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Design principles of residential space to enhance children's (3-7 years old) creativity in iran (Case study:Tehran district 4)

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Abstract

In recent years, there have been an increasing number of studies on the effect of natural and artificial environments on humans. There is much evidence that being in natural environments, or just looking at nature, promotes recovery from stress. In the residential context, it has also been suggested that views of nature from windows enhances residents' sense of well-being. Viewing a 10- minute video dominated by natural elements (trees, vegetation, or water) after the participants were stressed by a video of industrial accidents facilitated recovery from stress, as indicated by lowered blood pressure, lowered muscle tension, and skin conductance. Young children spend most of their time at home. Although some spend a lot of their time at outside facilities such as daycare center, kindergarten, or school, most children still recognize home as their permanent space. They become attached to their home and feel safe and secure. When they are at home. They attach meanings to their home and that becomes part of their culture. Children's experiences and images of early childhood are "the most deeply scored and enduring". Children develop interests at this environment, which helps them resolve inner conflicts, make sense of their existence, and develop self-regulation and self-concept. Cohen states that "the passionate interests of young children can be thought of as the seeds of adult creativity. Creativity has been the subject of interest and study for the past 60 years. Because of being in growth ages, activation, promoting and directing creativity in children is important. Still, creativity is mysterious! It is hard to do systematic analysis. This makes it hard to understand and explain why and how creativity happens and what elements it is related to. Furthermore, the variety of definitions of creativity among researchers makes it even more complicated to understand and study because there is no definitive meaning accepted by all. People define creativity as the ability to produce novel and original work within specific framework and limitations. Children are creative by nature. Social psychologists argue that creative people begin their creative production early in life. The focus of research on the creativity has been from psychology features to the impact of the physical environment on these features. One of the ways to promote creativity, using the impact of natural or artificial environment to create and enhance the creativity factors in children. Literature suggests that Space and environment in creativity and its quality of growth have an important role. This spaces may be natural spaces or artificial space and in other words the architecture environment. But the construction of architecture to influence the cultivation of creativity is very pale. The real question is, which features in residential space impact on the promotion of creative task. The present study seeks to achieve residential space design principles that will enhance children's creativity. This research is developmental and research method is descriptive that is done in five main step. Then, using the survey method one of descriptive research methods, Second stage and third stage of the research community are psychology experts and architecture professionals. Fourth stage research community are 3-7 years-old children in Tehran from district 4.

After selecting the sample and data collection by interview, questionnaire, using inferential statistics, hypothesis tests are proposed. To evaluate the hypothesis of descriptive statistics and statistical indicators set by the frequency and inferential non-parametric Spearman test, multiple linear regression test and Friedman nonparametric test was used.

According to the findings, physical environment in residential spaces affects the development of children's creativity and in residential space, using natural elements, creating a safe space, complex space and flexible space, through a positive impact on children's motivation for physical activity(playing), mental relaxation, initiative and Child's curiosity children's creativity can be promoted. The present study seeks to achieve the design principles of residential space that will enhance children's creativity.

Keywords

Creativity, Promote children's creativity, Residential space.

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Introduction

Until 1950, the creativity concept was little known, only a few researches were done on mental and intellectual ability. Since 1950, psychologists found that intelligence and creativity are not the same and need to understand of creativity was felt and gradually began extensive research in this area (Shafaie & Madani, 2010). Creativity is made possible in individuals by a confluence of cognitive, emotional, environmental and motivational variables.

Psychologists have identified many cognitive factors related to creativity, such as divergent thinking (Guilford, 1950; Guilford, 1959), styles of thinking (Sternberg, 1997) and openness to experience (George and Zhou, 2001). Environmental factors involved in creativity have been studied from a social psychological perspective (Chien & Hui, 2010). The focus of creativity research has been on personal characteristics to the exclusion of potential contributions by the physical setting (Amiable, 1983; Barron, 1969; Guilford, 1968; MacKinnon, 1962; Stein, 1974; Torrance, 1966).Yet many creative thinkers themselves have recognized the potential role of the environment to influence creativity.

Dubos (1971) suggested that people confined to a "featureless environment" suffer intellectually and emotionally and that "the potentialities of human beings can become fully expressed only when the (physical) environment provides a wide variety of experiences". Theories about the restorative qualities of nature also allude to creativity as a process that is enhanced by contact with natural elements (Kaplan & Kaplan, 1989). Creativity as achievement is the production of works that are novel or innovative in the public sense. In Iran, according to Census 2010 statistics, the population of children and people with developmental age compared to other age groups, is significant (Table 1).On the other hand, childhood especially the stage of pre-school ages, is the beginning of the cognitive perception that is component of the creative process (Shafaie, 2010). Children and adolescents are important groups of users of residential spaces in the scale of house, and neighborhood spaces, local streets, children's garden and local parks (Azemati, 2009). These places are allocated to major part of children's daily life. Due to this reason improving the quality of these spaces to be effective on personal development, social interaction, enhance of the sense of cooperation and eve their education. Lack of appropriate design criteria for the design of residential spaces, including the psychological needs of children and their psychological and spiritual realities caused their potential talents could not grow well. Therefore, recent research looking for a set of elements of residential space designed to achieve a positive impact on child's psychology, and make him to be creative and innovative, so that the accomplishment of these elements in the design and construction of houses, especially the interior spaces, child's imagination will be stimulated.

Creativity is the ability to fluently solve problems with original, innovative, novel, and appropriate solutions (Amabile & Gryskiewicz, 1989; Guilford, 1967; McCoy & Evans, 2002). Creativity is important and interesting to read, but is difficult in practice and applying it in different parts.

Creativity has important role in technological innovation, education, business, arts and other fields of science. Many famous persons have earned their reputation of creativity (Runco, 2007).

Since 1950, psychologists found that intelligence and creativity are not the same, and it was felt to recognize creativity. Gradually, widespread researchers launched in the field accordingly (Shafayi, 2009). Flourishing creativity and innovation are among the most significant ideas of today's world. Promoting the creativity during childhood affects the whole life of an individual and progress and development of any nation depends on this factor as well (Guilford, 1968). Gardner believes that the imagination formed during early childhood affects the entire life of an individual (Amabile, 1996). Due to the importance of the subject of creativity, this research intends that from among different areas affecting children's creativity,

the domain of environmental psychology and the physical role of the residential space where children spend most of their lifetime will be chosen and studied accordingly. The researches on residential have not paid enough attention to the relation between the quality of the residential spaces and promoting the children's creativity (Hosseini, 2009). Lack of any thought idea for the design of residential spaces and development of the residential spaces without proper criteria (Azemati, 2008) caused that the subject of development of residential space for development of children's creativity has been ignored. This subject is of great importance because from among various factors affecting growth of children's creativity. Researchers have studied many educational methods, emotional-cognitive aspects, and educational issues accordingly. However, the effect of the quality of life physical environment and architectural space in the development of creativity has been considered less while the children's creativity finds practical aspect at the age of 3-7 (Riahi, 2001). During these years, the children's creativity is more affected by the environment. This research is aiming at design of the houses that cause growth and promotion of children's creativity. This aim is realized through analytical study of the relationship between physical characteristics of residential spaces and promotion of creativity. In the next stage achievement of a collection of elements and approaches for design of the residential spaces toward a positive effect on creativity, are noted. Thus, precise application of these elements in design and development of the house and its interior space in particular shall indirectly promote the children's creativity.

• Research Hypothesis and Questions

Houses and residential spaces may be designed in such a manner as they lead to promotion of creativity among children. This promotion could be through positive effect of physical and functional characteristics of the residential spaces in promotion of individual elements of creativity. This general hypothesis may be presented in the form of the following five hypotheses:

1. Utilization of natural elements in residential spaces leads to promotion of the potential of children's creativity through motivating children's feelings in the environment and a positive effect in promoting the motivation of children to play.
2. Development of a safe atmosphere in residential spaces promotes potential of children's creativity through decrease of stress and eventually a positive effect on promoting mental tranquility of children.
3. Establishment of complexity (physical variation) in residential spaces leads to promotion of potential of children's creativity through development of a challenge in children and a positive effect on creating initiative.
4. Development of flexibility of residential spaces leads to promotion of potential of children's creativity by promoting the capability of environmental manipulation through a positive effect on promotion of inquisitiveness.
5. Use of attractive visual tricks leads to promotion of children's creativity by promoting visual thinking among children and a positive effect on children's power of imagination.

In the end, the research questions are stated as follows:

A. Which architectural (physical and functional) characteristics in a residential space influence the variables of children's motivation to play, mental tranquility, initiative, inquisitiveness, and imagination?

B. What are the design and architectural approaches for promoting the potential of creativity in residential spaces?

Literature review

• Definition of Creativity

Scientists have stated creativity using different definitions in such a way as each definition reveals one of the significant aspects of creativity. As it is stated by Guilford, creativity is a collection of abilities and characteristics that may lead to creative thinking (Hosseini, 2009). Creativity is a process whose result is a new work which is accepted by

a group at a time as a useful and satisfactory thing (stein, 1974). In the author's viewpoint, creativity is the result of the imaginary and rational forces of an individual, which overwhelm his mental forms and intellectual limitations by using previous knowledge and new discoveries, presenting fresh approaches for solving the problem (Table 1).

• Effective elements in creativity

Study of the components of creativity reveals that creativity is not a fixed feature of personality, hidden in the nature of humans without any change. But, it is among the items, which may completely be weakened or even destroyed due to the effect of certain elements or obstacles. Some conditions provide suitable grounds for appearance and development of creativity while some other conditions may cause the roots of creativity die in humans (Hosseini, 2009); (Table 2).

• Role of environment in development of creativity

The Environment enjoys a widespread definition that comprises geographical environment, physical environment, social environment, cultural environment and the ones (Lang, 1987). From the most well-known scientists, who studied the effect of the environment on individuals, one may name Amabile. He had a great effect in the movement of the specialist in creativity toward study of the role of environmental variables in creativity (Azemati, 2008). The Environment has a more clear-cut role in growth and development of creativity compared to the factors of personality. Natural factors vary to a great extent, and they may easily be manipulated in comparison with features of personality and individual aptitudes (Amabile, 1983). Due to the close relationship between human and the environment (in terms of perception and behavior), any of environmental aspects influences the process of creativity (perception, analysis and imagination) (Shafayi, 2008). Upon the development of human communities and change of lifestyle and habitation of people, architects, designers and planners paid attention to quality of built environments and spaces. As researchers in the field of creativity have focused on its personal characteristics, the share of physical potential of the environment has been discarded (Amabile, 1983). If the environment is so simple,

Table 2. The effective elements. Source: authors.

Variable	Manipulation in environment	Curiosity in children	Variable	Flexibility of interior space	Manipulation in environment
Manipulation in environment	1		Flexibility of interior space	1	
Curiosity in children	0.368 Sig.=0.047	1	Manipulation in environment	0.548 Sig.=0	

Table 1. Definition of Creativity from the Viewpoints of Researchers. Source: authors.

Definition of Creativity from Researchers' Viewpoints			
Amabile, 1990	Creativity is a combination of capabilities including innovation, flexibility and sensitivity against the viewpoints that allow the learner to think outside unreasonable thinking to different and generative results whose conclusion is satisfactory.	Khosrownejad, 2008	Creativity is a process which results in codification or production of ideas, approaches and or new products that enjoy artistic and scientific credibility.
Runco, 2007	Creativity is the capability to solve problems fluently by innovative, new and appropriate solutions.	Davoudi, 2006	Creativity is to utilize mental capabilities to establish a new thought or concept.
Robins, 1991	Creativity is to provide new qualities of concepts, meanings and ideas.	Hosseini, 2009	Creativity is to pass through a new route or to pass in a new way a route that has been passed through previously.
Taylor, 1988	Creativity is the formation of experiences in new reorganizations.	Azemati, 2009	Creativity includes total personal factors, processes and products that interact in a social environment.

the perceptual system of children will not try to complete survival procedures. However, in various world where it is not possible to find the nature of events through usual observation, inevitably, the process must occur to predict ambiguous situations (Thorisson, 2004). Nowadays, architects and urban planners try utmost to establish a logical relationship between structure and nature. Further to putting forward such ideas as building harmony and respecting the nature, they consider sociability of physical and natural environment, considering the cultural, climate and belief conditions of users, including the nature in buildings because of which humans find spirits in the house. Moreover, they study the effective elements in human interaction and natural environment in a physical environment (Daneshgar, Bahraini and Einyfar, 2011). Children like environment in nature and are born with a love toward nature. This love may clearly be found in their sense of curiosity when they face nature and through their brave involvement (Farah Pour, 2009). Concerning the fact that more suitable ground for supervision in a residential space and house is available without interference of parents and that the parents feel more safety through supervision, on the one hand, and on the other, they develop both elements of free and inquisitive activity and safety for promoting the potential of creativity through establishment of suitable grounds for activity, curiosity and intensifying environmental complexity and using the elements of natural environment and making the environment to accept supervision and concerning interior safety of a residential space of which provision is much possible compared to exterior spaces.

Research Methodology

This research is associated with the three elements of architecture (the concept of residential spaces), children (the concept of growth psychology) and creativity. The method chosen for this research is a combination of qualitative and quantitative one (Table 3).

Table 3. Research Areas. Source: authors.

Research Areas			
Human Sciences		Architecture	
Psychology		Residential Space	
Children (psychology)	Creativity	Functional	Physical
Findings			

Then, using survey research, which is based on qualitative method, and after choosing the sample subject of study and collecting the data through interview and questionnaire, the most important variables affecting this research are studied using factor analysis method. Afterward, based on the relation among the said variables, the preciseness of the research hypotheses are studied using correlation method of variables. Data collection of this research is based on Delphi Technique (benefiting from the specialists' viewpoint). In this research, the attitude of the specialists in the two fields of psychology and architectures were assessed with respect to any of the hypotheses. The researchers of environmental psychology usually use "Assimilation Technology" only when they want to study the behavior under specific environmental conditions, and the intended conditions have not been developed yet. It is difficult or impossible to experience the intended environmental conditions directly (Sarmad, 2010). Under such circumstances and in order to evaluate the research findings for children, a visual questionnaire may be used (Maccoy, M. and Evans, 2002). Thus, the results obtained through attitude assessment from specialists are changed to intelligible images, and the children of 3-7 years old were polled with respect to the said results accordingly. Upon data analysis and review of research findings, the effective design principles in the promotion of children's creativity in residential spaces were extracted. Staging this research is given as follows:

Stage 1: The research literature was studied, and a theoretical framework has been completed and hypotheses were corrected by the help of semi-structuralized interview through psychologists of children's creativity.

Stage 2: Attitude assessment of psychologists (area:

children's creativity) using close response method for confirmation of a theoretical framework and the findings of the previous stage.

Stage 3: Attitude assessment of specialists in architecture (area: housing) at the two preliminary and complementary stages stated below for achievement of architectural principles.

Stage 4: Attitude assessment of children at the age group of 3-7 for implicit confirmation of findings

Stage 5: Analysis, conclusion and explanation of design principles and corresponding criteria.

Compiling a theoretical framework

According to the research literature and the effect of the architectural body on creativity, it is necessary to find proper design principles for residential spaces especially for their interior space where children spend most of their time. Through study of the background of the respective researches conducted in this regard, fifty variables and elements have been extracted as indicated in the table 4:

• Classification of Effective Factors in Creativity (Based on a Semi-structuralized Interview)

At this stage, a poll was made from 5 psychologists (of the university faculty) who were specialists in children's creativity through a semi-structuralized interview and an open questionnaire. The effective variables in creativity were examined with them,

Table 4. Effective factors in creativity. Source: authors.

Effective Factors In Creativity					
Effective Factors In Creativity (Creativity Variables)				Major References	
1	Curiosity	26	Motivation for playing	(Ana Craft, 2012)	(Shibata and Suzuki, 2004)
2	Intellectual playing	27	Democracy and respect	(Daneshgar, Bahrein and Einifar, 2011)	(Taylor, 1988)
3	Mobility	28	Stress reduction	(Shaki, 2009)	(Austin, 1974)
4	Participation	29	Challenge	(Torrance, 1981)	(Vernon, 1989)
5	Imagination	30	Resources (access to suitable and appropriate resources)	(Rogers, 1954)	(Sternberg, 2001)
6	Security	31	Cooperation (relation with peers freely)	(Amabile, 1983, 1989 and 1998)	-
7	Comfort	32	Understanding	(Farahpour, 2009)	(Davoudi, 2006)
8	Control	33	Stimulation of feelings in the natural environment	(Kamelnia, et al., 2009)	(Seif, 2004)
9	Intellect	34	Mental relaxation of the child	(Krippner, 1999)	(Hosseini, 2009 and 2011)
10	Interest in risk	35	Cheerfulness	(Robins, 1991)	(Torrance, 1981)
11	No limitation	36	Diversity	(Kaplan and Kaplan, 1989)	(Shafayi, 2009)
12	Exploration in environment	37	Child's gender (boy or girl)	(Mccoy and Evans, 2002)	(Bohem, 1998)
13	Reward and motivation	38	Cultural classes	(MacKinnon, 1962)	(Cheng and vang, 2001)
14	Freedom	39	Number of children in the family (home)	(Barron, 1989)	(Rapoport, 2009)
15	Flexibility	40	Extent of the house	(Guilford, 1968)	(Falahat, 2010)
16	Extent of practice	41	Visual thinking	(Ulrick, 1993)	(Nasabi, 2012)
17	Talent	42	Coherence	(Azemati, 2008)	(Dobus, 1971)
18	Competition	43	transparency	(Runnco, 2007)	(Kristensen, 2004)
19	Evaluation	44	Diverse performance inside the house	-	-
20	Getting used to the condition	45	Environment complicatedness	-	-
21	Risking	46	Environment manipulation	-	-
22	Experience	47	Furniture flexibility	-	-
23	Pressure	48	Creating attractive visual effects	-	-
24	Habit	49	Natural elements of the environment	-	-
25	Innovation	50	Color and texture of surfaces	-	-

and their viewpoints about the subject and different dimensions of it were received and classified. Finally, the variables were classified by reviewing and confirmation of findings of the research literature.

Final Factors) based on the Review of Subject Literature and a Semi-structuralized Interview (at this stage were selected by summing their viewpoints (Table 5,6).

Opinion Poll from Psychologists (Closed Questionnaire – Response)

At this stage, an opinion poll was made from another group of psychologists specialized in the field of creativity by using closed questionnaire response and Likert Scale in order to ensure the preliminary findings (theoretical framework) about creativity and individual and environmental variables and factors affecting creativity as well as the effect and mechanism of this effect. In this approach, about 300 psychology professors from domestic and foreign authentic universities (150 from Iranian universities and 150 from the universities abroad) were elected and were asked about the specialty field of the research. Finally, 150 of the specialists who had declared that their research field was children's creativity were elected, and the questionnaire was sent for them. After collecting 108 questionnaires and analyzing the provided information and data, the extracted variables were ranked in the research literature section, and the correlation of provided variables was reviewed in the theoretical framework table. Cronbach's alpha was used to evaluate the reliability of the questionnaire. Alpha coefficient was obtained at a value of 0.788 which indicates high reliability of the results.

Table 5.Final selected variables. Source: authors.

Structural environment variables	Individual variables
Natural elements of environment	Increase of activity and playing (motivation for playing)
Safety and security	Mental relaxation of a child
Environment complicatedness	Increased innovation
Flexibility of interior environment	Curiosity
Creating attractive visual effects	Imagination

• Friedman's Test

In this section, we rank the effective factors in children's creativity by using Friedman's test. This test is used for prioritizing and ranking the variables based on the highest effect on the dependent variable (children's creativity). The outputs related to Friedman's test are as follows (Table 7,8).

Considering the amounts of statistic of Chi-square and sig., it can be concluded that the individuals' views on the effect of each factor on children's creativity are different. The order of importance of questions from the views of sample people is shown in Table 4. On this basis, five variables including innovation, exploration in the environment, child's mental relaxation and imagination have the highest scores. Five variables including getting used to the existing condition, competition, pressure, number of children in the family and child's gender have the lowest scores.

Table 6. Communication of selected factors, (Interviewing with psychologists and creativity specialists), (theoretical framework). Source: authors.

Architecture			Psychology	Final goal
Independent variable		Interfering factors	Effective intermediary variables	Dependent variable
1	Natural elements of environment	Stimulation of feelings in the natural environment	Increase of activity and playing (motivation for playing)	Promoting the potential for children's creativity
2	Security	Stress reduction	Mental relaxation of the child	
3	Environment complicatedness	Challenge	Increase of innovation	
4	Flexibility of the inside environment	Environment manipulation	Curiosity	
5	Creating attractive visual effects	Visual thinking	Imagination	

Table 7. Ranking the effective factors in children's creativity (questions of the questionnaire) by Friedman's test. Source: authors.

Rank	Effective factors in children's creativity	Mean ranks	Rank	Effective factors in children's creativity	Mean ranks
1	Motivation for playing	41.74	26	Experience	26.39
2	Innovation	40.89	27	Environment complicatedness	26.37
3	Exploration in the environment	39.91	28	Mobility	26.23
4	Mental relaxation of the child	37.60	29	Understanding	26.23
5	Imagination	37.46	30	Participation	25.83
6	Curiosity	37.39	31	Interest in risk	25.60
7	Environment manipulation	36.56	32	Coherence	24.91
8	Challenge	35.67	33	Cooperation (relation with peers freely)	24.57
9	Creating attractive visual effects	35.13	34	Furniture flexibility	22.30
10	Flexibility	34.73	35	Talent	21.03
11	Cheerfulness	34.30	36	No limitation	19.61
12	Natural elements of environment	33.92	37	Intellect	19.5
13	Motivation of feelings in a natural environment	33.72	38	Control	18.71
14	Visual thinking	31.76	39	Resources (access to suitable and appropriate resources)	18.37
15	Intellectual playing	31.0	40	Comfort	14.43
16	Performance diversity at home	30.43	41	Reward and encouragement	12.79
17	Freedom	29.56	42	Evaluation	12.64
18	Reduction of stress	29.40	43	Habit	12.25
19	Color and texture of surfaces	28.84	44	Home extent	12.24
20	Diversity	28.11	45	Cultural classes	12.01
21	Transparency	28.02	46	Getting used to the condition	11.71
22	Extent of practice	27.86	47	Competition	11.68
23	Democracy and respect	27.66	48	Pressure	9.83
24	Risking	26.70	49	No. of children in the family (home)	9.27
25	security	26.47	50	Child's gender (boy or girl)	5.70

Table 8. Output of the statistic related to Friedman's test. Source: authors.

Number	103
Chi-square statistic	2388,753
Freedom degree	49
sig.	0.0

• Correlation and Multivariable Linear Regression Tests

- Hypothesis 1st test

1. It seems that there is a significant relation between natural elements of the environment in the residential space and stimulation of feelings in the natural environment (Table 9).

Table 9. Correlation between natural elements of environment and motivation of feelings in a natural environment and correlation between stimulation of feelings in a natural environment and increase of activity. Source: authors.

Considering the results obtained from the correlation table, it can be said that the variable "natural elements of the environment" has a significant and direct (positive) relation with the variable "stimulation of feelings in the natural environment"; i.e. as natural elements of the environment in the residential space increase, stimulation of feelings in the natural environment increases with a positive proportion. (R=0.401, p-value=0.011). Therefore, the first sub-hypothesis is confirmed.

2. It seems that there is a significant relation between stimulation of feelings in the natural environment and increase of motivation for playing in the children. Considering the results obtained from the correlation table, it can be said that the variable "stimulation of feelings in the natural environment"

has a significant and direct (positive) relation with the variable "increase of activity and playing in the children"; i.e. as stimulation of feelings in the natural environment increases, activity and playing in the children increases with a low proportion. ((R)=0.378, p-value=0.039). As a result, natural elements in the environment along with stimulation of feelings in the natural environment by increase of motivation for playing are effective in promoting the potential of children's creativity.

- Hypothesis 2th test

1. It seems that there is a significant relation between children's security and reduction of stress in them (Table 10).

According to the results obtained from the correlation table, it can be said that children's security has a significant and direct (positive) relation with reduction of stress in them. It means that by the increase of children's security, stress increases in them with an average proportion. (R=0.421, p-value=0.015) and, therefore, the hypothesis is confirmed.

2. It seems that there is a significant relation between reduction of stress in children and their mental relations. According to the results obtained from the correlation table, it can be said that there is a significant and direct (positive) relation between reduction of stress in children and their mental relaxation. (R=0.372, p-value=0.042), therefore, the hypothesis is confirmed. As a result, security and reduction of stress and consequently, mental relaxation of children affect the potential of children's creativity.

- Hypothesis 3th test

1. It seems that there is a significant relation between environment complications and communication challenge (Table 11).

According to the results obtained from the correlation coefficient, it can be said that environment complications have a significant and direct (positive) but weak relation with relation challenge. It means that as environmental complications increase, challenge increases with a low proportion. (R=0.245, p-value=0.049), therefore, this hypothesis is confirmed.

2. It seems that there is a significant relation between challenge and increase of innovation. According

Table 10.Correlation between security and reduction of stress in children and correlation between reduction of stress in children and their mental relaxation. Source: authors.

Variable		Reduction of stress in children	Mental relaxation in children	Variable		Children's security	Reduction of stress in children
Reduction of stress in children	Spearman correlation coefficient	1	0,372*	Children's security	Spearman correlation coefficient	1	0.421*
		Sig=0.042				Sig=0.015	
Mental relaxation in children	Spearman correlation coefficient	0,372*	1	Reduction of stress in children	Spearman correlation coefficient	0.421*	1
		Sig=0.042				Sig=0.015	

Table 11. Correlation between environment complications and challenge and the correlation between challenge and increase of innovation. Source: authors.

Variable		Challenge	Increase of innovation	Variable		Environment complications	Challenge
Challenge	Spearman correlation coefficient	1	0,299*	Environment complications	Spearman correlation coefficient	1	0.245*
		Sig=0.002				Sig=0.049	
Increase of innovation	Spearman correlation coefficient	0,299*	1	Challenge	Spearman correlation coefficient	0.245*	1
		Sig=0.002				Sig=0.049	

to the results obtained from the correlation table, it can be said that challenge has a significant and direct (positive) but weak relation with the increase of innovation. It means that as challenge increases, innovation in the children increases with a low proportion. (R=0.299, p-value=0.002). Therefore, this hypothesis is confirmed. As a result, environmental complications and challenge and consequently increase of innovation in the children affect promotion of children's creativity potential.

- Hypothesis 4th test

1. It seems that there is a significant relation between flexibility of interior space and capability of manipulation in the environment (Table 12).

Considering the results obtained from the correlation table above, it can be said that there is a significant and direct (positive) relation between flexibility of interior space and manipulation in environment; however, there is no significant relation between flexibility of interior space and exploration.

2. It seems that there is a significant relation between manipulation in the environment and children's curiosity. According to the results obtained from the correlation table, it can be said that children's curiosity has a significant and direct (positive) relation with manipulation in the environment and exploration. It means that as manipulation in the environment and exploration increase, children's curiosity increases as well. Therefore, the hypothesis is confirmed. As a result, flexibility of interior space and manipulation of the environment affect promotion of children's creativity potential by the increase of curiosity in children.

- Hypothesis 5th test

1. It seems that there is a significant relation between creating attractive visual effects and increase of visual thought (Table 13).

According to the results obtained from the correlation table, it can be said that there is no significant relation between creating attractive visual effects and visual thought.

2. It seems that there is no significant relation between visual thought and imagination. According to the results obtained from the correlation table, it can be said that there is no significant relation between visual thought and imagination. The hypothesis is; therefore, rejected. As a result, creating attractive visual effects affect promotion of children's creativity by increase of visual thought and positive effect on the child's imagination (no correlation factors). Considering the correlation and multivariable linear regression tests, mechanisms of the effect of variables and different stages of creativity that are presented in the table of the theoretical framework were examined, and

Table 12. Correlation between flexibility of interior space and capability of manipulation in environment and correlation between manipulation in environment and curiosity. Source: authors.

Variable	Manipulation in environment	Curiosity in children	Variable	Flexibility of interior space	Manipulation in environment
Manipulation in environment	1		Flexibility of interior space	1	
Curiosity in children	0.368 Sig.=0.047	1	Manipulation in environment	0.548 Sig.=0	

Table 13. Correlation between creating attractive visual effects and visual thought and the correlation between visual thought and imagination. Source: authors.

Variable	Visual thought	Imagination	Variable	Creating attractive visual effects	Visual thought
Visual thought	1		Creating attractive visual effects	1	
Imagination	0.095 sig.=0.305	1	Visual thought	0.086 sig=0.342	1

the correlations of all stages were confirmed except section 5. For the next stage; therefore, hypothesis No. 5 was set aside, and the research was followed up with the four other variables.

Attitude Assessment of architectural specialists by using an Open-Ended questionnaire

Following the previous stages, the attitude assessment of architectural specialists was conducted using an open-close response questionnaire. In this questionnaire, a brief explanation was given with respect to the obtained variables and the mechanisms of the effect of variables (according to Table 3) as confirmed in the previous stage. Furthermore, the architectural specialists were requested to present manner of the architectural execution and approach and the respective techniques in an architectural system to realize the above-mentioned goal. This assessment has been conducted through 50 specialists in residential architecture, which mainly include the students of postgraduate studies and university professors as well researchers by propounding several questions and collecting their comments on the subject of research in the field of architecture. The questions put forth in this section are given as follows:

How are natural elements of the environment (water, plants and the ones) used in residential spaces with respect to children as a factor to promote play (children's motivation) leading to promotion of children's creativity by stimulating their sensations in a natural environment?

How can children's safety be materialized in residential spaces concerning children (interior residential space and an open environment) as a factor for mental tranquility of children, which is an element for the promotion of children's creativity by decreasing stress.

How can environmental complexity be created in residential spaces concerning children (interior residential space and an open environment) to develop a challenge as a factor for the promotion of children's initiative and also an element for the promotion of children's creativity?

How can interior space flexibility be created in residential spaces concerning children to create a sense of manipulation in an environment by children as a factor for promotion of children's inquisitiveness and also an element for promotion of children's creativity (Table 14).

Finally, after collection of responses for analysis and conclusion of the approaches presented, first, a matrix of the submitted questions and provided responses was developed. Then, the responses presented by any of specialists were given on each row corresponding to each question. The first row of each question of testable and the response to these questions were identified. In the end, through final analysis, the conclusion of replies was made and arranged in clear strains indicating the intention of the replies. A specific mark was put in the corresponding column of each indicating the agreement of each specialist. Finally, using descriptive statistics, the strains were arranged in consideration of the percentage of agreement of the specialists in such a manner as about 10-15 architectural approaches were presented for any of questions. In the end, five main approaches were chosen to continue the process and assessment with another group of architectural specialists by using a close-ended questionnaire. The sample tables used for each hypothesis are given as above.

Attitude assessment of another group of architectural specialists using a close-ended questionnaire

At this stage of research and by using an open-close response questionnaire, we assess five architectural suggestions and findings of the previous stage with the highest degree of agreement among architectural specialists in term of priority as compared to the criterion of some other architectural specialists. In the case of confirmation of final results, the corresponding principles shall be extracted. For the statistical population of this part, the researches of well-informed architectural specialists regarding the subject and the researchers of architecture who conducted researches in the field of environmental psychology as an upstream area and especially the concept of creativity was used. The sample selected

Table 14. Architectural procedures proposed by architectural specialists in relation to the first question. Source: authors.

Analysis of the results of the preliminary questionnaire for Architectural Experts					
		Architectural Experts Procedures	Total participants	Total agreements with the options	Percent agreement with the option
Question No. 1 (Natural elements)	1	Using and farming rare plant species and allocating a part of interior space for farming plants (establishment of a greenhouse inside)	50	35	70%
	2	Creating small gardens in the balcony or on the roof (green balcony)	50	24	48%
	3	Creating a waterscape in the balcony or open space for a child to play	50	20	40%
	4	Use of an aquarium inside the house	50	11	22%
	5	Building different netted windows for playing with light and creating a window in the roof to see and watch the sky	50	7	14%
Question No. 2 (Mental relaxation and security)	1	Design of safe decorations with no sharp edges hindering child's fall from above (bevelled edges)	50	19	38%
	2	Flooring and materials of the house should be made from wood which is one of the natural materials (materials should not be breakable, like glass)	50	15	30%
	3	Use fences designed proportionally to the child's spirit in open spaces towards the street so that the child does not have a sense of limitation	50	14	28%
	4	One of the most important factors in providing mental security for children is to use sufficient natural and artificial light	50	13	26%
	5	Use of light colours in designing preferred by children	50	13	26%
Question No. 3 (Environment complicatedness)	1	By providing a complicated arrangement in his/her room and making him/her to arrange the room based on the previous plan	50	20	40%
	2	Design of floor height and surface difference (mezzanine, ramp, etc.)	50	12	24%
	3	Playing with different lights and shadows through use of colourful glasses and roof windows	50	11	22%
	4	There should be light walls between the spaces so that the child can move them and finds the capability of the environment changing and enjoys that	50	11	22%
	5	Establishment of spiral routes and surfaces so that the child passes through them and feels their complicatedness	50	11	22%
Question No. 4 (Flexibility)	1	By using furniture and changeable elements	50	26	52%
	2	To make the spaces flexible, one can divide the space into necessary performances in different times and by using moveable elements	50	15	30%
	3	By using material, lighting and special colours suitable for the intended environment	50	11	22%
	4	The wall of a part of the room can be considered for activities such as painting	50	10	20%
	5	By using natural elements, e.g., by combining open and closed spaces	50	6	12%

for this part of the statistical population should have postgraduate degrees in the field of architecture (from among the architectural specialists who have articles and researches published in this field in scientific journals or hold the postgraduate degree in architecture). Then, for control of sufficiency of the

sample, the following two methods are used:
A. First, assessment of sample sufficiency using SPSS 18 B. Control using Morgan Sample Table
The questionnaire was sent to specialists, and about 120 replied questionnaires were received in return. Then, after collection of the questionnaires and analysis of information and data presented, the corresponding approaches were studied, and final rating was finalized and the respective principles were extracted accordingly.
Upon confirmation of the main research hypothesis, the conclusion of prioritized result of the sub-hypotheses is given as follows:
• In a residential space associated with children (an interior residential space and open environment), safety upon decrease of stress among children influences the mental tranquility of children- as an element for the promotion of children's creativity.
• In a residential space associated with children (an interior space), use of natural elements of the environment (water, plants and light) has an effect on promotion of children's motivation to play – as an element for promoting the children's creativity by stimulating the sensations in a natural environment.
• In a residential space related to children, flexibility influences the promotion of children's inquisitiveness – as an element for promoting children's creativity- by creating a sense of manipulating the interior space.
• In a residential space associated with children, environmental complexity has an effect on the promotion of children's initiative- as an element for the promotion of children's creativity- by creating a challenge.

Rating the approaches

Using the following table (Kruskal-Wallis Analysis), one may find a rating of architectural questions and approaches. Rating the architectural approaches (using the aforesaid tables and statistical test) indicated ten standard priorities listed hereunder:
Upon the development of a waterscape in the terrace or open space of the house where the children may play with water, it promotes the children's motivation for activity and play (design of a specific space for play with water).
Using an aquarium inside the house promotes the children's motivation for activity and play (presence of water in different forms such as aquariums, small swimming pools, fountains and a small spring inside the house).
By using light colors liked by children in the design, mental tranquility of children is promoted.
By designing interchanging elements and short moving walls, children's curiosity is promoted (for example, one part of the wall of the room may be considered for such activities as painting or collage).
Designing changeable and flexible furniture that enables children to create diffident layouts, children's inquisitiveness shall be promoted.
By natural materials, lightening or joyful, specific and proper colors considering the intended environment, the children's inquisitiveness shall be promoted.
By sufficient natural and artificial light, the element of the children's mental tranquility shall be promoted.
Through establishment of green spaces and small gardens in terrace or on the top roof (green terrace or green roof), the children's motivation for activity and play shall be promoted (green space and closed spaces are overlapped).
Designing interchanging elements and using light walls among spaces and changeability (changeability of the environment by children) shall promote children's inquisitiveness.
Changing the materials and surface texture (floor and wall) and using proper, and various coloration shall promote the children's initiative.
Change of the achieved approaches to design techniques by images (pictorial questionnaire) and asking the children about the images, inference and explaining the design principles
Considering the conceptual characteristics of the children of 3-7 years old, a pictorial questionnaire was drawn up to study the extent of their inclination toward the results of the previous stages. For this purpose, the corresponding test was conducted by the photos of the residential spaces with potentials

extracting the creativity of children through the instructors, who were present in the nursery and narration and explanation of the said instructors regarding the said photos to children. They were also asked about their inclination for being present in any of conditions. At this stage, first, 300 photos of the residential spaces were reviewed. For each finding of the previous stage, about 30 photos were reviewed. Then, for any of the findings of the previous stage, ten photos of the residential spaces with the required potentials were chosen. Moreover, for prioritizing these photos, two independents surveyors with expertise in the field of environmental psychology were used. For each case, five prioritized photos were chosen to be used for evaluation of any of the items of the previous findings by children (The prioritized images as appendix were enclosed with research means for evaluation by children). Using random sampling, three nurseries where the children were present, were evaluated with respect to images, proportionate to children's perception by the help of instructors of the nursery and explanation given on the said photos considering the subject and goal of the research. Fifty-five participants (children) participated in the said test. First, the children's motivation for the presence in the said spaces was questioned.

Findings and Results of Children's Polling Test

According to the results obtained from Polling Test, the majority of children indicated their interest in existence and use of any of the architectural and physical instances at their homes and their inclination presence and played in the said spaces. The following table indicates the results of children's polling test (Table 15).

It can be said that considering the findings of the present research in residential space and within its dimensional framework, design and establishment of spaces that provide games and help physical activities of children when they are at home will help increasing the potential of their creativity. In the structural space of home, game-making at home is possible by using design principles which can be taken from plants and design of natural views in the residential space as well as maximum use of natural light considering design criteria and use of water characteristics inside and outside the spaces of residential spaces. These principles promote physical activity of the child for playing by motivating the feelings that occur in the natural environment. All these principles and procedures can be applied to the walls and floors and even interior and exterior ceilings of residential spaces including children's book rooms and open areas of residential spaces.

Table 15. Level of children's agreement with the obtained results. Source: authors.

	Hypotheses	Architectural procedures	No. of participants	No. of agreements	Percentage of agreement
1	Increase of child's motivation for activity and playing	Design of waterscape inside and outside of residential space	55	55	100%
2	Increase of child's motivation for activity and playing	Design of aquarium inside the residential space	55	51	93%
3	Child's mental relaxation	Designing the below of residential spaces with the colours mostly preferred by children	55	50	91%
4	Child's curiosity, innovation	Design of a changeable and flexible furniture	55	47	86%
5	Child's curiosity, innovation	Design of interior bodies of residential spaces using natural and variable materials	55	45	82%
6	Child's mental relaxation	Design of residential spaces by diverse lighting (natural and artificial lights)	55	54	98%
7	Increase of child's motivation for activity and playing	Design of green space inside and outside the residential space	55	55	100%

Conclusion and Presentation of Design Principles

Based on the research findings, the following principles can be presented for design of residential spaces through the approach of promoting children's creativity in Iran.

• Design and establishment of physical residential spaces by using motivating and game making walls.

- Providing the possibility of the presence of nature and natural elements including plants, green spaces, sky, stars, moon and sunlight in the residential space and design of green space and natural elements inside and outside the residential space by considering supervision principle.
- Architectural use of water by using its different characteristics (transparency and fluidity, movement, flow, noise) in the interior and exterior spaces and landscapes, as well as child's access without any reason.

• Establishment of mental relaxation by designing and establishing secure residential spaces (physical security).

- Maximum use of natural light in residential spaces by using architectural procedures and facilities that natural light can offer to the designer.
- Use of natural materials in the interior and exterior walls of the residential spaces.
- Using specific forms that have tranquility feature and avoiding sharp walls.
- Designing the spaces that may accept supervision.

• Designing and development of complicated and challenging spaces.

- Development of the spaces presenting a great quantity of visual and environmental data in the interior and exterior walls of the residential spaces.
- Development of walls of the residential spaces using natural compound materials using designing approaches and criteria.
- Using a combination of light and form in the interior and exterior walls of the residential space that creates space with physical and complicated variety.

• Design and development of changeable and flexible residential spaces (spatial and shape flexibility)

- Furniture changeability and combination.
- Designing a free plan and space division using movable partitions.
- Extension of open and close spaces and establishment of usable inter-joints.

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