Risk taking	Self-courage (0.945), humor (0.921)

The first factor that is named 'behavioral flexibility', involves 3 items that are related to assessment of creative characteristics, traits and behavior of the designer while dealing with the task. The completion of the task had the highest loading and followed by being sensitive to the environment in terms of social, physical, perceptual and emotional terms. Originality was the third item in approaching the task as a problem solving activity.

The second factor that is named 'emotional variability', involves 3 items as negativity, control and isolation. Negativity had the highest loading that shows unconstructive characteristics that are found in individuals during the creative process such as being annoying or totally ignorant of others in the same environment. Control is defined as being non-defensive and stable person that is not considered as a creative behavior and is depicted with a negative correlation value in Table 1. Isolation is a characteristic of a student who works alone and is uncooperative.

The third factor that is named 'risk taking,' involves 2 items as self-courage and humor. Self-courageous students were self sufficient, emotionally mature, able to cope with stress, willing to take risks and self-centered. Humorous students were make use of the environment and were playful in accomplishing the task.

### Process Characteristics

Principle component analysis was conducted on the correlations of 7 items of the process characteristics. Two factors were extracted with eigenvalues greater than 1. The first factor that is composed of originality, sensitivity, self-courage and identification accounted for 42.22% of the variance. The second factor that is composed of negativity, completion and movement accounted for 31.70% of the variance. These two factors were then orthogonally rotated. The loadings greater than 0.50 were chosen. The items are ranked according to their loading on the factor from those with the highest loadings to those with the lowest loadings in Table 2.

The first factor that is named as 'creativity in problem solving' process involves 4 items as originality, sensitivity, self-courage and identification in design process.

TABLE 2  
Process Observation Sheet Items Ranking From the Highest to Lowest Loading in Each Factor

Factor	Scale	Items (Loading)
1	Creativity in problem solving	Originality (0.896), sensitivity (0.874), self-courage (0.777), identification (0.730)
2	Human behavior in problem solving	Negativity (0.813), completion (-0.790), movement (0.760)

Originality in the design process involves easily defining the problem, use of different material, tools and media and thinking out of the boundaries of traditional problem solving process. Sensitivity item has characteristics as fully reacting to experience in thought and feeling and showing increasing awareness in the environment while working. Self-courage consists of characteristics such as being independent of others in decisions or freely and easily transferring thoughts onto the task. Identification involves items such as being connected to the task being done and reflecting this with gestures while working.

The second factor that is named as 'human behavior in problem solving' process involves 3 items as negativity, completion and movement. Characteristics as being rebellious during the process, sloppy or capricious define negativity. Students who were indifferent to rules and warnings inside the studio, or who did not care about the mess made around oneself were accepted as more creative. Completion identifies behavior such as being completely involved in the project, not looking for inspiration and ignoring the environment. These acts were not creative acts and were depicted with negative correlation value in Table 2. Students who were not working in a rigid posture and who changed places in order to get material or cut a large piece of cardboard were accepted as more creative in the movement item.

### Related to Rating Scales

Moreover, the rating scales had no items that had a 'ceiling' effect (mean above 4.5) or 'floor' effect (mean below 1.5). Also, no item was found having correlations among scores below 0.30 in the correlation matrix in rating scales. Principle component analysis was conducted independently on the 10 items of creativity assessment, 7 items of design elements, 7 items of unifying principles and 11 items of spatial qualities. One factor was extracted with eigenvalues greater than 1 in creativity assessment, 2 factors each in design elements, unifying principles and spatial qualities (see Table 3).

Principle component analysis conducted on creativity assessment showed that all the items were well-defined and acting together as one factor. Elaboration is a

TABLE 3  
Rating Scale Items Ranking From the Highest to Lowest Loading in Each Factor

<i>Factor</i>	<i>Scale</i>	<i>Item (Loading)</i>
Creativity assessment		
1	Creative product characteristics	Elaboration (0.991), fluency (0.960), novelty (0.931), open-endedness (0.917), value (0.896), originality (0.893), flexibility (0.891), ability to redefine (0.880), ability to answer deficiencies (0.824), appropriateness (0.822)
Design elements		
1	Internal elements	Shape/form (0.988), color (0.972), space (0.918), line (0.901), value (0.873), texture (0.754)
2	External elements	Light (0.984)
Unifying principles		
1	Integrity	Harmony (0.891), emphasis (0.862), rhythm (0.841), unity (0.831)
2	In parts	Variety (0.870), repetition (0.805), balance (0.638)
Spatial qualities		
1	Design attributes	Craftsmanship (0.943), furniture (0.938), atmosphere/ambience (0.914), concept execution (0.909), detail (0.888), presentation (0.880), planning/layout (0.848), material (0.787)
2	Technical attributes	Building system (0.906), use of standards (0.852), ergonomics (0.656)

quality of a product that has been designed with given attention to details. Fluency shows that the project solution is quick, smooth and natural as opposed to difficult and painful. Novelty depicts that the quality of something being new and unusual for the student and at that level of education. Open-endedness shows the quality of the task as not being limited, showing progress and evolving creativity. Value includes certain external standards that may directly relate to the problem. Originality involves a product that has fresh, authentic and unusual ideas and precedes the other products. Flexibility shows that the project is being responsive to change and adaptable if situation arises. Redefinition is the reinterpretation of the given problem in an original way. The product should answer the needs of the design problem in terms of timing and general quality. Appropriateness involves the extent to which the solution content of the problem answers the needs of the user in terms of function and aesthetics. These items are the components of 'creative product characteristics.'

Design elements issue is composed of 2 factors as 'internal and external elements.' 'Internal elements' are composed of design elements that are the characteristics of the project. Shape and form item with the highest loading involves the use of 2 and 3 dimensional geometric shapes in the project. This item is followed by the items as use of colors, spatial aspects and line quality in the project. Value involves the use of relative darkness and lightness of colors in the project. Also, the amount of texture use for surface differentiation is considered. The use of lighting and awareness of its effects on the atmosphere of the project is the 'external design element.'

Unifying principles issue is composed of 2 factors as approaching the project for 'integrity or in parts.' Harmony is the item with the highest loading that can

be described as an aesthetic and pleasing combination of project elements. It is followed by emphasis as the use of special techniques to single out or accentuate certain features of the project. Rhythm is the use of alternating patterns and regular recurrence of design features to convey familiarity. Unity as the least loaded item for 'integrity' shows the functional continuity among the parts of the project. Approaching to project 'in parts' has the highest loading for variety that can be described as the use of various design elements in order to depict certain effects such as surprise. Also, the use of repeating elements in order to convey particular design decisions is a component for approaching the project in parts. The last component is balance that can be explained as the harmonious arrangement or proportion of parts of project.

Spatial qualities issue is composed of 2 factors as 'design and technical attributes.' 'Design attributes' factor has 8 items. Craftsmanship with the highest loading depicts the skill in preparation of drawings and models. Choice, design and utilization of furniture, is the second loaded item. The created atmosphere or ambience by choice of material, color, texture and lighting is the third loaded item. Success in applying the concept to the three-dimensional space and design details are the two following items. Presentation techniques and success in planning the layout and organization of the design are also important. Success in choice and use of material is least loaded item in design attributes for spatial qualities. 'Technical attributes' factor has 3 items as the appropriate use of building system and components, the efficient use of standards and ergonomics. Building systems involve heating ventilation, air-conditioning and sound systems. Use of standards involves compliance of design with the technical standards as building codes or design specifications. Ergonomics involve the health,

TABLE 4  
Summary of Rotated Dimensions

Dimension	Eigenvalue	Variance (%)	Cumulative (%)
1	5.19	45.85	45.85
2	1.63	19.54	65.39
3	1.17	14.46	79.85

safety and comfort of the users while using the designed product.

Related to Overall Dimensions of Creativity Elements

As Widaman (1993) suggested, there should be at least three measured items for each factor since principle component analysis method produces substantially inflated estimates of factor loadings when there are less than three items. Therefore risk taking scale under person (see Table 1) and external design elements scale under product (see Table 3) were eliminated from the overall assessment. All the reliabilities were checked and no reliability was below 0.70 value to be avoided as Fabrigar et al. (1999) had suggested.

After combining the chosen components under person, process and product (total of 10 components), three dimensions were extracted with eigenvalues greater than 1 as seen in Table 4. The first dimension accounted for 45.85% of the variance, the second dimension 19.54% and the third dimension 14.46%. These three dimensions explain 79.85% of the total variance.

These three dimensions were then orthogonally rotated. The loadings greater than 0.70 was chosen. There was only technical attributes scale of spatial qualities component that had loading below 0.70. The components are ranked according to their loading in each dimension from those with the highest loadings to those with the lowest loadings in Table 5.

Overall assessment of creativity involves 3 dimensions within the perspective of design process. The first dimension only involves the factors that are obtained from the product element consisting of the related items (see Table 3). The second and the third dimensions both

TABLE 5  
Overall Creativity Components Ranking From the Highest to Lowest Loading in Each Dimension

Dimension	Components (loading)
1	Internal elements (0.960), integrity (0.950), design attributes (0.929), creative product characteristics (0.876), in parts (0.808)
2	Creativity in problem solving (0.885), behavioral flexibility (0.830)
3	Human behavior in problem solving (0.874), emotional variability (0.771)

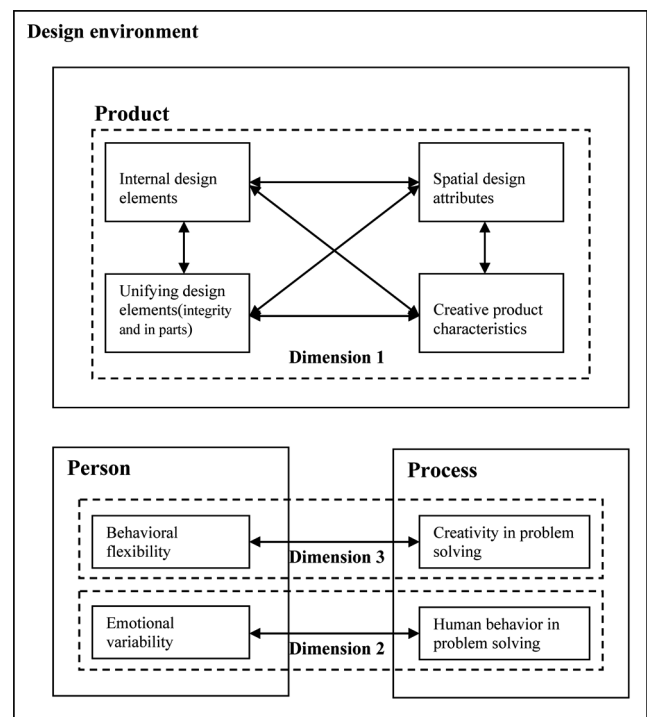


FIGURE 1 Overall dimensions of creativity elements.

consist of person and process elements with the related items (see Tables 1 and 2). As seen in Figure 1, there is no interaction of product elements with either person or process elements.

DISCUSSION AND CONCLUSION

On Each Creativity Element

Previous studies on creative person were mainly focused on identifying the common creative acts during design process of the exceptional designers (Lawson, 1994; Candy & Edmonds, 1996; Cross, 2002). However, this study is aimed to determine the components of personality characteristics that are associated with creativity in design process. After Guilford (1950) who identified certain abilities that may be involved in creativity, many researchers conducted studies in order to identify certain abilities and their impacts on creativity (Runco & Shaw, 1994; James & Asmus, 2000–2001; Lubart, 2000–2001). In this study as seen in Table 1, three factors were identified as being responsible for creative acts in design process and named as “behavioral flexibility, emotional variability and risk taking as personal tendencies” as proposed by James and Asmus (2000–2001, p. 150). Among the three factors, ‘behavioral flexibility’ and ‘emotional variability’ were considered to have items that have a unique relationship with the corresponding dimensions (see Table 5).

There were various approaches to the analysis of design process relevant to creativity. Akin and Akin's (1998) analyses were focused on the shifts between problem to solution domains and Goldschmidt's (1991; Goldschmidt & Tansa, 2005) on the links among creative design ideas and decisions. The findings of this study showed that there are two factors that determine creativity in the design process. The first factor is composed of 'creative problem solving' process acts that are defined as originality, sensitivity, self-courage and identification. The second factor is composed of the characteristics of 'human behavior in creative problem solving' process as negativity, non-completion and movement (see Table 2). Therefore, it can be concluded that the creative process should be investigated both in process of design and human behavior contexts.

Empirical researchers in creativity studies mostly investigated creativity through the products that arise from the creative process (Besemer, 1998; Hennessey, 1994; Roy & Design Innovation Group, 1993; Christiaans & Venselaar, 2005; Dorst & Cross, 2001; Kruger & Cross, 2006). In this study, however, the product was assessed mainly in two aspects while using the rating scales developed by Hasirci and Demirkan (2007). The first aspect was related to the characteristics of a creative product. It was found that all the items were well defined and classified under one factor (see Table 3). This shows that the rating scales that were developed in the previous study have internal consistency and reliability (Hasirci & Demirkan, 2007). As a second aspect, the product is assessed under three categories that may involve creative design characteristics related to the use of design elements, unifying principles and spatial qualities. Creative use of 'internal design elements' was found to be an important factor. Unifying principles that provide the 'integrity' of the whole product as well as among the design elements were found to have an impact on the creative product. It is also found that spatial qualities can be described as 'design attributes' or 'technical attributes.' These three categories related to creative product design can develop through design education. Akin and Akin (1998) had obtained similar results and concluded that knowledge related to design creativity differs among expert and novice designers. These factors that are found under each creativity element are composed of various creativity items. An overall analysis of these components should be conducted to have a holistic approach to design process.

#### On Dimensions of Creativity Elements in Design Process

The primary dimension that is responsible of 46% of the total variance is only composed of product components

(see Tables 4 and 5). This finding supports Amabile's (1983) findings as she stated that creativity is a property of products. Also Christaans' (1992) study also confirmed the findings of this study. The important aspect is that the 'internal design elements' which is composed of items such as shape, color, space, line, value and texture are having the highest loading. 'Integrity' of unifying principles, which is composed of harmony, emphasis, rhythm and unity, follows as the second important aspect. 'Design attributes' of spatial qualities, which is composed of craftsmanship, choice of furniture, atmosphere and concept execution, is the third important aspect of the design process. These three important aspects of design process show that design knowledge enhances creativity. However, this is contrary to what Christaans and Venselaar (2005) have found, as creativity was not correlated with design knowledge. They claimed that creativity was correlated with process knowledge as they described it as "knowledge of managing and monitoring the solution generating process" (p. 219). In this study, there is no evidence about how design process analysis is related to the creativity process. The findings of this paper also partially supports what Akin and Akin (1998) have claimed as the importance of domain knowledge for a "unified theory of creativity" in design process (p. 136). They stated that procedural knowledge and representational knowledge are both important for creative problem solving. This study only focuses on representational knowledge and should be a base for further studies that are also considering procedural knowledge. The findings of this study show that knowledge is a primary aspect in creative design process where also Runco and Chand (1995) considered knowledge as a secondary component which is contributing to the creative thinking process.

The second dimension that is composed of the interaction of person and process creativity elements is responsible of 19.54% of variance (see Tables 4 and 5). 'Creative problem solving' characteristics which is composed of originality, sensitivity, self-courage, and identification acts conducted during the design process have the highest loading. It is followed by 'behavioral flexibility' which is composed of completion, sensitivity, and originality traits of the designer. This dimension shows that certain creative acts are a result of creative personality.

Although the third dimension looks like it is composed of the process and person elements (i.e., human behavior in problem solving and emotional variability, respectively), it reflects the intrinsic human traits and is responsible of 14.46% of variance (see Tables 4 and 5). Negativity, project incompleteness and movement during the design process are closely related to 'emotional variability' and are the expected traits for creative personality. Also Eysenck (1994) found that there was a

relationship between negative personality and amount of creativity. Carson, Peterson and Higgins (2003) explained this relationship as “the highly creative individual may be privileged to access a greater inventory of unfiltered stimuli during early processing, thereby increasing the odds of original recombination ideation” (p. 505).

In the previous study (Hasirci & Demirkan, 2003), it was found that there was no significant difference between three elements of creativity. Besides it was found that the highest correlation was between process and overall creativity. This study also supports that the evidence that the elements of creativity are all responsible for creativity. Hence the product is the strongest factor in determining creativity while the second and third factors result in person and process element interactions. Therefore, the main finding is that the product is the strongest dimension in determining creativity of a design process. This study further stated that there are other dimensions of creativity based on the design domain and knowledge as a construct should be further explored in design process.

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