Principles of Nature in the Design of Playgrounds

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Abstract: The purpose of this paper is to apply the principles of nature in the design of appealing playgrounds in Iran with emphasis on the south area of Tehran. This paper examines whether applying principles of nature in design of playgrounds will improve children’s satisfaction. The study’s findings have important implications for future architectural design involving nature in children’s opportunities for play in Iran. This paper seeks to re-establish the connection between nature, children, and architecture in Iran, and is a new look at the design of playgrounds; therefore it is a contribution to this body of knowledge. We asked two-hundred parents, who were chosen at random and had children in primary schools, to answer a questionnaire that evaluated each principle. An analysis of the data showed that the design of playgrounds with natural principles would enhance children’s satisfaction in Iran.

Keywords: Nature, design, playground, children, architecture

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1 INTRODUCTION

1.1 Important Role of Nature for Children

Nature has a positive impact on wellbeing and helps children achieve harmonious and healthy lifestyles (Wells 2000; Wells and White 2002). In this paper, we consider the meaning of the word “nature” as the physical world and everything in it such as plants, animals, mountains, oceans, stars, etc. that is not made by people (Merriam-Webster Online Dictionary 2014). The endless richness of these natural elements wrap children in colors, textures, tastes, fragrances, and movement; they encourage curiosity and motivate a passion for learning (Cosco and Moore 1999). Cosco and Moore (2005) state that “Powerful experiences of nature are necessary antidotes to the artificial environments of the new century. Without these experiences, children will see themselves apart from nature because it has never been incorporated into their innermost being. If so, as adults they will lack the passion for nature necessary to protect our planet.” This quote shows the crucial role of nature in children’s life. Louv (2005) suggests that “Nature inspires creativity in a child by demanding visualization and the full use of the senses.” Nature requires the use of all the senses: sight, sound, smell, touch, and taste. It is the diversity of sensory experiences that initiates a more creative learning environment for children (Parsons 2011).

However, childhood connection with nature is decreasing from generation to generation as emphasis on book-learning, media entertainment, and increased programmed time are becoming more prevalent (Parsons 2011). This is creating a disconnection between children and nature. Richard Louv calls this disconnection “Nature-Deficit Disorder” (Louv 2005). Nature-Deficit Disorder is hypothesized to be a contributing cause of childhood depression and Attention Deficit Disorder (ADD) (Parsons 2011).

1.2 Reasons of Dissatisfaction with Playgrounds

According to a research done by Veitch et al. (2005), approximately half of surveyed parents raised concerns about the play equipment in playgrounds or parks. Parents believed that “play equipment was designed for toddlers and younger children. Older children found parks boring because there was no equipment that appealed to them.” They also reported wanting a range of stimulating play equipment that was challenging and appealing for children of all ages (Veitch et al. 2005).
Based on the research, parents reported that if a good quality park were nearby, they were more likely to take their child to that park. This research suggests that from the children’s and parents’ points of view playgrounds today are far from satisfactory and have uninteresting play equipment (Veitch et al. 2005). This research leads to the conclusion that children’s interaction with nature is diminished as they are not satisfied with the circumstances of spaces for playing, particularly of playgrounds. They think that playgrounds are not attractive enough for playing. Especially in Iran, playgrounds are basic and uninteresting places for child’s play (Shieh 2006). Iran’s playgrounds are reproduced from manufactured models and tightly designed play equipment. The site's context and nature are rarely incorporated. If there is nature, most of the time, children are not allowed to interact with it. Most of Iran’s playgrounds, especially in the city of Tehran, do not respond to the needs of children. Therefore, children try to find other ways to release their energy by watching TV and playing with computers for long hours, which lead to health issues (Shieh 2006). It is important for designers to learn from nature and its principles especially in designing for children. As mentioned before, bringing children closer to nature can improve health, imagination, and social skills.

1.3 Proposed Solution

This paper explores how using principles of nature in the design of playgrounds can enhance children’s satisfaction. By applying principles of nature in the design of playgrounds, we would expect them to compensate for the lack of interesting and appealing play equipment. As a result, children would be more satisfied with playgrounds.

To test this hypothesis, we asked 200 parents who had children in primary schools in the south area of Tehran to fill out a questionnaire that evaluated their perception of the importance of the inclusion of principles of nature in playground design. We focused on children who lived in the south of Tehran. These children have fewer opportunities to play in appealing playgrounds (Shieh 2006). However, the solutions offered in this research can also be useful for the design of playgrounds for children in other parts of Tehran.

This paper is organized into three major parts. The first is a review of current playground design and features. The second describes principles of nature that have been extracted from a survey of architectural perspectives and architectural documents. The third part analyzes data collected from the survey of parents with children in primary schools in southern Tehran.

In the present paper, natural principles used in the design of playgrounds have been described. In addition, some examples for each one have been presented. At the heart of this paper is an effort to re-establish the connection between nature, children, and architecture in Iran. Without nature, the playground would be a boring place with limited or no opportunities for responding to the children’s needs and curiosity.

2 PLAYGROUND DESIGN

2.1 Benefits of Playgrounds for Children

Outdoor play benefits health, motor development, social development, and attention. Play in natural landscape can help children develop an environmental consciousness that could impact their adult morals and values (Parsons 2011). The opportunity to explore and experiment with nature will foster the development of a child’s intellect and prepare the child to deal with real-world problems. Play is an important avenue of socialization into a particular culture and a way of learning about the world. The right play environment such as a well-designed playground can also promote social interaction, self-confidence, individuality, and a sense of responsibility (Bhattacharya et al. 2003).

Playgrounds enhance children’s motor skills. Bar-Haim and Bart (2006) study on the relationship between motor abilities and social behavior indicates significant associations between children’s motor abilities and social and nonsocial forms of play. In general, the study concludes that children with low motor ability often experience low social play and typically play alone (Dyment and Bell 2008). Children with lower motor abilities than their peers may have a hard time dealing with the demands of a social environment (Bar-Haim and Bart 2006). A playground provides a setting where children can interact on a variety of equipment and utilize their mental, physical, and social skills simultaneously (Frost and Klein 1979).

2.2 Important Criteria for Designing Playgrounds

Playgrounds should be designed to optimize interaction between groups of various sizes. However, the ideal playground accommodates activities for a variety of group sizes and ages. This includes areas for solitary play (so that social interaction is indeed genuine when it occurs), areas for adult interaction, and areas for small and larger groups of children to play (Hudson and Thompson 2001). These spaces do not always need mechanical play equipment. We can design some special spaces in playgrounds, which play a role as play equipment. When children play alone or with their peers, they often use their imagination to create new games. However, fixed play equipment restrict children in specific games (Veitch et al. 2005). Therefore, designing solitary spaces for play along with interaction spaces for various group sizes can be more interesting and challenging for children than fixed play equipment.
Bhattacharya et al. (2003) outline criteria for designers to follow in their design of playgrounds. The first criterion is safety. This can be fulfilled by utilizing more synthetic rubber products; maintaining the playground to guarantee that it has no broken parts, rust, or splinters; building a barrier between the playground and any danger zones; keeping the playground completely clear of trash and debris; and providing adult supervision in the layout.

The second criterion is ensuring equipment is accessible. A truly good playground connects numerous pieces of equipment so that it will be integrated for all children (even children with disabilities). Additionally, designers must create accessible facilities such as restroom facilities, pathways with no obstacles, safe handicap parking, benches for easy rest and supervision, and shaded areas to allow child to cool down and relax (Bhattacharya et al. 2003).

The other criteria guide the design of separate spaces for different age groups. These promote social development by creating spaces for group interactions and aid physical development with equipment that improves physical strength and balance, and develops fine motor skills. Furthermore, a good playground provides activities that encourage imagination and exploration, mental growth, and problem solving. It will also have noisy activities or equipment, a variety of textures, and fragrant landscaping (Bhattacharya et al. 2003).

2.3 Evolution of Playgrounds

The following is a brief review on the evolution of playgrounds in the United States, from 19th century to 21st centuries. By understanding how playgrounds have evolved, we may find moments of weaknesses and strengths in each type. Iran mostly has traditional playgrounds.

Traditional Playgrounds

Traditional playgrounds often contain large expanses of turf and asphalt that limit opportunities for different types of activities. These playgrounds also limit the amount of physical activity by only offering a few play structures such as swings, balance beams and ladders. Lack of vegetation in traditional playgrounds restricts the amount of natural experiences (Parsons 2011).

Adventure Playgrounds

Adventure playgrounds address issues that were not addressed in traditional playgrounds. Where traditional playgrounds only offered programmed play in supervised environments focused on social development, adventure playgrounds offer children the ability to experience construction play. Construction play also offers a variety of physical and social development that traditional playgrounds lack. Children using adventure playgrounds have the ability to work together to cooperatively solve problems as well as explore the physical demands of building their own playground. In terms of natural experiences, adventure playgrounds also offer children exposure to natural elements which traditional playgrounds did not incorporate (Parsons 2011).

Modern adventure playgrounds are still “constructed from the natural environment” and children still “actively construct their own play space using available materials” but in a controlled and supervised environment unlike previous adventure playgrounds (Holmes and Procaccino 2009).

Imagination Playgrounds

Adventure playgrounds are still not a widely accepted in U.S. playground design by parents, parks and recreation departments. However, they have inspired a new type of playground design that is becoming increasingly popular especially in densely developed urban neighborhoods. This new type of playground is called the Imagination Playground (Playgrounds in Parks 2010).

Imagination playgrounds address many of the same issues as adventure playgrounds but in a more programmed way (Parsons 2011). These playgrounds utilize many of the ideas of adventure playgrounds, but are mostly made with a mixture of prefabricated materials. The Imagination Playground provides movable and permanent play equipment under the supervision of personnel whom have been trained to keep children safe while playing on equipment (Barovick 2010).

In imagination playgrounds, supervised children can get creative with a wide variety of objects. They follow the prevailing [play] theory that free, child-initiated play is a critical component of healthy social, emotional and intellectual development (Barovick 2010). Supervision is important for this type of playground to ensure that movable pieces do not leave the site, play equipment isn’t mistreated, and children are playing safely (Parsons 2011).

In Iran, most of the playgrounds are traditional (Shieh 2006). What is needed is a combination of different types of playgrounds that respond to the need for a variety of games, social interaction, physical development, and interaction with nature. We would expect that design of playgrounds based on the principles of nature can fill this purpose.

3 PRINCIPLES OF NATURE

The principles of nature that have been extracted from nature and design documents, are multifunction, adaptability, optimization, dynamics, and resistance. These principles are shown in Table 1. The purpose of this table is to show where these principles were cited by the literature. These principles are described in following paragraphs.
Table 1. Principles of nature that have been mentioned by some researchers and architects

<table>
<thead>
<tr>
<th></th>
<th>Multifunction</th>
<th>Adaptability</th>
<th>Optimization</th>
<th>Dynamics</th>
<th>Resistance</th>
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<tbody>
<tr>
<td>Alberti</td>
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<td>Arnheim</td>
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<td>Ball</td>
<td>×</td>
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<tr>
<td>Calatrava</td>
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<td>Isaac</td>
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<tr>
<td>Euler</td>
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<tr>
<td>Gruber</td>
<td>×</td>
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<td>×</td>
</tr>
<tr>
<td>Macnab</td>
<td>×</td>
<td>×</td>
<td></td>
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<td>×</td>
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<td>McHarg</td>
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<tr>
<td>Nachtigall</td>
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<tr>
<td>Thompson</td>
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3.1 Multifunction

Multifunction is the potential for various features. Every natural pattern has a different function. There is no pattern in nature that only has one special function (Isaacs 2008). Nature never relies on just one solution. Diversity is built into nature to provide options, and complexity provides many ways to get there (Macnab 2012). Nachtigall (1997) argues that natural constructions should be created with multifunctionality instead of monofunctionality. When a natural construction is multifunctional, elements are integrated into more than one system. Integrated functionality is possible at many scales (Gruber 2011). As we see in nature, its patterns recur in situations that appear to have nothing in common with one another. For instance, we see a spiral form in plants such as Aloe polyphylla, Yew Spirals, and Fern, the shape of a ram’s horn, a helix of human’s ear, or a snail’s shell. These all show that natural patterns occur in different situations and have different functions.

3.2 Adaptability

The definition of adaptability may be found in McHarg (1971) book, Design with Nature. “In nature, we shall see that there are consistencies in land morphology, soils, stream patterns, plant association, wildlife habitats, and even land use, and that these can well be examined through the concept of the physiographic region.” Alberti (1988) also discusses adaptability in his book “On the art of building”. Alberti (1988) states that it is essential for the living to adapt to the environment. Nachtigall (1997) also says that “fine adjustment with regard to the environment” is one of the rules of natural constructions. Nature is always in flux, rebalancing and restoring itself continually in new environmental circumstances. Nature continually adjusts itself to change. Change may occur as a mutation or a spontaneous change in a previously consistent genome sequence. These alterations can support the organism by adapting to changing environmental circumstances (Macnab 2012). The implicit ability of complex adaptive behavior is a central characteristic of living systems (Euler 2000). The adaptation of structural features of a living structure to its environment is essential for the continuation of its life (Isaacs 2008).

3.3 Optimization

Nature runs its business without waste or excess. It is a straight-up exchange policy. When something is consumed in nature, the waste does not go to a landfill; it is broken down into parts that are renewed and reused (Macnab 2012). The only concern in nature is the optimal and perfect ordering of systems. It is filled with variation and complexity that architects have yet to fully explore. For example, we can learn from nature’s energy efficiency. Organisms have to be efficient in terms of energy to survive. They do not waste energy and operate with high effectiveness (Gruber 2011). Nachtigall (1997) considers “optimization of the whole instead of maximizing single elements” as one rule of natural constructions. He argues that all natural constructions and processes are optimized for energy use. Nature reuses and recycles what it can. Renewable resources in nature are examples of optimization.

As Ball (2001) states in his book “The Self-Made Tapestry”, nature is economical and we should expect that it would not construct complex forms through a series of unnecessarily laborious processes, but by using organizational pattern-forming phenomena. This means that growth and form need not to be mysterious and that the rules for generating them are generally of a simple nature. Additionally, Isaacs (2008) argues that nature’s form does not follow its function. Nature’s constructions arise through optimization, iteration, mutation, and feedback, each of which produces forms that are as elegant as they are robust. Calatrava (2003) also states that the optimal use of materials is one of the most significant features in nature. Furthermore, Thompson (1992) describes that the effort of nature is to create phenomena with the highest function and the least waste of energy. Consequently, based on these views, optimization is an inseparable principle of nature.
3.4 Dynamics

One of the very important principles in nature is dynamics. Nature’s dynamics cause the changeability of natural phenomenon. We can see dynamics in every phenomenon. In Design with Nature, McHarg (1971) emphasizes that “natural phenomena are dynamic interacting processes.” His example of New Jersey Shore confirms this principle. He describes how the shore is continuously involved in a contest with the sea and its shape is dynamic (McHarg 1971). Isaacs (2008) writes in his thesis, “Like patterning in nature, a building should be capable of taking up any internal forces without giving up function, being able to exist in a perpetual state of emergence, yet always complete. It is an organizational method through which a building can escape being a fixed organism with a predetermined form.” Therefore, natural constructions can tackle various conditions. Through their dynamic characteristic, they are able to absorb changing conditions, alter their visual appearance, all while remaining topologically the same (Isaacs 2008). Calatrava also considers nature as an inspiration, but he does not use any specific natural form. Rather, his buildings have been designed based on the dynamic signs in natural phenomenon (Mashayekhfaridani 1994). These dynamic signs are the results of the process of evolution in natural phenomenon (Arnheim 1969). Based on the views of these researchers and architects, dynamics is one of the crucial features of a living structure.

3.5 Resistance

The ability to deal with unknown situations and find new solutions is important for survival in a changing environment (Gruber 2011). Natural constructions resist unpredictable events by responding suitably in crises. They have been designed in a way through which they can face dangerous circumstances and react perfectly. The snail and turtle’s contraction into a protective shell in response to a threat is an example of resistance. Another good example is chameleon that can escape being a fixed organism with a predetermined form.” Therefore, natural constructions can tackle various conditions. Through their dynamic characteristic, they are able to absorb changing conditions, alter their visual appearance, all while remaining topologically the same (Isaacs 2008). Calatrava also considers nature as an inspiration, but he does not use any specific natural form. Rather, his buildings have been designed based on the dynamic signs in natural phenomenon (Mashayekhfaridani 1994). These dynamic signs are the results of the process of evolution in natural phenomenon (Arnheim 1969). Based on the views of these researchers and architects, dynamics is one of the crucial features of a living structure.

4 METHODOLOGY

The descriptive survey of parents’ opinions of the use of natural principles in playgrounds involved making a questionnaire with multiple-choice questions based on the principles that were extracted in the first part of the study. Two-hundred parents, who were chosen at random and had children in primary schools of the south area of Tehran, were asked to answer a questionnaire to evaluate each principle. The reliability of the questionnaire was evaluated with the Cronbach’s Alpha method. All the data of the questionnaire was analyzed by using the quantitative software SPSS (Version 15). Figure 1 shows the research process in a flowchart.

To estimate parents’ level of satisfaction with playgrounds that engage the principles of nature in playgrounds, we made a questionnaire with multiple-choice questions with four levels of satisfaction. It contained 25 questions that examined the use of principles of nature in playgrounds. The principles consist of these items: dynamics, adaptability, multifunction, optimization and resistance. Furthermore, we added another factor in questionnaire, the use of natural forms in making equipment and buildings in an architectural design.

The reliability of the questionnaire was tested by the Cronbach’s Alpha method and was rated 0.79%, which is acceptable. The questionnaire may be found at the end of the paper in the appendix. The classification of the questionnaire is shown in the Table 2. Questions nine and ten touch on both adaptability and optimization.

Two-hundred parents from several primary schools in the south area of Tehran city (Iran) were chosen at random for participating in this survey. Of the 200-person sample, 146 represented acceptable questionnaire. Data from the questionnaire were analyzed by using the quantitative software SPSS (Version 15).

5 RESULTS

As mentioned before, each of the questions in the questionnaire had four options (multiple-choice questions) which defined four levels of satisfaction. Table 3 shows percentage frequency of response to each option of each question. The types of questions and related principles are also shown in Table 3.

The socio-demographic characteristics of the sample are presented in Table 4. Over 72% (106/146) of the parents replied the questionnaire were mothers. The majority (80.8%) had either one or two children. 50.7% of the parents had daughters and 46.6% had sons. The average age of the children of participating parents was nine years (+2).

This paper aimed to identify parents’ level of satisfaction with using principles of nature in playgrounds. By a designed questionnaire, all these principles have been tested. Table 5 shows the descriptive results of the principles.

A T-Test (Student’s T) was used for analyzing the data. The results of the test on all the principles have been shown in Table 6, which is the summary of the analysis with the T-Test. It shows there is a meaningful difference in response to every principle. As a result, with 95% confidence, we can conclude that parents are satisfied with the use of these principles in a playground.
6 DISCUSSION

After preparing statistics and analyzing the data of questionnaire, the results showed parents have a positive view of the use of principles of nature in playgrounds. These principles can be used in architectural design through different methods, which have been discussed in this section. Information about each question and distribution of responses to principles is shown in Table 3.

6.1 Multifunction

In the questionnaire, multifunction is divided into several items. One of these items is the design of spaces with different functions (questions no.1-2), such as the

Table 2. Principles and number of corresponding questionnaire

<table>
<thead>
<tr>
<th>Principles</th>
<th>Number of questions</th>
</tr>
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<tbody>
<tr>
<td>Multifunction</td>
<td>1-6</td>
</tr>
<tr>
<td>Adaptability</td>
<td>7-10</td>
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<tr>
<td>Optimization</td>
<td>9-12</td>
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<tr>
<td>Dynamics</td>
<td>13-18</td>
</tr>
<tr>
<td>Resistance</td>
<td>19-21</td>
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<tr>
<td>Using the natural forms</td>
<td>22-25</td>
</tr>
</tbody>
</table>
design of multifunction spaces and centers that have different functions. Another item is providing facilities that can respond to children’s different taste, verve, talent, and character (questions no.4-6). This section also asked parents about educational facilities (question no.3). Parents were interested in these items, especially spaces that provide various activities and educational facilities. Therefore, designers should design playgrounds with functional variety. In addition, their design should respond to the tastes and characters of children.

### 6.2 Adaptability

This principle involves responding and adaptation to the environment and site. For instance, taking advantage of the site’s topography in design (question no.7) (Figure 2), using natural materials and paying attention to climate.

When designing playgrounds, the designer must match the play equipment with the child’s ability. In the questionnaire, we asked parents about their preference for variety of equipment and their child’s ability to

<table>
<thead>
<tr>
<th>Table 3. Percentage frequency of response to each option of each question</th>
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</thead>
<tbody>
<tr>
<td><strong>Type of questions</strong></td>
</tr>
<tr>
<td>Positive</td>
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<tr>
<td>Negative</td>
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<tr>
<td>Positive</td>
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<td>Negative</td>
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<td>Positive</td>
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<td>Negative</td>
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<td>Positive</td>
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<td>Positive</td>
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<td>Negative</td>
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<table>
<thead>
<tr>
<th>Table 4. The socio-demographic characteristics of the sample</th>
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</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
</tr>
<tr>
<td><strong>Parents gender</strong></td>
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<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td><strong>Parents age</strong></td>
</tr>
<tr>
<td>25-35</td>
</tr>
<tr>
<td>+35</td>
</tr>
<tr>
<td><strong>Parents level of education</strong></td>
</tr>
<tr>
<td>Some high school</td>
</tr>
<tr>
<td>Completed high school or technical school certificate</td>
</tr>
<tr>
<td>University or tertiary education</td>
</tr>
<tr>
<td><strong>Total number of children per family</strong></td>
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<tr>
<td>-2 or 2 children</td>
</tr>
<tr>
<td>+2 children</td>
</tr>
<tr>
<td><strong>Gender of selected children</strong></td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
</tbody>
</table>
6.3 Optimization

This principle is concerned with a balance of economical and functional aspects of design. An optimal design reduces wasted energy as much as possible without having a negative impact on the function of building. This may include utilizing natural and local materials or finding the proper place for building structures by paying attention to the influential factors in the site. As mentioned before in the adaptability section, parents preferred natural to artificial materials. Therefore, this item is common with adaptability in the principle optimization (questions no.9-10). There would be less energy waste by using natural materials.

The other aspect of optimization is creating opportunities for children to play in groups. In a recent study by Hume et al. (2005), 147 children aged 10 years were asked to draw maps of their local neighborhood. A sub-sample of 44 children took photographs of places in their local neighborhood that were important to them. Many children drew and took photographs of common meeting places. The importance of children interact with them (question no.8). In this case, parents showed a great interest. Parents preferred play equipment that is age-appropriate rather than various but not suitable to age and ability. The present study concluded that in most cases, play equipment was designed for toddlers and younger children. Older children found parks boring because equipment did not appeal to them. Parents preferred a range of stimulating play equipment that was challenging and appealing for children of all ages. The importance of age-appropriate play equipment in the present study was also evident in a study by Cunningham and Jones (1999) in which 26, 10 to 13 year old children wrote short essays on the importance of play. When the children were later asked why they rarely mentioned playground equipment in the essays, the children responded that, “They did indeed appreciate good equipment but a lot of it was boring”. Therefore, designers should pay more attention to the design of equipment in playgrounds. In addition, the use of natural instead of artificial materials such as iron and concrete, in making play equipment, is considered more preferable (questions no.9-10).

### Table 5. Descriptive analysis of the principles

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
<th>Mean</th>
<th>Std. Deviation</th>
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<tr>
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<td>2.59</td>
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<tr>
<td>Adaptability</td>
<td>11</td>
<td>10.95</td>
<td>2.77</td>
</tr>
<tr>
<td>Optimization</td>
<td>12</td>
<td>11.1</td>
<td>2.67</td>
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<tr>
<td>Dynamics</td>
<td>15</td>
<td>11.13</td>
<td>3.37</td>
</tr>
<tr>
<td>Resistance</td>
<td>11</td>
<td>11.47</td>
<td>2.24</td>
</tr>
<tr>
<td>Using natural forms</td>
<td>10</td>
<td>13.16</td>
<td>2.32</td>
</tr>
</tbody>
</table>

### Table 6. The summary of analysis of principles by T-Test

<table>
<thead>
<tr>
<th>Item</th>
<th>T</th>
<th>df</th>
<th>Sig.(2 tailed)</th>
<th>Mean Difference</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifunction</td>
<td>64.32</td>
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<td>0</td>
<td>13.82</td>
<td>16.82</td>
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Figure 2. Taking advantage of the site’s topography in a playground
having someone to play with is consistent with studies of social support among young adults (Leslie et al. 1999) and adults (Ball et al. 2001), which have found that people are more likely to be physically active if they have someone to be active with. In addition, Al-Homoud and Abu-Obeid (2003) mention that “Suitable design structures in open spaces support group boundaries, which in turn encourage friendship formation.” Obviously, it is economical and optimal to design a social space in a place that is responsive to a wide number of people. An economical design can be achieved by paying more attention to group work activities rather than individual ones. Parents expressed a very strong interest about providing group work possibilities for children’s play in playgrounds (question no.11). This evidence shows that they believe their children are more likely to go to playgrounds or other public open spaces if they have peers with which to play.

Another aspect of optimization is distance. This refers to how close or far a playground should be located and designed from their houses. Parents preferred closer playgrounds when they had proper facilities (question no.12). A comparison between distance and facilities in playgrounds showed that in some cases, parents might prefer playgrounds with better facilities to closer ones. Nevertheless, distance, as an economical issue, is important. The best solution is to locate playgrounds at social hubs, which tend to be located in densely populated areas.

6.4 Dynamics

This principle creates an environment with changeable features. Any design that creates a potential for variety can be dynamic. For instance, the direct use of nature, which always changes, can create a dynamic design. Another example of the use of this principle in playgrounds is providing spaces with the interplay between lights and shadows. As stated in the Ramzy (2013) research, daylight has the dynamic quality. In addition, a dynamic character can be introduced by using masses of buildings with various forms, shapes, and colors in the design of buildings and structures such as movable walls and facades (Figure 3).

In the questionnaire, parents were asked to provide situations in which children can manipulate the equipment and environmental elements in a playground (question no.14). It also asked about opportunities for playing with water (question no.15), soil (question no.16), trees to climb (question no. 17), or areas to play safely in different weather such as rain, wind, or sun (question no.18). Parents did not show much interest in their children manipulating playground equipment by or climbing trees. Nevertheless, they were interested in the idea of playing with water and soil. Parents may consider playing with water and soil safer than climbing trees. Therefore, designers should pay attention to safety when designing for this kind of play.

Providing good facilities for children in different weather may also create a dynamic environment. However, parents may be worried about safety in conditions other than sunny weather. This might be a reason of their concern. Consequently, safety is one of the most important factors to consider when creating a dynamic environment. Despite safety concerns, parents showed great desire for their children to connect with nature directly (question no.13). Therefore, using nature in playgrounds and offering a safe environment for children to interact with nature is one of the most significant features of playgrounds’ design.

6.5 Resistance

This principle considers how to design a playground that responds to possible threats and dangers to children. It is multifaceted and includes: location, supervision, and medical response. The first item is the location of the playground. The main danger to children is passing vehicles. Parent response showed serious con-
cern about this issue (question no.19). A significant challenge for urban designers should be locating parks and playgrounds in safe places with entries for vehicles that are separate from realms for children. Parents cited safety concern as an impediment to their child’s independent mobility. A study in the UK showed a significant loss of independence among children. The result of the study showed a decline in the proportion of children aged 10-11 years allowed to travel around local areas unaccompanied (Pooley et al. 2004).

Providing supervision throughout a playground is a key to safety. Parents showed strong opinions about this issue (question no.20). Most of them preferred their children to play under their supervision. To enhance safety, playgrounds need to be designed to support adult supervision. This can be achieved by using transparent materials for tunnels and arranging equipment so there are no blind spots. A playground should have numerous benches for parents to sit on as they watch their children, and these benches should have a view of a majority of the activity on the playground (Wade 2002). Furthermore, parents were also asked about the existence of a medical treatment center in a playground (question no.21). Most parents were in favor of such places in a playground. Therefore, medical facilities should be included in a playground’s design.

6.6 The Use of Natural Forms

The last factor parents were asked about was the use of natural forms in the design of buildings, furniture, paths, or equipment in a playground (questions no.22-25). Parents expressed great interest. Children have curious minds and they like to find similarities between natural elements such as the sun, moon, trees, flowers, animals, clouds, etc. and the things with which they play. For example, a building that resembles shape of a spider is more interesting for children than a building with ordinary shape. In Figure 4, such a building is shown. Consequently, using natural forms in designs for children would be valuable to improving children’s creativity.

6.7 Limitations

Several important limitations of this study should be noted. First, the majority of respondents in the present study were mothers and as such the results reflect the perceptions of mothers more than those of fathers. However, it could be argued that the mother is typically the main caregiver and therefore may have greater influence over a child’s activities (Anderson et al. 2003). Second, the respondent was not blinded to the nature of the present study and as such there is the possibility of socially biased responses from the parent. Third, the questions were limited to parents; therefore, children’s perceptions were not considered. However, parents exert considerable control over their child’s access to play spaces and the perceptions held by parents will ultimately influence the extent to which their child’s opportunities for playing are restricted. Lastly, this research was conducted on a specified group of parents in Tehran. However, the use of a sound theoretical framework and the consideration of influences on the individual at social and environmental levels in questionnaires were the strengths of the present study. The structure of the questions enabled parents to provide depth in their responses.

For the external validity, we should consider other environmentally based issues and cultural backgrounds. This may come in our future research considerations. Future studies may also benefit from exploring children’s attitudes to the outdoor play, and finding other design solution that involve nature.

7 CONCLUSION

This paper attempts to draw architects’ attention to the fundamental values of nature. It would be useful
for those who are interested in new methods of design. Nature is the best source of inspiration in design. We should discover how nature works and learn from it. This is particularly relevant to the design of playgrounds since children are so close to nature. It is necessary for their development to play in and interact with nature. This research evaluates parents’ perceptions in the design of playgrounds based on these unique principles. This is a new look at design of playgrounds that aims to establish a positive relationship between children and nature.

Based on the results of our survey, parents showed a great interest in using principles of nature in playground design. The principles included: multifunction, adaptability, optimization, dynamics, and resistance. We derived solutions based on these principles to improve the circumstances of today playgrounds in Iran.

To apply the principle of multifunction, designers should pay attention to functional variety and design playgrounds that respond to the different tastes and characters of children. An adaptable design responds to its environment by using natural materials and by being in harmony with the site’s topography and climatic conditions. Age-appropriate play equipment also contributes to an adaptable design. To apply the principle of optimization, we propose using natural and local materials and finding proper places for building structures based on influential factors of the site. Locating playgrounds at social nodes and creating opportunities for group play in playgrounds are other aspects of optimization. Dynamics in design can be achieved by the direct use of nature, providing spaces with an interplay between lights and shadows and using masses of buildings with various forms, shapes, and colors. A dynamic place to play can also be created by providing opportunities to play with water and soil and trees to climb or creating areas to play in different weather. However, safety should always be the first priority. The principle of resistance includes location, supervision, and medical response that can be accomplished by designing of safe entries and paths, considering areas for adult supervision, and providing medical facilities in playgrounds.

Designers may need to revisit playground design with regard to nature and its principles so that playgrounds are interesting for an array of age groups while remaining safe. Future playground designs should be more connected with nature. We need to change our narrow view of what playgrounds are and how they can provide places of play.

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APPENDIX: Questionnaire

Please fill in the blanks:

Respondent age: ____________  □ Female  □ Male  Education: ______________
Number of children: ____________  School grade of children: ____________

Please indicate your level of agreement with the following statements.

1. The existence of various playground equipment is essential for a playground.
2. The possibility for various activities is essential for a playground. (I prefer to choose a playground that has different spaces such as a cinema, restaurant, or animal pens rather than take my child to a separate cinema, zoo, etc.)
3. A suitable playground necessarily provides educational facilities in addition to amusement facilities.
4. A suitable playground is not necessarily responsive to all of children's tastes and verve.
5. A suitable playground is not necessarily responsive to children's different talents.
6. A suitable playground is not necessarily responsive to children's different personalities.
7. A playground must include different levels of topography (higher and lower places, steps and hills, etc.)
8. Suitability of playground equipment with a child's ability is more preferable to variety.
9. Natural materials such as wood and stone in the furniture of the playgrounds (seats, bins, etc.) are more preferable to artificial materials such as iron and concrete.
10. Natural materials such as wood and stone in playground equipment (slides, swings, seesaws, etc.) are more preferable to artificial materials such as iron and concrete.
11. When designing a playground, children's group work is more important to consider than individual activities.
12. The distance of a playground to home is more important than the variety of facilities in the playground.
13. Children should be allowed to have contact with natural phenomenon in the playgrounds such as flowers, trees, grass, water, soil, etc.
14. Children should be allowed to manipulate the equipment of the playgrounds
15. The possibility of playing with water should be available for children.
16. The possibility of playing with soil should be available for children.
17. The possibility of climbing trees and running in the grass should be available for children.
18. It is necessary for children to be able to play in different weather.
19. It is necessary that a playground be located in a place that is far away from crossing vehicles.
20. It is necessary to provide supervision in all areas of a playground.
21. It is not necessary to provide a medical treatment center for a playground.
22. It is better when the buildings in a playground draw inspiration from natural forms.
23. It is better when equipment in a playground draw inspiration from natural forms.

24. It is better when the furniture in a playground draws inspiration from natural forms.

25. It is better that the paths in a playground draw inspiration from natural forms.